

Olivencia, Mildred

From: dsahler@wcpclaw.com
Sent: Tuesday, August 11, 2015 1:40 PM
To: Olivencia, Mildred
Cc: Torres-Rojas, Genara; Van Duyne, Sheree; Ng, Danny
Subject: Freedom of Information Online Request Form

Information:

First Name: debra
Last Name: sahler
Company: WILDENHAIN CRINO
Mailing Address 1: 95 mt. bethel road
Mailing Address 2:
City: warren
State: NJ
Zip Code: 07059
Email Address: dsahler@wcpclaw.com
Phone: 2015191825
Required copies of the records: No

List of specific record(s):

Request for copies of the contract, including scope of work and contract details for the following contract numbers: EWR 154.028 between the Port Authority and Paving Materials and Construction Company.

THE PORT AUTHORITY OF NY & NJ

FOI Administrator

September 25, 2015

Ms. Debra Sahler
Wildenhain Crino
95 Mt. Bethel Road
Warren, NJ 07059

Re: Freedom of Information Reference No. 16235

Dear Ms. Sahler:

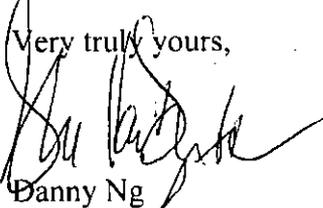
This is in response to your August 11, 2015 request, which has been processed under the Port Authority's Freedom of Information Code (the "Code", copy enclosed) for copies of the contract, including scope of work and contract details for the following contract numbers: EWR 154.028 between the Port Authority and Paving Materials and Construction Company.

Material responsive to your request and available under the Code can be found on the Port Authority's website at <http://www.panynj.gov/corporate-information/foi/16235-C.pdf>. Paper copies of the available records are available upon request.

Pursuant to the Code, certain portions of the material responsive to your request are exempt from disclosure as, among other classifications, privacy.

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 7348 F: 212 435 7555

CONFORMED



THE PORT AUTHORITY OF NY & NJ

October 13, 2009

Lillian D. Valenti
Director, Procurement Department

VIA FACSIMILE AND UPS NEXT DAY DELIVERY

Paving Materials & Construction Co., Inc.
616 West First Avenue
Roselle, NJ 07203

SUBJECT: NEWARK LIBERTY INTERNATIONAL AIRPORT – REHABILITATION OF PARKING LOT P6 AND GAS STATION SITE - CONTRACT EWR-154.028 AND REHABILITATION OF PARKING LOT P6 AND GAS STATION SITE – LANDSCAPE AND HARDSCAPE MAINTENANCE – CONTRACT EWR-154.028M
PURCHASE ORDER UEW154028 AND UEW154028M

Gentlemen:

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

The Port Authority elects to require you to furnish a performance and payment bond in accordance with the terms of the Contract. A copy of the required bond form is enclosed, which should be executed by you and your surety and returned to Terri Flores of the Port Authority of New York and New Jersey, 1 Madison Avenue, 7th Floor, New York, NY 10010 along with a copy of the invoice from the bonding company and bond broker if applicable, for the premium for said bond.

Please note that under the Contract clause entitled "Performance and Payment Bond", you are required to return the executed bond within seven days.

Your attention is directed to the clause of the Contract entitled "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.

Subject to the provisions of the Form of Contract, including those of the clause entitled "Extra Work Orders", the Chief Engineer shall have the authority to order any item of Extra Work if the cost thereof to the Authority, together with the cost of all other Extra Work previously ordered, will not be in the aggregate in excess of \$100,000.

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 Michael B. [Signature]
PO/ Director of Procurement

1 Madison Avenue, 7th Floor
New York, NY 10010
T: 212 435 8427

UPS DELIVERED ON OCTOBER 14, 2009

PAVING MATERIALS & CONSTRUCTION
Co., INC.  

THE PORT AUTHORITY OF NY & NJ

CA04-154.028

F.F.
C.M.

NEWARK LIBERTY INTERNATIONAL AIRPORT

**REHABILITATION OF PARKING LOT P6 AND GAS
STATION SITE**

CONTRACT EWR-154.028

JULY 2009

This proposal is not complete unless bidder's
Signature appears on page 23



THE PORT AUTHORITY OF NY & NJ

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JUN 22 2009

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Port Commerce Department

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16121	WIRES, CABLES, SPLICES, TERMINATIONS (MEDIUM VOLTAGE: 601 VOLTS TO 34,500 VOLTS, INCLUSIVE)
16125	TRAFFIC SIGNAL CABLES
16127	CONTROL/SIGNAL TRANSMISSION MEDIA
16128	ARCPROOFING
16133	CONTROL PANELS, ENCLOSURES/CABINETS, AND TERMINAL BOXES
16135	BOXES AND FITTINGS
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16150	MOTOR POWER AND CONTROL WIRING
16190	SUPPORTING DEVICES
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16450	GROUNDING
16452	ELECTRICAL BONDING
16470	PANELBOARDS
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Permits

Schedule of Minimum Wage Rates (NJ)

Notification of M/WBE On-line Directory and Forms

Schedule A

Schedule B

Schedule C

Schedule D

ADVERTISEMENT

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Sealed proposals for the following contract will be received by The Port Authority of New York and New Jersey in the office of the Director of Procurement, Attn: Bid Custodian, One Madison Avenue, 7th Floor, New York, NY 10010, until 2:30 P.M. on the date indicated where the proposals will then be publicly opened and read in the Bid Room.

Contract documents may be seen at the Contract Desk on the 3rd Floor, 3 Gateway Center, Newark, NJ and may be obtained upon receipt of a non-refundable payment of \$100.00 per set. Only company checks or money orders payable to the order of The Port Authority of New York and New Jersey will be accepted. If checks or money orders for documents are mailed, they should be addressed to The Port Authority of New York and New Jersey, Contract Desk, 3rd Floor, 3 Gateway Center, Newark, NJ 07102. For availability of contract documents, go to www.panynj.gov/DoingBusinessWith/contractors/html. Questions by prospective bidders concerning the contract should be directed only to the person whose name and phone number is listed.

A VALID PHOTO ID IS REQUIRED TO GAIN ACCESS INTO EITHER BUILDING.

Contract EWR-154.028 – NEWARK LIBERTY INTERNATIONAL AIRPORT – Rehabilitation of Parking Lot P6 and Gas Station Site. Estimate Range: \$20M - \$30M. Bids Due Tuesday, June 23, 2009.* The work under this contract consists generally of paving, utilities, lighting, environmental remediation, underground tank removal, removal and replacement of toll plaza, and related Work at the construction site. For questions, call Jessamma Vatakencherry at (212) 435-3953 or email – jvataken@panynj.gov.

MONDAY, May 25, 2009

* The date for receipt of Proposals was subsequently changed to Wednesday, July 15, 2009 and is subject to further revision.

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 Wednesday, July 15, 2009 in the office of the Director of Procurement, Attn: Bid Custodian, One Madison Avenue, 7th Floor, New York, NY 10010 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.

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.

C.

- ✓ 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.

3. 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 clause 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", 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 General Manager, Business and Job Opportunity, Office of Regional and Economic Development 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.

4. ACCEPTANCE OR REJECTION OF PROPOSAL

Within ninety (90) 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 ninety (90) 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 ninety (90) 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.

5. 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.

6. 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, One Madison Avenue, 7th Floor, New York NY 10010.

7. 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.

Said documents are as follows:

- A. Hatch Mott Macdonald Building 75 Aquifer Testing Report (July 2008)
- B. Building 75 Monitoring Well Installation Details (May 2009)
- C. Building 75 Soil and Groundwater Monitoring Results and Figures (May 2009)
- D. Port Authority Facility Condition Survey Program: Group 1 Buildings – Condition Survey (December 1997)
- E. Building 75 Paint Containing Lead Analytical Report (May 2009)

* NOTE: For the Bidder's Convenience, these documents will be Transmitted with the Contract Documents

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

The Port 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 project, the Authority has set a combined goal of 17 percent for firms owned and controlled by minorities and firms owned and controlled by women.

In the event that the Contractor subcontracts any portion of the Work, the Contractor shall use and document every good faith effort to meet the above goals for MBE and WBE participation in the Work. Such good faith efforts shall include at least the following:

- A. Attendance at pre-bid meetings, if any, scheduled by the Engineering Department;
- B. Utilization of the Port 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 Port 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 subcontractors in order to increase the likelihood of achieving the MBE/WBE goals;
- F. Providing a sufficient supply of plans 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; contractor's groups; local, State and Federal business assistance/development offices and other organizations that provide assistance to MBE/WBEs.

Subsequent to Contract award, the Contractor shall use and document every good faith effort to comply with its MBE/WBE Participation Plan and to permit its 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:

- H. Ensuring that progress payments are made in a timely fashion in accordance with the requirements of this Contract;
- I. Not requiring bonds from and/or providing bonds and insurance for subcontractors where appropriate;
- J. Soliciting specific recommendations on methods for enhancing MBE/WBE participation from Port Authority staff responsible for such participation; and
- K. 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 Contract award, 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 Contract award 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 Contractor has not made a good faith effort to meet the MBE/WBE participation goals set forth above and that the Contractor 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 its MBE/WBE Participation Plan and in permitting its 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 it 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 its 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 its 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 & Job Opportunity 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 & Job Opportunity 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 Directory² 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 & Job Opportunity 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.

² 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

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| <p>9. Greater Jamaica Development Corp.
90-04 161st Street
Jamaica, NY 11432
(718) 291-0282
Fax (718) 291-7918
www.gjdc.org</p> | <p>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</p> |
| <p>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</p> | <p>12. NY/NJ Minority Purchasing Council
330 Seventh Avenue, 8th Floor
New York, NY 10001
(212) 502-5663
www.nynjmsdc.org</p> |
| <p>13. National Minority Business Council
120 Broadway, 19th Floor
New York, NY 10271
(212) 693-5050
www.nimbc.org</p> | <p>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</p> |
| <p>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</p> | <p>16. Small Business Development Center -
Rutgers University, University Heights
3 Bleeker Street
Newark, NJ 07102
(973) 353-1927
Fax (973) 353-1110
www.msbdc.newark.rutgers.edu</p> |

17. New Jersey Association of Women
Business Owners (NJAWBO)
186 Princetown 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

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| <p>23. New York State Federation of Hispanic Chambers of Commerce
2710 Broadway
New York, NY 10025
(212) 222-8300
Fax (212) 222-8412
www.nvsfhcc.com</p> | <p>24. Orange County Chamber of Commerce
30 Scott Corners Drive
Montgomery, NY 12549
(845) 457-9700 Ext. 1101
www.orangeny.com</p> |
| <p>25. Regional Alliance For Small Contractors
625 Eighth Avenue, 2nd Floor,
North Wing
New York, NY 10018
(212) 268-2991
www.regional-alliance.org</p> | <p>26. Women Builders Council
500 Hampton Avenue
Brooklyn, NY 11235
(212) 367-2130
www.wbcnyc.org</p> |

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 Port 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 Port 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 onsite 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".

9. 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 Tom Moroney, at (973) 961-6109.

10. QUESTIONS BY BIDDERS

Questions by prospective bidders concerning the Contract may be addressed to Jessamma Vatakencherry, at (212) 435-3953 or email at jvataken@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 Jessamma Vatakencherry 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.

11. PORT AUTHORITY 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 Contract Work, including on the Contractor, its staff and subcontractors and their staffs depending upon the level of security required, as determined by the Authority. The Contractor shall, and shall instruct its subcontractors, to cooperate with Authority staff in adopting security requirements. These security requirements may include, but are not limited to, the following.

A. Identity Checks and Background Screening:

Contractor/subcontractor identity checks and background screening shall include but shall not be limited to: (1) inspection of not less than two forms of valid and current government issued identification (at least one having an official photograph) to verify staff's name and residence; (2) screening federal, state and local criminal justice agency information databases and files; (3) screening of any terrorist identification files; (4) multi-year check of personal, employment and/or credit history; (5) access identification to include some form of biometric security methodology such as fingerprint, facial or iris scanning.

The Contractor may be required to have its staff, and any subcontractor's staff, authorize the Authority or its designee to perform background checks. Such authorization shall be in a form acceptable to the Authority. If the Engineer directs the Contractor to have identity checks and background screening performed by a particular firm designated by the Engineer, the Authority will compensate the Contractor for the cost of such screening at the Net Cost of such screening. "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 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.

B. Issuance of Photo Identification Badges:

No person will be permitted on or about the construction site without a photo identification badge approved by the Engineer. The Contractor shall provide such badges for employees, subcontractors and materialmen. All employees of the Contractor, subcontractors and materialmen shall wear identification badges in a conspicuous and clearly visible position whenever they are working at the construction site.

If the Authority requires facility-specific identification badges for the Contractor's and subcontractors' staffs, the Authority will supply such identification badges at no cost to the Contractor.

C. Construction Site Access Control:

- 1.) The Authority may provide for construction site access control, inspection and monitoring by Authority retained security guards. However, this provision shall not relieve the Contractor of its responsibility to secure its equipment and work at the construction site at its own expense.
- 2.) At the beginning of each work period the Contractor shall furnish to the security guards, if any, or to the Engineer a memorandum showing for that work period:
 - a. The name and company affiliation of each employee of the Contractor or of a subcontractor who is expected to enter the site and,
 - b. The name of any firm anticipated to be delivering materials or servicing equipment that day and a description of such materials or services.

The Authority may impose, increase, and/or upgrade security requirements for the Contractor, subcontractors and their staffs during the term of this contract to address changing security conditions and/or new governmental regulations.

12. 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.

13. 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.

**14. 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 the 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.

15. 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.

16A. COMPARISON OF PROPOSALS

A bidder submitting a Proposal on Contract EWR-154.028 must submit a Proposal on Contract EWR-154.028M. In comparing Proposals, the Authority will use the following figures inserted by the bidder herein referred to as the "Total":

	Figures ^{1A}
A. The "Estimated Total Contract Price" for Contract EWR-154.028 (insert same figure as inserted in Clause of the Form of Contract entitled "Unit Prices and Lump Sum").	15,138,628.10
B. The "Total Price for Maintenance" for Contract EWR-154.028M (insert same figure as inserted in the clause of the Contract EWR-154.028M entitled "Price for Maintenance").	49,800.00
C. TOTAL COMPENSATION FOR CONTRACT EWR-154.028 AND CONTRACT EWR-154.028M (insert the total of A. and B. above). ^{2A}	15,188,428.10

Such "Total" shall be computed by adding amounts in A. and B. above.

Such "Total" is solely 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.

If the Authority accepts any Proposals for Contract EWR-154.028 and Contract EWR-154.028M the Authority will accept the Proposals, both from the same bidder, which have the lowest total amount as shown above.

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^{1A} In case of discrepancy between amounts inserted in this Summary and the amounts inserted in the Unit Prices and Lump Sum hereto and the Total Price for Maintenance for Contract EWR-154.028M, the amount given in such Unit Prices and Lump Sum and the Total Price for Maintenance shall control.

^{2A} The Estimated Total Contract Price for Contract EWR-154.028 plus the Total Price for Maintenance for Contract EWR-154.028M shall be used for bid comparison purposes only.

16. 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 undersigned³ Paving Materials and Construction Company, Inc.,
a corporation organized under the laws of the
State of New Jersey

(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 clause of the Form of Contract entitled "Unit Prices and Lump Sum".

This offer shall be irrevocable for ninety (90) 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.

³ 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 office⁴:

616 West First Avenue

Roselle, NJ 07203

The telephone number of the bidder is:

908-241-2424

The fax number of the bidder is:

908-241-2420

The E-Mail address of the bidder is:

caromano45@hotmail.com

⁴ Insert office address.

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SIGNATURE AND CERTIFICATE OF AUTHORITY⁵

Dated, July 15, 20 09

(Signature of individual or name of corporation or partnership)

Paving Materials and Construction Company, Inc.

(Signature of agent, partner or corporate officer)

By^{6,7}



Michael A. Whitehead, Vice President

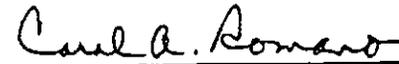
(Acknowledgment of signature to be taken on proper form on following page(s)) office: home:

616 West First Avenue, Roselle. NJ 07203

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)



Carol A. Romano, Secretary

⁵ 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.

⁶ If Proposal is signed by an officer or agent, give title.

⁷ **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.).

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CONTRACT EWR-154.028

STATEMENT ACCOMPANYING PROPOSAL⁹

Names and Residences of Officers, If Bidder is a Corporation

Name	Title	Residence ¹⁰
Robert J. Bauer	Chairman	
Thomas B. Boak	President	
Michael A. Whitehead	Vice Pres./Constr. Mgr.	
Carol A. Romano	Secretary/Asst. Treas.	

Names and Residences of Partners, If Bidder is a Partnership

Name	General or Limited Partner	Residence ¹¹
------	----------------------------	-------------------------

Bidder's Residence, If an Individual¹²

⁹ 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.

¹⁰ Give Street and Number of Residence. Do not give business address.

¹¹ Give Street and Number of Residence. Do not give business address.

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

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned¹³
Paving Materials and Construction Company, Inc. a corporation organized under the laws of the
State of New Jersey
as principal(s); and¹⁴
Travelers Casualty and Surety Company of America a corporation organized under the laws of the
State of Connecticut
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 Three Million Dollars (\$3,000,000), 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 15th day of July, 2009.

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 EWR-154.028, "Newark
Liberty International Airport - Rehabilitation of Parking Lot P6 and Gas Station Site", 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.

¹³ 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.

¹⁴ Insert name of surety.

PROCUREMENT

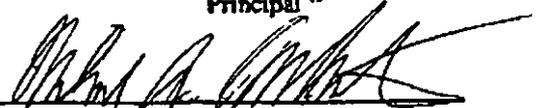
The surety, for value received, hereby stipulates and agrees that the obligations of said surety and its bond shall be in no way impaired or affected by any extensions of the times within which the Authority may receive or accept such Proposal or within which the principal(s) may furnish a Performance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

PAVING MATERIALS AND CONSTRUCTION COMPANY, INC.

Principal ¹⁵

(Seal)

By¹⁶ 
Michael A. Whitehead, Vice President

TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA

Surety

(Seal)

By¹⁷ 
Jeanne Primavera, Attorney-in-Fact

¹⁵ 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.

¹⁶ If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

¹⁷ If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

ACKNOWLEDGMENT¹⁸

ACKNOWLEDGMENT OF BIDDER, IF A CORPORATION

State of New Jersey

SS:

County of Union

On this 15th day of July, 2009 before me personally came and appeared Michael A. Whitehead, to me known, who, being by me duly sworn, did depose and say that he resides at _____ that he is the Vice President of Paving Materials and Construction Company, 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)

Carol A. Romano

(Notary Signature)

CAROL A. ROMANO
NOTARY PUBLIC OF NEW JERSEY
MY COMMISSION EXPIRES OCT. 6, 2013

ACKNOWLEDGMENT OF BIDDER, IF A PARTNERSHIP

State of _____

SS:

County of _____

_____ 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

¹⁸ 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.

PROUREMENT
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SURETY ACKNOWLEDGMENT

State of New Jersey }
County of Monmouth } ss:
City of Farmingdale }

On this 15th day of July, in the year of 2009
before me personally came Jeanne Primavera
to me known, who, being by me duly sworn, did depose and say that (s)he resides in Tinton Falls,
New Jersey; that (s)he is the Attorney-in-fact of Travelers Casualty and Surety Company of America
the corporation described in and which executed the attached instrument; that (s)he knows the
corporation; that the seal affixed to the said instrument is such corporate seal; and that it was so affixed
by order of the Board of Directors of the said corporation, and that (s)he signed his/her name
thereto by like order.


Notary Public
JOANNE BATTAGLIA

NOTARY PUBLIC OF NEW JERSEY
Commission Expires **5/15/2013**

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PROCUREMENT

Consent of Surety

The **TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA**, a Corporation organized and existing under the laws of the State of **CONNECTICUT** and licensed to do business in the State of New Jersey, hereby consents and agrees that if the contract for

Contract EWR-154.028, "Newark Liberty International Airport - Rehabilitation of Parking Lot P6 and Gas Station Site

be awarded to **PAVING MATERIALS AND CONSTRUCTION COMPANY, INC.**
616 WEST FIRST AVENUE
ROSELLE, NJ 07203

the undersigned Corporation agrees with the said **PORT AUTHORITY OF NEW YORK & NEW JERSEY**
3 GATEWAY CENTER
NEWARK, NY 07102

to execute the final bond as required by the specifications and to become surety in the full amount of the contract price for the faithful performance of the contract.

In witness whereof, the undersigned Corporation has caused this agreement to be signed by its duly authorized representative and its Corporate Seal to be hereto affixed this 15th day of July, 2009.

TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA

By Jeanne Primavera
Jeanne Primavera, Attorney-in-fact

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PROCUREMENT

N. J. CONSENT OF SURETY

Form S-4028-1 Printed in U. S. A.

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. Section 9305)

Travelers Indemnity Company, St. Paul Fire and Marine Insurance Company, Travelers Casualty and Surety Company, United States Fidelity and Guaranty Company, Standard Fire Insurance Company, Travelers Casualty and Surety Company of America, Travelers Casualty Insurance Company of America, Farmington Casualty Company, Seaboard Surety Company, Fidelity and Guaranty Insurance Underwriters, Inc., St. Paul Mercury Insurance Company, Fidelity and Guaranty Insurance Company, St. Paul Guardian Insurance Company, surety(ies) on the attached bond, hereby certifies(y) the following:

- 1) The surety(ies) meets (meet) 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(ies) participating in the issuance of the attached bond is (are) in the following amounts as of the calendar year ended December 31, 2007 (most recent calendar year which capital and surplus amounts are available), which amounts have been certified on a Consolidated Certification by *KPMG 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.

<u>Surety Company</u>	<u>Capital</u>	<u>Surplus</u>
Travelers Indemnity Company	\$ 10,770,000	\$8,470,643,647
St. Paul Fire and Marine Insurance Company	\$ 20,000,000	\$6,881,107,266
Travelers Casualty and Surety Company	\$ 25,000,000	\$5,408,584,262
United States Fidelity and Guaranty Company	\$ 35,214,075	\$1,928,503,054
Standard Fire Insurance Company	\$ 5,000,000	\$1,422,079,139
Travelers Casualty and Surety Company of America	\$ 6,000,000	\$1,290,646,286
Travelers Casualty Insurance Company of America	\$ 6,000,000	\$432,447,024
Farmington Casualty Company	\$ 6,000,000	\$272,828,219
Seaboard Surety Company	\$ 5,000,000	\$130,986,358
St. Paul Mercury Insurance Company	\$ 4,230,000	\$59,362,805
Fidelity and Guaranty Insurance Underwriters, Inc.	\$ 5,000,000	\$32,572,442
St. Paul Guardian Insurance Company	\$ 4,200,000	\$25,942,697
Fidelity and Guaranty Insurance Company	\$ 5,000,000	\$19,286,340

- 3) With respect to each surety participating in the issuance of the attached bond that has received from the U.S. Secretary of the Treasury, a certificate of authority pursuant to 31 U.S.C. Section 9305, the underwriting limitation established therein on July 1, 2008 (most recent calendar year available) is as follows:

<u>Surety Company</u>	<u>Limitation</u>
Travelers Indemnity Company	\$847,064,000
St. Paul Fire and Marine Insurance Company	\$472,026,000
Travelers Casualty and Surety Company	\$348,511,000
United States Fidelity and Guaranty Company	\$192,850,000
Standard Fire Insurance Company	\$142,208,000
Travelers Casualty and Surety Company of America	\$129,065,000
Travelers Casualty Insurance Company of America	\$43,245,000
Farmington Casualty Company	\$27,283,000
Seaboard Surety Company	\$13,099,000
St. Paul Mercury Insurance Company	\$5,936,000
Fidelity and Guaranty Insurance Underwriters, Inc.	\$3,257,000
St. Paul Guardian Insurance Company	\$2,594,000
Fidelity and Guaranty Insurance Company	\$1,929,000

- 4) The amount of the bond to which the statement and certification is attached is \$ Three Million Dollars (\$3,000,000)

5) 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 reinsurer under that contract and the amount of the reinsurer's participation in the contact is as follows:

<u>Reinsurer</u>	<u>Address</u>	<u>Amount</u>
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and;

b) Each surety that is party to such contract of reinsurance certifies that each reinsurer 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, Lawrence A. Siuta, as Attorney-in-Fact for the companies herein listed, 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.



(Signature of certifying agent/officer)

Lawrence A. Siuta
(Print name of certifying agent/officer)

Chief Financial Officer, Bond & Financial Products
(Title of certifying agent/officer)

Date: July 15, 2009

TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA

HARTFORD, CONNECTICUT 06183

FINANCIAL STATEMENT AS OF DECEMBER 31, 2008

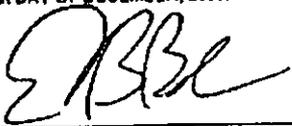
AS FILED IN THE STATE OF NEW JERSEY

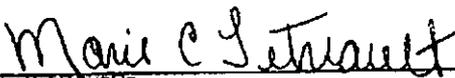
CAPITAL STOCK \$ 6,000,000

ASSETS		LIABILITIES & SURPLUS	
CASH & INVESTED CASH	\$ 148,779,723	UNEARNED PREMIUMS	\$ 246,309,219
BONDS	3,452,929,381	LOSSES	822,955,804
STOCK	7,588,826	LOSS ADJUSTMENT EXPENSES	278,222,162
INVESTMENT INCOME DUE AND ACCRUED	48,660,631	COMMISSIONS	52,167,086
PREMIUM BALANCES	303,582,195	TAXES, LICENSES AND FEES	43,371,400
NET DEFERRED TAX ASSET	40,073,233	OTHER EXPENSES	29,247,064
REINSURANCE RECOVERABLE	12,428,353	FUNDS HELD UNDER REINSURANCE TREATIES	105,982,816
OTHER ASSETS	86,225,430	CURRENT FEDERAL AND FOREIGN INCOME TAXES	104,163,980
		REMITTANCES AND ITEMS NOT ALLOCATED	57,573,235
		AMOUNTS WITHHELD / RETAINED BY COMPANY FOR OTHERS	31,584,808
		RETROACTIVE REINSURANCE RESERVE	11,097,864
		POLICYHOLDER DIVIDENDS	9,605,141
		PROVISION FOR REINSURANCE	5,452,296
		CEDED REINSURANCE NET PREMIUMS PAYABLE	(46,467,530)
		OTHER ACCRUED EXPENSES AND LIABILITIES	11,021,928
		TOTAL LIABILITIES	\$ 2,361,267,253
		CAPITAL STOCK	\$ 8,000,000
		PAID IN SURPLUS	303,297,402
		OTHER SURPLUS	1,425,678,916
		TOTAL SURPLUS TO POLICYHOLDERS	\$ 1,734,976,318
TOTAL ASSETS	\$ 4,096,243,572	TOTAL LIABILITIES & SURPLUS	\$ 4,096,243,572

STATE OF CONNECTICUT)
 COUNTY OF HARTFORD)SS.
 CITY OF HARTFORD)

ERIC B. BRUDER, BEING DULY SWORN, SAYS THAT HE IS CHIEF FINANCIAL OFFICER - TRAVELERS BOND & FINANCIAL PRODUCTS, OF TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA, AND THAT TO THE BEST OF HIS KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT STATEMENT OF THE FINANCIAL CONDITION OF SAID COMPANY AS OF THE 31st DAY OF DECEMBER, 2008.


 CHIEF FINANCIAL OFFICER - BOND & FINANCIAL PRODUCTS


 NOTARY PUBLIC

SUBSCRIBED AND SWORN TO BEFORE ME THIS
 17th DAY OF APRIL, 2009



MARIE C. TETREAUULT
 Notary Public
 My Commission Expires June 30, 2011

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., Seaboard Surety Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company, which resolutions are now in full force and effect, reading as follows:

RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President, any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary may appoint Attorneys-in-Fact and Agents to act for and on behalf of the Company and may give such appointee such authority as his or her certificate of authority may prescribe to sign with the Company's name and seal with the Company's seal bonds, recognizances, contracts of indemnity, and other writings obligatory in the nature of a bond, recognizance, or conditional undertaking, and any of said officers or the Board of Directors at any time may remove any such appointee and revoke the power given him or her; and it is

FURTHER RESOLVED, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President may delegate all or any part of the foregoing authority to one or more officers or employees of this Company, provided that each such delegation is in writing and a copy thereof is filed in the office of the Secretary; and it is

FURTHER RESOLVED, that any bond, recognizance, contract of indemnity, or writing obligatory in the nature of a bond, recognizance, or conditional undertaking shall be valid and binding upon the Company when (a) signed by the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary and duly attested and sealed with the Company's seal by a Secretary or Assistant Secretary; or (b) duly executed (under seal, if required) by one or more Attorneys-in-Fact and Agents pursuant to the power prescribed in his or her certificate or their certificates of authority or by one or more Company officers pursuant to a written delegation of authority; and it is

FURTHER RESOLVED, that the signature of each of the following officers: President, any Executive Vice President, any Senior Vice President, any Vice President, any Assistant Vice President, any Secretary, any Assistant Secretary, and the seal of the Company may be affixed by facsimile to any power of attorney or to any certificate relating thereto appointing Resident Vice Presidents, Resident Assistant Secretaries or Attorneys-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and any such power of attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding on the Company in the future with respect to any bond or understanding to which it is attached.

I, Kori M. Johanson, the undersigned, Assistant Secretary, of Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., Seaboard Surety Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 15th day of July, 20 09


Kori M. Johanson, Assistant Secretary



To verify the authenticity of this Power of Attorney, call 1-800-421-3880 or contact us at www.travelersbond.com. Please refer to the Attorney-In-Fact number, the above-named individuals and the details of the bond to which the power is attached.



POWER OF ATTORNEY

Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
Seaboard Surety Company
St. Paul Fire and Marine Insurance Company

St. Paul Guardian Insurance Company
St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company

Attorney-In Fact No. 220827

Certificate No. 002802122

KNOW ALL MEN BY THESE PRESENTS: That Seaboard Surety Company is a corporation duly organized under the laws of the State of New York, that St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company and St. Paul Mercury Insurance Company are corporations duly organized under the laws of the State of Minnesota, that Farmington Casualty Company, Travelers Casualty and Surety Company, and Travelers Casualty and Surety Company of America are corporations duly organized under the laws of the State of Connecticut, that United States Fidelity and Guaranty Company is a corporation duly organized under the laws of the State of Maryland, that Fidelity and Guaranty Insurance Company is a corporation duly organized under the laws of the State of Iowa, and that Fidelity and Guaranty Insurance Underwriters, Inc. is a corporation duly organized under the laws of the State of Wisconsin (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint

K. A. Gelok, Scott R. Kuzmic, Donald Goetz, and Jeanne Primavera

of the City of Farmingdale, State of New Jersey, their true and lawful Attorney(s)-in-Fact, each in their separate capacity if more than one is named above, to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

IN WITNESS WHEREOF, the Companies have caused this instrument to be signed and their corporate seals to be hereto affixed, this 29th day of January, 2009.

Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
Seaboard Surety Company
St. Paul Fire and Marine Insurance Company

St. Paul Guardian Insurance Company
St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company



State of Connecticut
City of Hartford ss.

By: [Signature]
George W. Thompson, Senior Vice President

On this the 29th day of January, 2009, before me personally appeared George W. Thompson, who acknowledged himself to be the Senior Vice President of Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., Seaboard Surety Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

In Witness Whereof, I hereunto set my hand and official seal. My Commission expires the 30th day of June, 2011.



[Signature]
Marie C. Tetreault, Notary Public



State of New Jersey
DEPARTMENT OF BANKING AND INSURANCE

CERTIFICATE OF AUTHORITY

DATE: MAY 9, 2008

NAIC COMPANY CODE: 31194

THIS IS TO CERTIFY THAT THE TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA OF HARTFORD, CONNECTICUT, HAVING COMPLIED WITH THE LAWS OF THE STATE OF NEW JERSEY, AND ANY SUPPLEMENTS OR AMENDMENTS THERETO WITH RESPECT TO THE TRANSACTION OF THE BUSINESS OF INSURANCE, IS LICENSED TO TRANSACT IN THIS STATE UNTIL THE FIRST DAY OF MAY, 2009, THE LINES OF INSURANCE SPECIFICALLY DESIGNATED BY THE FOLLOWING NUMERALS: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21 AND 27.

PROPERTY/CASUALTY COMPANY
N.J.S.A. 17:17-1

1. Fire & Allied Lines
2. Earthquake
3. Growing Crops
4. Ocean Marine
5. Inland Marine
6. Workers' Compensation & Employers' Liability
7. Automobile Liability (BI)
8. Automobile Liability (PD)
9. Automobile Physical Damage
10. Aircraft Physical Damage
11. Other Liability
12. Boiler & Machinery
13. Fidelity & Surety
14. Credit
15. Burglary & Theft
16. Glass
17. Sprinkler Leakage & Water Damage
18. Livestock
19. Smoke or Smudge
20. Physical Loss to Buildings
21. Radioactive Contamination
22. Mechanical Breakdown/Power Failure
23. Other (see reverse side)

N.J.S.A. 17B:17-4

26. Accident and Health

N.J.S.A. 17:17-1(g) and
N.J.A.C. 11:7-1.1 et seq.

27. Municipal Bond Insurance

LIFE INSURANCE COMPANY
Title 17B

28. Life
29. Health
30. Annuities
31. Variable Contracts
32. Other (see reverse side)

OTHER COMPANIES
N.J.S.A. 17:46B-1 et seq.

33. Title Insurance
N.J.S.A. 17:44A-1 et seq.
34. Fraternal Benefit Society
N.J.S.A. 17:46A-1 et seq.
35. Residential Mortgage Guaranty Insurance
36. Commercial Mortgage Guaranty Insurance

SPECIAL CONDITIONS

40. Non-participating Insurance Only
50. Reciprocal Exchange
60. Reinsurance Only
70. Participating Business Requirements
80. Capital & Surplus Guarantee (see reverse side)
99. (see reverse side)

STEVEN M. GOLDMAN
COMMISSIONER



ACKNOWLEDGMENT¹⁸

ACKNOWLEDGMENT OF BIDDER, IF A CORPORATION

State of New Jersey

SS:

County of Union

On this 15th day of July, 20⁰⁹, before me personally came and appeared Michael A. Whitehead, to me known, who, being by me duly sworn, did depose and say that he resides at _____, that he is the Vice President of Paving Materials & Constr. Co., 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)

CAROL A. ROMANO
NOTARY PUBLIC OF NEW JERSEY
MY COMMISSION EXPIRES OCT. 8, 2013

Carol A. Romano

(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

¹⁸ 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
2009 AUG -3 PM 3:00

FORM OF CONTRACT

CHAPTER I

GENERAL PROVISIONS

17. 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 Parking Lot P6, Building 75, and the vicinities thereof at Newark Liberty International Airport.

"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 paving, utilities work, relocation of toll plaza, building removal, underground tank removal 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 and Lump Sum", which provisions shall form a part of the items in said Schedules of Unit Prices.

"Unclassified Work" shall mean Work other than Classified Work.

"Extra Work" shall mean Work required by the Chief Engineer, Deputy Director of Construction or Engineer of Construction 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 "Unit Prices and Lump Sum".

"Estimated Total Contract Price" shall mean the result obtained by adding together the Estimated Total for Classified Work and the Lump Sum, whether or not such result is correctly shown in the Contractor's Proposal.

"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.

"Director" shall mean the Director of Aviation of the Authority for the time being, or his successor in duties for the purpose of this Contract, acting personally or through his authorized representative for the purpose of this Contract, who is at present the Authority's Director of Aviation Operations.

"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.

"Deputy Director of Construction" shall mean the Deputy Director of 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 (including temporary or consumable materials) 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.

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.

18. GENERAL AGREEMENT

The Contractor agrees to perform paving, utilities, relocation of toll plaza, building removal, 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 consisting of the following amounts and such amounts only, subject only to the express provisions of this Contract specifically setting forth actual, defined additions to or deductions from such compensation.

- A. An amount based upon the Classified Work performed, computed at the rates quoted in the Schedule of Unit Prices, said Classified Work to be measured and said amount to be computed in the manner provided in the clause hereof entitled "Unit Prices and Lump Sum"; and
- B. The amount of the Lump Sum quoted in the clause hereof entitled "Unit Prices and Lump Sum".

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.

19. 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.

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.

20. EXEMPTION FROM NEW JERSEY STATE SALES TAXES

The attention of the Contractor is directed to the following provision of the New Jersey State Sales and Use Tax Act:

Receipts 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:

(a) organizations described in subsections (a) and (b) of section 9 of the "Sales and Use Tax Act," P.L. 1966, c.30 (C. 54:32B-9);

*** are exempt from the tax imposed under the "Sales and Use Tax Act," provided any person seeking to qualify for the exemption shall do so pursuant to such rules and regulations and upon forms as shall be prescribed by the director.
N.J.S.A. 54:32B-8:22.

The Authority is an exempt organization of the type described in subsection (a) of section 9 of the act.

In view of the foregoing, the Contractor should not include in his price(s) any amounts for New Jersey State sales and use taxes on such materials, supplies and services.¹⁹

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, 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 taxes and have filed all the forms and certificates required by the applicable laws, rules and regulations in connection therewith; 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, 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.

21. 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 Estimated Total Contract Price and such bond shall be signed by one or more sureties²⁰ 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.

¹⁹ Note regarding equipment rentals: The attention of the Contractor is directed to the fact that the New Jersey State Sales Tax Bureau has ruled that the "rental of equipment is taxable whether or not the job is performed for an exempt organization." Therefore in the case of equipment rentals, if any, the Contractor should include in his prices an amount for taxes thereon.

²⁰ 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.

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.

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 Estimated Total Contract Price 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 \$3000 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.

CHAPTER II

COMPENSATION AND PAYMENTS

22. UNIT PRICES AND LUMP SUM

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 Total Contract Price is solely for the purpose of fixing the amount 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. The estimated quantities are given solely as a basis for the computation of the Estimated Total Contract Price. 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.

I. SCHEDULE OF UNIT PRICES FOR CLASSIFIED WORK				
Item No.	Estimated Quantities	Items of Classified Work With Unit Prices Written	Figures	
			Unit Prices	Amounts ²¹
1	75,665 S.Y.	MILL ASPHALT CONCRETE TO 2" BELOW FINISHED GRADE, PER SQUARE YARD Three _____ DOLLARS No _____ CENTS	3.00	226,995.00
2	40,345 S.Y.	FULL DEPTH FLEXIBLE PAVEMENT REMOVAL - 6" ASPHALT CONCRETE AND 6" AGGREGATE BASE COURSE, PER SQUARE YARD Nine _____ DOLLARS Twenty _____ CENTS	9.20	371,174.00
3	2,300 S.Y.	FULL DEPTH FLEXIBLE PAVEMENT REMOVAL - 4" ASPHALT CONCRETE AND 6" AGGREGATE BASE COURSE, PER SQUARE YARD Eleven _____ DOLLARS No _____ CENTS	11.00	25,300.00
4	3,612 S.Y.	REMOVE CONCRETE SIDEWALK OR CONCRETE ISLANDS, PER SQUARE YARD Eight _____ DOLLARS No _____ CENTS	8.00	28,896.00
5	260 C.Y.	REMOVE CONCRETE SLAB, PER CUBIC YARD Twenty-three _____ DOLLARS No _____ CENTS	23.00	5,980.00
6	830 TON	ASPHALT CONCRETE MIX I-4 PG 64-22, PER TON Fifty-seven _____ DOLLARS Forty-five _____ CENTS	57.45	47,683.50
7	27,685 TON	WARM MIX ASPHALT CONCRETE PG 64-22, PER TON Fifty-six _____ DOLLARS No _____ CENTS	56.00	1,550,360.00

²¹ 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 ²¹
8	116,800 S.Y.	TACK COAT, PER SQUARE YARD <u>No</u> DOLLARS <u>Thirty-three</u> CENTS	0.33	38,544.00
9	151,990 S.Y.	RUBBERIZED COAL TAR EMULSION SEALCOAT, PER SQUARE YARD <u>Two</u> DOLLARS <u>Forty-four</u> CENTS	2.44	370,855.60
10	6,500 C.Y.	BASE COURSE, PER CUBIC YARD <u>Forty-five</u> DOLLARS <u>No</u> CENTS	45.00	292,500.00
11	685 TON	PLANT MIX MACADAM, PER TON <u>Seventy-seven</u> DOLLARS <u>No</u> CENTS	77.00	52,745.00
12	15,000 LBS.	REPLACEMENT OF CARBON IN THE WATER TREATMENT SYSTEM'S LIQUID PHASE GRANULAR ACTIVATED CARBON UNIT, PER POUND <u>No</u> DOLLARS <u>Seventy-five</u> CENTS	0.75	11,250.00
ESTIMATED TOTAL FOR CLASSIFIED WORK ²²				\$3,022,283.10

²² The Estimated Total for Classified Work shall be computed by totaling the amounts inserted in the "Amounts" column.

II. LUMP SUM FOR UNCLASSIFIED WORK	
Writing	Figures
Twelve Million One Hundred Sixteen Thousand	12,116,345.00
Three Hundred Forty-five -----Dollars	
NoCents	

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PROCUREMENT

III. RECAPITULATION	
	Figures
ESTIMATED TOTAL FOR CLASSIFIED WORK.	3,022,283.10
LUMP SUM FOR UNCLASSIFIED WORK	12,116,345.00
ESTIMATED TOTAL CONTRACT PRICE:	²³ 15,138,628.10

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.

²³ The Estimated Total Contract Price shall be computed by adding the Estimated Total for Classified Work to the Lump Sum for Unclassified Work.

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

In the case of Item No. 1 (MILL ASPHALT CONCRETE TO 2" BELOW FINISHED GRADE), the quantity for payment shall be the number of square yards of existing asphalt concrete pavement actually milled 2" below finished grade prior to asphalt concrete paving, measured on the surface of the pavement after milling.

In the case of Item No. 2 (FULL DEPTH FLEXIBLE PAVEMENT REMOVAL - 6" ASPHALT CONCRETE AND 6" AGGREGATE BASE COURSE), the quantity for payment shall be the number of square yards of existing full depth flexible pavement (6" Asphalt concrete, 6" Aggregate Base Course) actually removed, measured on the surface of the pavement after full depth flexible pavement removal.

In the case of Item No. 3 (FULL DEPTH FLEXIBLE PAVEMENT REMOVAL - 4" ASPHALT CONCRETE AND 6" AGGREGATE BASE COURSE), the quantity for payment shall be the number of square yards of existing full depth flexible pavement (4" Asphalt concrete, 6" Aggregate Base Course) actually removed, measured on the surface of the pavement after full depth flexible pavement removal.

In the case of Item No. 4 (REMOVE CONCRETE SIDEWALK OR CONCRETE ISLANDS), the quantity for payment shall be the number of square yards of existing concrete sidewalk or concrete island actually removed, measured on the surface of the pavement after concrete sidewalk or concrete island removal.

In the case of Item No. 5 (REMOVE CONCRETE SLAB), the quantity for payment shall be the number of cubic yards of existing 8" thick concrete actually removed, measured on the surface of the pavement after concrete slab removal.

In the case of Item No. 8 (ASPHALT CONCRETE MIX 1-4, PG 64-22), the quantity for payment shall be the number of tons of asphalt concrete, PG 64-22, mix 1-4 PG 64-22 actually placed. The weight of this item shall be based on the certified scale weight of material in trucks weighed on approved scales, or at the option of the Engineer, on certified automated printouts at plants using an automatic batching and mixing system. In case of conflict between the printout weight and the scale weight, the scale weight shall control.

In the case of Item No. 9 (WARM MIX ASPHALT CONCRETE, PG 64-22), the quantity for payment shall be the number of tons of warm mix asphalt concrete, PG 64-22, actually placed. The weight of this item shall be based on the certified scale weight of material in trucks weighed on approved scales, or at the option of the Engineer, on certified automated printouts at plants using an automatic batching and mixing system. In case of conflict between the printout weight and the scale weight, the scale weight shall control.

In the case of Item No. 10 (TACK COAT), the quantity for payment shall be the number of square yards of surface on which tack coat is actually placed, measured on the surface after placement. No deductions from the measured area will be made for catch basins, manholes or other horizontal structures and no vertical surfaces will be measured for payment.

In the case of Item No. 11 (RUBBERIZED COAL TAR EMULSION SEALCOAT), the quantity for payment shall be the number of square yards of surface on which rubberized coal tar emulsion sealcoat is actually placed, measured on the surface of the pavement after placement. No deductions from the measured area will be made for catch basins, manholes or other horizontal structures and no vertical surfaces will be measured for payment.

In the case of Item No. 12 (AGGREGATE BASE COURSE), the quantity for payment shall be the number of cubic yards of aggregate base course actually placed, computed by the Engineer using the Average End Area Method, based upon the cross-sections taken by the Contractor before and after placement of the aggregate base course.

In the case of Item No. 13 (PLANT MIX MACADAM), the quantity for payment shall be the number of tons of plant mix macadam actually placed. The weight of this item shall be based on the certified scale weight of material in trucks weighed on approved scales, or at the option of the Engineer, on certified automated printouts at plants using an automatic batching and mixing system. In case of conflict between the printout weight and the scale weight, the scale weight shall control.

In the case of Item No. 15 (REPLACEMENT OF CARBON IN THE WATER TREATMENT SYSTEM'S LIQUID PHASE GRANULAR ACTIVATED CARBON UNIT), the quantity for payment shall be the number of pounds of carbon replaced in the water treatment system's liquid phase granular activated carbon unit, as determined by the Engineer.

23. 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.

24. 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, an amount equal to the actual net cost in money of the labor and materials required for the provision of such services, plus seven per cent (7%) of such net cost.
- 2.) For Extra Work consisting of performance of construction work at the construction site, an amount determined as follows:
 - a. In the case of Extra Work performed by the Contractor personally, an amount equal to the actual net cost in money of the labor and materials required for such Extra Work, plus twenty per cent (20%) of such net cost, plus such rental for equipment (other than small tools) required for such Extra Work as the Engineer deems reasonable.
 - b. In the case of Extra Work performed by a subcontractor, an amount equal to the actual net cost in money of the labor and materials required for such Extra Work, plus twenty per cent (20%) of such net cost plus such rental for equipment (other than small tools) required for such Extra Work as the Engineer deems reasonable, plus seven per cent (7%) of the sum of the foregoing cost, percentage of cost, and rental.

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) vacation allowances and union dues and assessments which the employer actually pays pursuant to contractual obligation upon the basis of such wages, and (b) 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 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 Extra Work. No amount for operating cost will be allowed during periods when such equipment is not actually engaged in performing Extra 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 equipment is in the Blue Book, the Engineer shall determine the reasonable rate of rental and/or hourly operating cost of the particular item of equipment by such other means as he finds appropriate.
 - 3.) In the event the Contractor is directed by the Engineer to immediately perform Extra Work within 24 hours of the direction to proceed, the Engineer shall determine the reasonable rate of rental and/all hourly operating cost of the items of equipment necessary to perform such Extra 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 equipment used on a particular Extra Work order 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
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- 2.) The rental rate shall be multiplied by the applicable regional adjustment factor shown for such item of equipment in the Blue Book. The adjustment factor shall not apply to the hourly operating cost.
 - 3.) If the Engineer should determine that the nature or size of the equipment used by the Contractor in connection with Extra Work is 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 Extra Work, the reasonable rental will not be based upon the equipment used by the Contractor but will be based on the smallest or least elaborate equipment determined by the Engineer to have been suitable for the performance of the Extra Work.
- C. In the case of equipment utilized only for Extra Work: (a) in addition to amounts determined as provided in subparagraphs A and B above, there will be added to the rental as computed above the taxes on the rental actually paid by the Contractor or subcontractor and the reasonable cost of transporting such equipment to and from the construction site, including applicable tolls, and (b) notwithstanding the number of hours during which such equipment is utilized, the minimum rental therefor will be for a period of eight hours.

In computing the Contractor's compensation insofar as it is based upon Extra Work, and notwithstanding any provision to the contrary appearing in the Blue Book, no consideration shall be given to any items of cost or expense not expressly set forth above, it being expressly agreed that the costs and percentage additions hereinbefore provided cover items of cost and expense to the Contractor of any type whatsoever, including administration, overhead, taxes (other than those enumerated above), clean-up, consumables including gas and oil, drafting (including printing or other reproduction), coordination, field measurements, maintenance, repairs, insurance, profit to the Contractor and small tools.

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 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 or his subcontractors 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 Contractor's 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 date 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.

25. 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.

26. COMPENSATION FOR EMERGENCY DELAYS

If the Contractor is specifically directed by the Engineer to suspend his operations as stipulated in the Specifications entitled "Airport Operations And Conditions" 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) taxes actually paid by the employer pursuant to law upon the basis of such salaries and wages, and (b) 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 workmen, 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.

27. 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 (other than Extra 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. The increases, if any, in the Contractor's compensation for which provision is specifically made elsewhere in this Contract.

As an aid to the Contractor and to facilitate his performance, the Authority shall, within fifteen days after the receipt of each such monthly certificate, advance to the Contractor by check the sums so certified, minus, however, either ten per cent (10%) of the sum certified pursuant to subparagraph A and B of this numbered clause or five per cent (5%) of the Estimated Total Contract Price, whichever is less, 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"

28. 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.

29. 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.

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.

30. 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

31. TIME FOR COMPLETION AND DAMAGES FOR DELAY

The Contractor shall complete the performance of all Work under this Contract within 600 calendar days after receipt by him of the acceptance of his Proposal.

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 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 Three Thousand Dollars (\$3000) per calendar day.

32. 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.

33. 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 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 "Compensation for Extra Work"; 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 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.

34. 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.

35. 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

36. AUTHORITY OF DIRECTOR

If at any time it shall be, from the viewpoint of the Authority, impracticable or undesirable in the judgment of the Director 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 Director 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.

37. 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.

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 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 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 \$25,000 and subject to the aggregate limit specified in said clause.

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.

38. 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 the 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.

39. 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.

40. EQUAL EMPLOYMENT OPPORTUNITY

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.

41. NO DISCRIMINATION IN EMPLOYMENT

During the performance of this Contract, 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 Port 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 subparagraphs A through C of this paragraph 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 Port 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 1st 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 clause 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 clauses 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 agreement.
- 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.

42. 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.

Each bidder, contractor or subcontractor (hereinafter called the Contractor) must fully comply with the clause entitled 'Equal Employment Opportunity' and these bid conditions. The Contractor commits itself to the goals for minority and female utilization set forth below and all other requirements, terms and conditions of these bid conditions by submitting a properly signed bid.

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

- 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 Section shall be based on its implementation of the clause entitled 'Equal Employment Opportunity', 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 General Manager, Business and Job Opportunity, Office of Regional and Economic Development 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 starting 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 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 these specifications:
 - a. Omitted
 - b. "Manager" means General Manager, Business and Job Opportunity, Office of Regional and Economic Development of the Authority;
 - c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U. S. Treasury Department Form 941;

- d. "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, it 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.) Omitted.
- 4.) The Contractor shall implement the specific affirmative action standards provided in paragraphs 7a 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 its 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.
- 5.) 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.
- 6.) 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.

- 7.) 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 its effort to achieve maximum results from its 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 its 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 7a 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 Manager 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 its 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 its 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 its 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.

- 8.) Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a 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 its obligations under 7a 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 its 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.
- 9.) 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 its goals for women generally, the Contractor may be in violation hereof if a specific minority group of women is under-utilized).
- 10.) 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.
- 11.) The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.
- 12.) The Contractor shall carry out such sanctions and penalties for violation of this clause and of the clause entitled "Equal Employment Opportunity", 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.
- 13.) The Contractor, in fulfilling its obligations hereunder shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 hereof so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of these provisions, the Authority shall proceed accordingly.

- 14.) 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.
- 15.) 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).

43. AFFIRMATIVE ACTION PROGRAMS

The Contractor assures that it will undertake an affirmative action program as required by 14 CFR Part 152, Subpart E, to insure that no person shall on the grounds of race, creed, color, national origin, or sex be excluded from participating in any employment activities covered in 14 CFR Part 152, Subpart E. The Contractor assures that no person shall be excluded on these grounds from participating in or receiving the services or benefits of any program or activity covered by this subpart. The Contractor assures that it will require that its covered suborganizations provide assurances to the Contractor that they similarly will undertake affirmative action programs and that they will require assurances from their suborganizations, as required by 14 CFR Part 152, Subpart E, to the same effect.

44. 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 its 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 its 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 social security number of each such employee, 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 its subcontractors shall permit such representatives to interview employees during working hours on the job 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.

45. EXTRA WORK ORDERS

No Extra Work of a cost in excess of \$25,000 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 \$25,000 or less shall be performed except pursuant to written orders of the Chief Engineer, Deputy Director of Construction or the Engineer of Construction expressly and unmistakably indicating his intention to treat the Work described therein as Extra Work; and, exclusive of Extra Work expressly authorized by or pursuant to a resolution of the Commissioners of the Authority or its Committee on Construction, the Chief Engineer and, subject to the foregoing limitation, the Deputy Director of Construction and the Engineer of Construction, shall have authority to order any item of Extra Work, if the cost thereof to the Authority together with the cost of all other Extra Work previously ordered and not expressly authorized as aforesaid will not in the aggregate be in excess of the sum specified in the letter of acceptance of the Contractor's Proposal as the limit on such authority to order Extra Work; provided, however, that Extra Work in excess of such aggregate amount may be ordered as above provided to the extent expressly authorized in a writing signed by the Executive Director of the Authority delegating authority vested in him pursuant to the By-Laws or a resolution of the Commissioners of the Authority or its Committee on Construction and in the case of Extra Work ordered by the Deputy Director of Construction or Engineer of Construction to the extent expressly authorized in a writing signed by the Chief Engineer delegating authority vested in the Executive Director as aforesaid, which in turn was vested in him by the Executive Director.

In the absence of such an order signed by the Chief Engineer in the case of Extra Work of a cost in excess of \$25,000 and by the Chief Engineer or Deputy Director of Construction or Engineer of Construction in the case of Extra Work of a cost of \$25,000 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 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.

46. 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.

47. 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.

48. 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" and "Non-Collusive Bidding and Code of Ethics Certification; Certification of No Solicitation Based on Commission, Percentage, Brokerage, Contingent Fee or Other Fee". 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.

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.

49. 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.

50. 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.

51. 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.

52. 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.

53. 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

54. 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.

55. 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 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, such defense to 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.

Inasmuch as the Authority has agreed to indemnify the City of Newark against claims of the types described in subparagraph C above made against said city, the Contractor's obligation under subparagraph C above shall include claims by said city against the Authority for such indemnification, including those arising from acts or omissions (whether negligent or not) of said city.

56. 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".

57. 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 its Proposal the Contractor shall deliver to the General Manager, Risk Management, 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 Contractors' 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 through C of this numbered clause are available for examination by appointment in the office of the General Manager, Risk Management, 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 through 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 through 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 its 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 it has examined and is familiar with the above stated coverages and that in submitting its Proposal it has relied solely on its 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.

58. INSURANCE PROCURED BY CONTRACTOR

The Contractor, in its own name as insured, shall maintain and pay the premiums on the policy or policies of insurance for coverage(s) as hereinafter described, which shall cover its 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 commercial available form:
 - 1.) Combined single limit for bodily injury and property damage liability with a minimum limit of \$ 5 million each accident.

The Authority 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 its 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, raise any defense involving in any way the jurisdiction of the Authority, its Commissioners, officers, agents or employees, the governmental nature of the Authority or the provisions of any statute 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 Management, 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 them by law or by this or any other Contract.

CHAPTER VI
RIGHTS AND REMEDIES

59. 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" and "Non-Collusive Bidding and Code of Ethics Certification; Certification of No Solicitation Based on Commission, Percentage, Brokerage, Contingent Fee or Other Fee", 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.

60. 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.

61. 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.

62. 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

63. 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.

64. 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.

65. 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.

66. 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.

67. 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.

68. 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.

69. 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 undersigned²⁴ Contractor and surety company (or companies), as principal and surety (or sureties), respectively,

Contractor

Surety

²⁴ 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 EWR-154.028 - "Newark Liberty International Airport - Rehabilitation of Parking Lot P6 and Gas Station Site"; 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 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.

(Seal)

Principal
By²⁵ _____

Surety
By²⁶ _____

APPROVED AS TO ACCEPTABILITY OF SURETIES:

Credit Manager
_____ 20

²⁵ If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

²⁶ 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

70. CONSTRUCTION REQUIRED BY THE SPECIFICATIONS

These Specifications relate generally to performing paving, utilities, relocation of toll plaza, building removal, 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.

71. 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 cross-hatched on Contract Drawing No. G003 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 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.

72. 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, as well as vehicular and pedestrian traffic 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.

73. 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.

74. 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.

75. CONTRACT DRAWINGS

The Contract Drawings which accompany and form a part of these Specifications bear the general title "The Port Authority of NY & NJ - Newark Liberty International Airport - Rehabilitation of Parking Lot P6 and Gas Station Site - Contract EWR-154.028" and are separately numbered and entitled as follows:

G001		
G002	LOCATION PLAN	General
G003	INDEX OF DRAWINGS 1 OF 2	General
G004	INDEX OF DRAWINGS 2 OF 2	General
G005	GENERAL NOTES	General
CS001	CONSTRUCTION STAGING PLAN STAGE -1-	General
CS002	CONSTRUCTION STAGING PLAN STAGE -2-	General
CS003	CONSTRUCTION STAGING PLAN STAGE -3-	General
CS004	CONSTRUCTION STAGING PLAN STAGE -4-	General
CS005	CONSTRUCTION STAGING PLAN STAGE -5-	General
CS006	CONSTRUCTION STAGING PLAN STAGE -6-	General
GT001	FOUNDATION AND EARTHWORK -NOTES AND DETAILS	General
A001	ARCHITECTURAL NOTES, ABBREVIATIONS & SYMBOLS	Architectural
A101	EXISTING ARCHITECTURAL BUS SHELTER REMOVALS	Architectural
A102	SITE PLAN AND BUS SHELTER RELOCATIONS	Architectural
A103	ENTRANCE AND EXIT PLAZA PLAN	Architectural
A104	PLAZA ELEVATIONS	Architectural
A201	PLAZA CANOPY ROOF PLAN & RCP	Architectural
A202	TYPICAL CANOPY SECTION	Architectural
A203	PLAZA CANOPY SECTION & DETAILS	Architectural
A204	PLAZA CANOPY ROOF DETAILS	Architectural
A205	PLAZA CANOPY DETAILS	Architectural
A301	TYPICAL ENTRANCE AND EXIT ISLAND PLANS	Architectural
A302	PLAZA LANE CLOSURE DETAILS	Architectural
A303	ISLAND DETAILS	Architectural
A304	TYPICAL EXIT PLAZA SIGNAGE LOCATION DIAGRAM AND DETAILS	Architectural

A305	TYPICAL ENTRANCE PLAZA SIGNAGE LOCATION DIAGRAM & DETAILS	Architectural
A401	TOLL BOOTH PLAN & RCP	Architectural
A402	TOLL BOOTH ELEVATIONS	Architectural
A403	TOLL BOOTH SECTIONS	Architectural
A404	TOLL BOOTH DETAILS SHEET 1	Architectural
A405	TOLL BOOTH DETAILS SHEET 2	Architectural
A406	TOLL BOOTH DETAILS SHEET 3	Architectural
A407	TOLL BOOTH SCHEDULES	Architectural
A501	SERVICE BUILDING FLOOR PLAN & FOUNDATION PLAN	Architectural
A502	SERVICE BUILDING ROOF PLAN & RCP	Architectural
A503	SERVICE BUILDING ELEVATIONS	Architectural
A504	SERVICE BUILDING SECTIONS	Architectural
A506	SERVICE BUILDING FINISH, DOOR & WINDOW SCHEDULES & DETAILS	Architectural
A507	SERVICE BUILDING DETAILS & PARTITION TYPES	Architectural
A509	SERVICE BUILDING INTERIOR ELEVATIONS	Architectural
A510	BUS SHELTER PLAN & ELEVATION	Architectural
S001	STRUCTURAL NOTES, LEGEND AND ABBREVIATIONS	Structural
S002	ENTRY AND EXIT TOLL PLAZA - CANOPY FOUNDATION PLAN, SECTIONS AND DETAILS	Structural
S003	ENTRY AND EXIT TOLL PLAZA - CANOPY FRAMING PLAN, SECTIONS AND DETAILS	Structural
S004	ENTRY AND EXIT TOLL PLAZA - TYPICAL CANOPY SECTIONS AND ELEVATION	Structural
S005	ENTRY AND EXIT TOLL PLAZA - SECTIONS AND DETAILS	Structural
S006	ENTRY AND EXIT TOLL PLAZA - ELEVATIONS	Structural
S007	ENTRY AND EXIT TOLL PLAZA - SIGNS SUPPORT, SECTIONS AND DETAILS	Structural
S008	SERVICE BUILDING - FLOOR SLAB AND FOUNDATION PLAN, SECTIONS AND DETAILS	Structural
S009	SERVICE BUILDING - ROOF FRAMING PLAN, SECTION AND DETAIL	Structural
S010	SERVICE BUILDING - ELEVATIONS	Structural
S011	SERVICE BUILDING - SECTIONS AND DETAILS	Structural

S012	MISCELLANEOUS FOUNDATION PLANS, SECTIONS AND DETAILS	Structural
S013	REMOVAL - EXISTING BUILDING 75 PLAN	Structural
S014	REMOVAL - EXISTING BUILDING 75 SECTION	Structural
S015	REMOVAL - EXISTING TOLL PLAZA PLAN AND SECTIONS	Structural
M001	REMOVAL - UNDERGROUND STORAGE TANKS	Mechanical
M002	MECHANICAL SYMBOLS AND NOTES, TOLL BOOTH FLOOR PLAN, SECTION & ELEVATION	Mechanical
M003	TOLL BOOTH SCHEDULES & NOTES	Mechanical
M004	SERVICE BUILDING ROOF PLAN, CEILING PLAN, DETAILS & SECTIONS	Mechanical
M005	SERVICE BUILDING SCHEDULES & DETAIL	Mechanical
M006	SERVICE BUILDING CONTROL WIRING SCHEMATICS AND DETAIL	Mechanical
P001	GAS STATION REMOVAL PLAN AND NOTES	Plumbing
P002	SERVICE BUILDING FLOOR PLAN, SYMBOL LIST, AND SCHEDULES	Plumbing
P003	TOLL PLAZA SITE CONNECTION PLAN, CANOPY ROOF PLAN, AND CANOPY SECTION	Plumbing
P004	IRRIGATION PLAN	Plumbing
P005	RISER DIAGRAM AND DETAILS	Plumbing
P006	IRRIGATION NOTES & DETAILS	Plumbing
C001	KEY PLAN	Civil
C002	LEGEND & ABBREVIATIONS	Civil
C003	CIVIL NOTES	Civil
C004	REMOVAL PLAN -1-	Civil
C005	REMOVAL PLAN -2-	Civil
C006	REMOVAL PLAN -3-	Civil
C007	REMOVAL PLAN -4-	Civil
C008	REMOVAL PLAN -5-	Civil
C009	REMOVAL PLAN -6-	Civil
C010	EXISTING TOLL PLAZA REMOVAL PART PLAN	Civil
C011	ABANDONED TOLL PLAZA DETAIL REMOVAL PART PLAN	Civil
C012	CURVE DATA TABLE -1-	Civil
C013	CURVE DATA TABLE -2-	Civil

C014	ALIGNMENT PLAN -1-	Civil
C015	ALIGNMENT PLAN -2-	Civil
C016	ALIGNMENT PLAN -3-	Civil
C017	ALIGNMENT PLAN -4-	Civil
C018	ALIGNMENT PLAN -5-	Civil
C019	ALIGNMENT PLAN -6-	Civil
C020	PROFILE	Civil
C021	SECTIONS -1-	Civil
C022	SECTIONS -2-	Civil
C023	SECTIONS -3-	Civil
C024	SECTIONS -4-	Civil
C025	GRADING PLAN -1-	Civil
C026	GRADING PLAN -2-	Civil
C027	GRADING PLAN -3-	Civil
C028	GRADING PLAN -4-	Civil
C029	GRADING PLAN -5-	Civil
C030	GRADING PLAN -6-	Civil
C031	PAVING PLAN -1-	Civil
C032	PAVING PLAN -2-	Civil
C033	PAVING PLAN -3-	Civil
C034	PAVING PLAN -4-	Civil
C035	PAVING PLAN -5-	Civil
C036	PAVING PLAN -6-	Civil
C037	TABLE OF DRAINAGE STRUCTURES -1-	Civil
C038	TABLE OF DRAINAGE STRUCTURES -2-	Civil
C039	UTILITIES PLAN 1	Civil
C040	UTILITIES PLAN 2	Civil
C041	UTILITIES PLAN 3	Civil
C042	UTILITIES PLAN 4	Civil
C043	UTILITIES PLAN 5	Civil
C044	UTILITIES PLAN 6	Civil
C045	DETAILS -1-	Civil
C046	DETAILS -2-	Civil
C047	DETAILS -3-	Civil

C048	DETAILS -4-	Civil
C049	DETAILS -5-	Civil
C050	DETAILS -6-	Civil
C051	DETAILS -7-	Civil
C052	DETAILS -8-	Civil
C053	DETAILS -9-	Civil
N001	NOTES AND DETAILS	Environmental
N002	EXTENT OF CONTAMINATED SOIL EXCAVATION	Environmental
N003	DEWATERING OF PETROLEUM CONTAMINATED EXCAVATION	Environmental
N004	SOIL EROSION AND SEDIMENT CONTROL PLAN -1-	Environmental
N005	SOIL EROSION AND SEDIMENT CONTROL PLAN -2-	Environmental
N006	SOIL EROSION AND SEDIMENT CONTROL PLAN -3-	Environmental
N007	SOIL EROSION AND SEDIMENT CONTROL PLAN -4-	Environmental
N008	SOIL EROSION AND SEDIMENT CONTROL PLAN -5-	Environmental
N009	SOIL EROSION AND SEDIMENT CONTROL PLAN -6-	Environmental
N010	SOIL EROSION AND SEDIMENT CONTROL NOTES AND DETAILS	Environmental
MT001	MAINTENANCE OF TRAFFIC - GENERAL TRAFFIC NOTES, SYMBOLS, ABBREVIATIONS AND SIGN DATA TABLE	Traffic
MT002	MAINTENANCE OF TRAFFIC - STAGE 1 LOCATION 1	Traffic
MT003	MAINTENANCE OF TRAFFIC - STAGE 1 LOCATION 2	Traffic
MT004	MAINTENANCE OF TRAFFIC - STAGE 2 LOCATION 1	Traffic
MT005	MAINTENANCE OF TRAFFIC - STAGE 2 LOCATION 2	Traffic
MT006	MAINTENANCE OF TRAFFIC - STAGE 2 LOCATION 3 - 1 OF 2	Traffic
MT007	MAINTENANCE OF TRAFFIC - STAGE 2 LOCATION 3 - 2 OF 2	Traffic
MT008	MAINTENANCE OF TRAFFIC - STAGE 3 - 1 OF 2	Traffic
MT009	MAINTENANCE OF TRAFFIC - STAGE 3 - 2 OF 2	Traffic
MT010	MAINTENANCE OF TRAFFIC - STAGE 4	Traffic
MT011	MAINTENANCE OF TRAFFIC - STAGE 5	Traffic
MT012	MAINTENANCE OF TRAFFIC - STAGE 6	Traffic
MT013	MAINTENANCE OF TRAFFIC - STANDARD DETAILS	Traffic

MT014	MAINTENANCE OF TRAFFIC - STANDARD DETAILS 2	Traffic
MT015	MAINTENANCE OF TRAFFIC - STANDARD DETAILS 3	Traffic
MT016	MAINTENANCE OF TRAFFIC - STANDARD DETAILS 4	Traffic
MT017	MAINTENANCE OF TRAFFIC - STANDARD DETAILS 5	Traffic
MT018	MAINTENANCE OF TRAFFIC - STANDARD DETAILS 6	Traffic
MT019	MAINTENANCE OF TRAFFIC - STANDARD DETAILS 7	Traffic
T001	GENERAL TRAFFIC NOTES, SYMBOLS AND ABBREVIATIONS	Traffic
T002	EXISTING SIGN LOCATION PLAN	Traffic
T003	FINAL PARKING LOT IDENTIFIER SIGN LOCATION PLAN AND MESSAGE TABLE	Traffic
T004	FINAL PAVEMENT MARKING, GUIDE RAIL AND SIGN LOCATION PLAN 1 OF 6	Traffic
T005	FINAL PAVEMENT MARKING, GUIDE RAIL AND SIGN LOCATION PLAN 2 OF 6	Traffic
T006	FINAL PAVEMENT MARKING, GUIDE RAIL AND SIGN LOCATION PLAN 3 OF 6	Traffic
T007	FINAL PAVEMENT MARKING, GUIDE RAIL AND SIGN LOCATION PLAN 4 OF 6	Traffic
T008	FINAL PAVEMENT MARKING, GUIDE RAIL AND SIGN LOCATION PLAN 5 OF 6	Traffic
T009	FINAL PAVEMENT MARKING, GUIDE RAIL AND SIGN LOCATION PLAN 6 OF 6	Traffic
T010	EXISTING SIGN DATA TABLE	Traffic
T011	FINAL VEHICULAR GUIDE & CMS SIGN DATA TABLE	Traffic
T012	FINAL VEHICULAR REGULATORY SIGN DATA TABLE & CMS SIGN DETAILS	Traffic
T013	BOX BEAM GUIDE RAIL LOCATION TABLE	Traffic
T014	STANDARD DETAILS PARKING LOT IDENTIFIER DETAILS 1 OF 2	Traffic
T015	STANDARD DETAILS PARKING LOT IDENTIFIER DETAILS 2 OF 2	Traffic

T016	STANDARD DETAILS SIGN MOUNTING, SIGN POST, VMS SIGN BASE AND FOOTING DETAILS	Traffic
T017	STANDARD DETAILS BATTERED BACK FACE HALF SECTION CONCRETE BARRIER & TRANSITION DETAILS	Traffic
T018	STANDARD DETAILS PAVEMENT MARKING DETAILS	Traffic
T019	STANDARD DETAILS BOX BEAM GUIDE RAIL TYPE I & TYPE II END ASSEMBLY DETAILS	Traffic
T020	STANDARD DETAILS BOX BEAM GUIDE RAIL TANGENT SECTION AND BOX BEAM END COVER DETAILS	Traffic
T021	STANDARD DETAILS BOX BEAM GUIDE RAIL TRANSITION TO CONCRETE BARRIER CONNECTION DETAILS	Traffic
T022	STANDARD DETAILS BOX BEAM GUIDE RAIL ON-END CONNECTION TO CONCRETE BARRIER AND ANCHOR BOLT DETAILS	Traffic
LS001	KEY PLAN	Landscape Architecture
LS002	PLANT SCHEDULE	Landscape Architecture
LS003	LANDSCAPE PLAN	Landscape Architecture
LS004	LANDSCAPE DETAILS -1-	Landscape Architecture
LS005	LANDSCAPE DETAILS -2-	Landscape Architecture
LS006	LANDSCAPE DETAILS -3-	Landscape Architecture
LS007	ORNAMENTAL PICKET FENCE DETAILS -1-	Landscape Architecture
LS008	ORNAMENTAL PICKET FENCE DETAILS -2-	Landscape Architecture
LS009	GATE DETAILS -1-	Landscape Architecture
LS010	GATE DETAILS -2-	Landscape Architecture
E001	LEGEND	Electrical
E002	GENERAL NOTES AND ABBREVIATIONS	Electrical
E003	LIST OF ACCEPTABLE MANUFACTURERS	Electrical
E004	KEY PLAN	Electrical
E101	EXISTING WEST SUBSTATION ONE LINE DIAGRAM REMOVALS	Electrical
E102	EXISTING EAST SUBSTATION ONE LINE DIAGRAM REMOVALS	Electrical
E103	CENTER AND WEST SUBSTATION ONE LINE DIAGRAM	Electrical

E104	FIRE ALARM RISER DIAGRAM, SYMBOL LIST AND SYSTEM NOTES	Electrical
E201	REMOVAL PLAN - 1 OF 6 -	Electrical
E202	REMOVAL PLAN - 2 OF 6 -	Electrical
E203	REMOVAL PLAN - 3 OF 6 -	Electrical
E204	REMOVAL PLAN - 4 OF 6 -	Electrical
E205	REMOVAL PLAN - 5 OF 6 -	Electrical
E206	REMOVAL PLAN - 6 OF 6 -	Electrical
E207	REMOVAL PART PLANS & ONE LINE DIAGRAM	Electrical
E301	SITE PLAN -1 OF 6-	Electrical
E302	SITE PLAN -2 OF 6-	Electrical
E303	SITE PLAN -3 OF 6-	Electrical
E304	SITE PLAN -4 OF 6-	Electrical
E305	SITE PLAN -5 OF 6-	Electrical
E306	SITE PLAN -6 OF 6-	Electrical
E307	UTILITY SITE POWER PLAN	Electrical
E401	LIGHTING FIXTURE SCHEDULE	Electrical
E402	PANELBOARD SCHEDULES	Electrical
E501	ENTRANCE AND EXIT PLAZA POWER PLAN	Electrical
E502	PLAZA ENTRANCE LANE TYPICAL POWER LAYOUT, SCHEDULE & DIAGRAM	Electrical
E503	PLAZA EXIT LANE TYPICAL POWER LAYOUT, SCHEDULE & DIAGRAM	Electrical
E504	TOLL PLAZA OBSTRUCTION LIGHTING AND TRAFFIC SIGNAGE POWER PLAN	Electrical
E505	PLAZA LIGHTING PLAN	Electrical
E506	TOLL BOOTH LIGHTING AND POWER PLAN	Electrical
E507	SERVICE BUILDING LIGHTING, POWER AND SIGNAL PLANS	Electrical
E508	SERVICE BUILDING ROOF POWER PLAN	Electrical
E509	SERVICE BUILDING AND TOLL PLAZA LIGHTNING PROTECTION PLANS	Electrical
E601	SITE LIGHTING DETAILS	Electrical
E602	DUCTBANK DETAILS	Electrical
E603	HANDHOLE/MANHOLE DETAILS	Electrical
E604	FIRE ALARM DETAILS	Electrical

E605	MISCELLANEOUS DETAILS	Electrical
E606	LIGHTNING PROTECTION DETAILS	Electrical
E607	GROUNDING DETAILS	Electrical
ES001	GENERAL NOTES, LEGEND, ABBREVIATIONS AND LIST OF APPROVED MANUFACTURERS	Electronics
ES101	BLOCK WIRING DIAGRAM TOLL LANE EQUIPMENT (SHEET 1 OF 2)	Electronics
ES102	BLOCK WIRING DIAGRAM TOLL LANE EQUIPMENT (SHEET 2 OF 2)	Electronics
ES103	BLOCK WIRING DIAGRAM EZ-PASS EQUIPMENT	Electronics
ES104	BLOCK WIRING DIAGRAM CCTV SYSTEM	Electronics
ES201	REMOVALS SITE PLAN (SHEET 1 OF 2)	Electronics
ES202	REMOVALS SITE PLAN (SHEET 2 OF 2)	Electronics
ES203	SITE PLAN REMOVALS PART PLAN	Electronics
ES301	SITE PLAN INSTALLATION (SHEET 1 OF 6)	Electronics
ES302	SITE PLAN INSTALLATION (SHEET 2 OF 6)	Electronics
ES303	SITE PLAN INSTALLATION (SHEET 3 OF 6)	Electronics
ES304	SITE PLAN INSTALLATION (SHEET 4 OF 6)	Electronics
ES305	SITE PLAN INSTALLATION (SHEET 5 OF 6)	Electronics
ES306	SITE PLAN INSTALLATION (SHEET 6 OF 6)	Electronics
ES307	CCTV COVERAGE PLAN	Electronics
ES401	PART PLAN TOLL PLAZA	Electronics
ES402	PART PLAN TOLL PLAZA CANOPY	Electronics
ES403	PART PLAN SERVICE BUILDING	Electronics
ES404	PART PLAN BUILDING 1	Electronics
ES501	ELEVATIONS (SHEET 1 OF 4)	Electronics
ES502	ELEVATIONS (SHEET 2 OF 4)	Electronics
ES503	ELEVATIONS (SHEET 3 OF 4)	Electronics
ES504	ELEVATIONS (SHEET 4 OF 4)	Electronics
ES601	DETAILS (SHEET 1 OF 5)	Electronics
ES602	DETAILS (SHEET 2 OF 5)	Electronics
ES603	DETAILS (SHEET 3 OF 5)	Electronics
ES604	DETAILS (SHEET 4 OF 5)	Electronics
ES605	DETAILS (SHEET 5 OF 5)	Electronics
ES701	SCHEDULES	Electronics

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.

76. NOT USED

77. 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, four copies and two reproduces, 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 Primavera Expedition software 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 be 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 nine 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.

In preparing the Shop Drawings, the Contractor may adopt a sheet of any reasonable size which best suits his needs, but having adopted such size, all sheets thereafter of a similar nature shall be of the same size as that adopted. Each drawing shall have a margin on the top, bottom and right-hand side of one-half inch and on the left hand side a margin of one and one-half inches.

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 four copies submitted and the Contractor shall make the revisions, corrections or additions shown thereon to be made. He shall resubmit four prints and one brownline (reproducible) 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 shall 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: Structural, 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.

As soon as approval has been given to any Shop Drawing or Catalog Cut, the Contractor shall within five days send to the Engineer six prints, except that when the Engineer specifically so directs, nine prints shall be sent. After approval thereof, no change will be permitted thereon unless approved in writing by the Engineer.

Before final payment for the Work is made, the Contractor shall furnish to the Engineer one set of Shop Drawings, which have previously been prepared by the Contractor in accordance with requirements elsewhere specified in these Specifications, all clearly revised, completed and brought up to date showing the permanent construction as actually made. These drawings shall be marked "RECORD DRAWING - NOT FOR REVIEW", dated and signed by the Contractor and be in the form of Mylar reproducibles, from which clear prints can be made. 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.

78. 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.

79. 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".

All items provided in this contract that use dates in the recording, storing or processing of information shall use such dates correctly at all times including using such dates correctly in the recording, storing or processing of information after January 1, 2000 (Year 2000 Compliant).

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.

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.

In various paragraphs of these Specifications, references may be made 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 bids upon the present Contract.

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 clause, 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.

80. 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.

81. 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.

82. 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.

83. 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.

84. 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 clause entitled "Compensation for Extra Work".

85. 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.

86. 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, 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.

87. 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

Excess Unrestricted Soil

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.

88. 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 clause. 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 Section 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 clause 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 Section 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 clause. 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 engines shall not be used in the performance of this Contract unless they have been upgraded to Tier 1 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 1, and where the Work of this Contract cannot reasonably be performed using alternative engines that comply with this clause. 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 clause. 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 clause 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 clause; 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 clause, 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.
 - c. Contract number and title.

- d. 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.
- e. Number, type, make, year of manufacture, manufacturer and serial number.
- f. Engine type, make, horsepower rating, year of manufacture, and serial number.
- g. Approximate fuel consumption rate per shift.
- h. Anticipated function, duration of use, and days and hours of operation.
- i. Technical explanation of safety hazard, mechanical constraint, warranty, limited availability, or functionality issues cited as basis for waiver.
- j. 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.
- k. 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.
- l. 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.

89. 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.

90. 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 Specifications 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 has applied/will apply for the following permits in connection with this Contract in its own name:

- 1.) GENERAL PERMIT FOR SITE REMEDIATION ACTIVITIES FOR GASOLINE CONTAMINATION AT VEHICLE FUELING STATIONS (GP-008)
- 2.) HUDSON-ESSEX-PASSAIC SOIL CONSERVATION DISTRICT: SOIL EROSION PERMIT
- 3.) NJPDES GENERAL PERMIT FOR STORMWATER DISCHARGES DURING CONSTRUCTION ACTIVITIES
- 4.) PASSAIC VALLEY SEWERAGE COMMISSIONERS SEWER CONNECTION PERMIT
- 5.) ON-SCENE COORDINATOR AUTHORIZATION FOR DISCHARGED TREATED GROUNDWATER

The Contractor shall comply with all provisions of the said permits, copies of which are attached hereto under PERMITS.

91. IDENTIFICATION

No person will be permitted on or about the construction site without a pass, permit or identification badge approved by the Engineer. The Contractor shall provide such passes, permits or identification badges for his employees, subcontractors and materialmen whenever necessary. Identification badges shall be worn in a conspicuous and clearly visible position by all employees of the Contractor whenever they are working at the construction site.

92. 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.

93. 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.

94. 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.

95. 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 are to be prepared by the Contractor, and when requested by the Engineer they shall be submitted for his review before being used. 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.

96. 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.

97. 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.

98. 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.

99. 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.

Make arrangements for securing, and pay all costs for heat, light, power, water, and other services which may be required for the performance of the Contract.

100. 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.

101. **PROGRESS SCHEDULE**

A. **Schedule Requirements**

- 1.) The Contractor shall, at its 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 Primavera Project Planner (P3 or P3e), or Primavera Suretrak.
- 2.) Progress schedules shall be sufficiently detailed to accurately depict all the Work (including any design, key submittals, procurement and construction activities performed by the Contractor) 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 Contractors' 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.
- 3.) 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.
- 4.) To assist the Contractor in preparing its progress schedule, a sample Network Diagram is shown in Figure 1. The sample is intended merely 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 should 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.
- 5.) 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 I entitled "Daily Progress, Equipment and Labor Reports."

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 30 calendar days
- 2.) **Activity Codes:** Activity Codes allow each activity in a project 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 are assigned specific Activity Codes as appropriate.
- 3.) **Alternative Solutions:** An analysis of the various options for dealing with encountered or anticipated Contract problems. An alternative solution is 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.
- 7.) **Constraint:** A constraint is a restriction imposed on the start or finish of an activity or project. An example of the use of constraints is the imposition of a "finish no later than" constraint²⁷ on the project 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.
- 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.

²⁷

A late finish or "finish no later than" constraint limits the latest time an activity can complete

- 9.) **Current Progress Schedule:** The most recent progress schedule which has been approved by the Engineer. The Baseline Schedule shall be referred to as "Revision 0". Each time a different Current Progress Schedule is accepted by the Engineer, the revision number must be increased by 1, and the old schedule must 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 is 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 must be completed if the succeeding Activity is to be started on schedule.
- 16.) **Late Start Date:** The latest date by which an Activity must 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.) **Baseline Schedule:** The detailed progress schedule first approved by the Engineer as provided for in the Contract.

- 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 appears in this Section.
- 22.) **Predecessor Activity:** An Activity which is a prerequisite to commencement of another Activity.
- 23.) **Preliminary Progress Schedule:** A detailed progress schedule for Work to be performed within one hundred days after the acceptance of the Contractor's Proposal.
- 24.) **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.
- 25.) **Successor Activity:** An Activity which cannot be started or completed without the prior completion or partial completion of a Predecessor Activity.
- 26.) **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.

C. **Schedule Submittal, Review & Approval Process**

- 1.) **Preliminary Progress Schedule**
 - a. Within twenty (20) calendar days of the acceptance of the Contractor's Proposal for contracts under \$20M, twenty-five (25) calendar days for contracts between \$20M to \$50M and thirty (30) calendar days for contracts over \$50M, the Contractor shall submit a Preliminary Progress Schedule containing the Contractor's detailed proposed plan for the first hundred days of Work, with summary detail for the remaining duration of the project. The first hundred days of the Preliminary Progress Schedule shall be prepared with the same level of detail and in the same format required for the Baseline Schedule. The submittal shall consist of one computer diskette and three printed reports
 - b. The Engineer will review the Preliminary Progress Schedule and provide the Contractor with comments or accept it as the official Preliminary Schedule, within fifteen (15) calendar days.
 - c. If it is not accepted, the Contractor shall revise the Preliminary Progress Schedule in accordance with the Engineer's comments, and resubmit three printed reports and one diskette for the Engineer's approval, within seven (7) calendar days of the receipt by the Contractor of the Engineer's comments. Until such time as the Engineer accepts it, the Contractor shall resubmit the Preliminary Progress Schedule as required by the Engineer within the same time frames and in the same format as required in this paragraph for the initial resubmission.
 - d. The Preliminary Progress Schedule, all reports and network diagrams required by this section shall be updated and submitted monthly during the first ninety days.

2.) Baseline Schedule

- a. Within ninety (90) 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 other than those required by the Contract will not be accepted.
- b. The Engineer will review the proposed Baseline Schedule and return it to the Contractor with comments, or accept it as the official 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 three printed reports and one diskette 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 the Engineer accepts it, the Contractor shall resubmit his proposed Baseline Schedule as requested by the Engineer within the same time frame and in the same format as required by this paragraph for the initial resubmission.
- d. After the approval of any progress schedule required by this Section 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.

3.) 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 update of the Current Progress Schedule. Schedule updates shall status the actual performance and progress of the Work and depict any changes.
- b. Within seven (7) calendar days after receipt by the Engineer of a 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 preliminary schedule submittal shall include one computer diskette and three copies of the following output reports:
 - a. A time-scale logic diagram in PDM format containing all activities displaying Activity ID, Activity Description, Calendar, original and remaining durations, percent complete, Early and Late Dates, and Total Float, and sorted by:
 - (i) Early Start, Early Finish, Total Float
 - (ii) Total Float, Early Start (Critical path report)
 - (iii) Late Start, Late Finish (if required by the Engineer)
 - b. A tabular Predecessor and Successor standard report showing the relationships between all activities in the schedule and sorted by ES, TF (if required by the Engineer)
 - c. Any other information which may be requested by the Engineer to assist him in the evaluation
- 2.) The baseline schedule submittal shall include one computer diskette and six copies of the following output reports:
 - a. A Schedule narrative that generally describes the Contractor's approach to meeting the project goals, lists the Critical Path Activities and compares Early and Late Dates with Contract Times and Milestone Dates. The basis for any constrained dates shall be explained.
 - b. A one-page time scaled Summary Schedule consisting of 20-40 Hammock activities or summary bars that show the entire project broken down into major portions of work, as agreed to by the Contractor and Engineer.
 - c. A time-scale logic diagram in PDM format containing all activities displaying Activity ID, Activity Description, Calendar, original and remaining durations, percent complete, Early and Late Dates, and Total Float, and sorted by:
 - (i) Early Start, Early Finish, Total Float
 - (ii) Total Float, Early Start (Critical path report)
 - (iii) Late Start, Late Finish (if required by the Engineer)
 - d. A tabular Predecessor and Successor standard report showing the relationships between all activities in the schedule and sorted by ES, TF (if required by the Engineer), as shown in figure 2.
 - e. Supporting data showing all activities with their associated cost, budgets or estimates
 - f. Any other information that may be requested by the Engineer to assist him in evaluation of the Contractor's progress. Such information may include, but not be limited to, the following:
 - (i) Cost Loading
 - (ii) Manpower loading charts
 - (iii) Equipment schedules

PORT AUTHORITY OF NY & NJ

PRIHAVERA PROJECT PLANNER

LINCOLN TUNNEL SCADA SYSTEM UPGRADE

REPORT DATE 2NOV00 RUN NO. 420

START DATE 1AUC97 FIN DATE 22JAN99*

18:47

Schedule Report - Predecessors & Successors

DATA DATE 1SHAY00 PAGE NO. 27

ACTIVITY ID	ORIG	REM	DUR	DUR CAL	+	CODE	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL FLOAT
							P.L.D.F., 7243.FS 0. 0. ,*					
							P.L.D.F.,* 7400.FS 0. 10. -549,					
7244	2	2	2	0			DDNE FIELD ACCRPIANCE TESTING NYLVB - SUBSYSTEMS	2JUN00	5JUN00	12AUC98	13AUC98	-465
							S.L.D.F., 7150.FS 0. 0. -549,					
							P.L.D.F.,* 7492.FS 0. 20. -549,					
7502	1	1	2	0			TEST FIBER OPTIC SYSTEM DYER PLAZA	12JUN00*	12JUN00	22APR98	22APR98	-549
							S.L.D.F.,* 7496.FS 0. 79. -549,					
							P.L.D.F.,* 7537.FS 0. 20. -549,					
7547	1	1	2	0			TEST FIBER OPTIC SYSTEMS 39TH FAN ROOM	12JUN00	12JUN00	22APR98	22APR98	-549
							S.L.D.F.,* 7536.FS 0. 79. -549,					
							P.L.D.F.,* 7587.FS 0. 20. -549,					

FIGURE 2

- 4.) 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 change was 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, lists the affected schedule activities by activity ID, and discuss who the contractor feels is responsible. Any revisions to durations or the logical sequence of Activities made to reflect these delays must be explained. The report shall propose appropriate schedule recovery such as multiple shifts or overtime to mitigate any potential delay to the overall project completion date, or request an extension of time, as appropriate.
 - c. A revised Network Diagram sorted by Early Start and Early Finish indicating actual start and finish dates and the remaining duration and percent complete of activities in progress. The critical path of the project shall be clearly shown.
 - 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 Baseline 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 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 it deems necessary or desirable, all as more fully provided in the clause of the Form of Contract entitled "Withholding of Payments".
- 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 as a representation by the Engineer that the Contractor can or will be permitted to follow a particular schedule or sequence of operations or that by following any such schedule or sequence he can 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 "Extensions of Time", may require the use by the Contractor of overtime labor, additional shifts or additional plant and equipment and/or other measures at no additional cost to the Owner. 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 project.
- 8.) Schedule float time disclosed or implied is not for exclusive use or benefit of the owner or contractor but is available to all parties as needed to meet contract milestones and the contract completion dates.
- 9.) Techniques such as preferential sequencing, special lead/lag logic restraints, extended activity times or imposed dates that tend to sequester float shall be cause for rejection of the Detailed Project Schedule and any revisions or updates.

ATTACHMENT A

MANDATORY ACTIVITY CODE STRUCTURE

- 1.) Responsibility (Owner, Contractor)
- 2.) Area (building, floor or area)
- 3.) Trade/CSI code (concrete, steel, etc as required)

- 4.) Location (3rd Fl, etc)
- 5.) Phase of Work, if applicable
- 6.) Change Order work, if applicable
- 7.) 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 Work		
OTH	As Req'd by Engr		

102. 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.

103. AIRPORT OPERATIONS AND CONDITIONS

A. General:

- 1.) Place "Water" identification signs on all water vehicles or water tanks, which are to be used for the transportation or storage of water during the course of the Work at the airport.
- 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.) Do not place temporary structures or store materials or equipment required in the performance of the Work within any of the buildings on the airport without specific prior approval of the Engineer.
- 4.) Do not store petroleum or combustible products, or any other flammable materials, within any buildings or in any part of the airport except as designated by the Engineer.
- 5.) Do not burn or bury debris of any type on Authority property, or wash waste materials down sewers or into waterways.
- 6.) Maintain haul routes in a satisfactory condition, and repair damage to such routes, resulting from the Contractor's operations. Unless otherwise approved by the Engineer, clean haul routes each work period and remove earth or other materials, which fall or are otherwise placed on such routes during the performance of Work.
- 7.) Do not park vehicles on any grass or unauthorized area. Free parking of vehicles in any of the airport parking lots will not be permitted.
- 8.) Protect against damaging existing lights, pavement, curbs and other fixed items that are to remain. Such items, which are damaged, either directly or indirectly, by the Contractor during the performance of the Contract, whether negligently or not, shall be restored to the condition that existed prior to such damage.
- 9.) 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.
- 10.) 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 U.S. Occupational Health and Safety Administration (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.
- 11.) Remove on an on-going basis, and before the end of each work period, all paving materials left in the grass shoulder areas, in manholes, catch basins or handholes as a result of the cleaning of the Contractor's equipment.

- 12.) Food or food related debris shall not to be left on or disposed of on the construction site.
- 13.) Equipment, vehicles and materials, not being utilized in the current work period shall be removed and stored in the area designated by the Engineer for such purpose, or if there is no such area designated then such items shall be removed from the airport.

B. Construction Site Conditions at Air Operations Areas:

- 1.) "Air Operations Area" (AOA) means that portion of the airport designed and used for landing, takeoff, parking or surface maneuvering of aircraft, as well as the Restricted Service Roads (RSR).
- 2.) During the time that the Contractor is performing the Work, the Air Operations Areas will remain in use by aircraft. To the extent feasible and convenient in the opinion of the Engineer, and to the extent permitted by the Federal Aviation Administration (FAA), the use by aircraft of aprons, runways and taxiways adjacent to areas where the Contractor is working will be so scheduled as to reduce disturbance to the Contractor's operations. However, during these periods aircraft may be taxiing through and around the construction areas. In order to minimize conflicts between aircraft operations and construction operations, the Contractor shall proceed with performance of the Work in a safe manner and in accordance with the requirements hereinafter stipulated, at all times coordinating operations with the Engineer, however no representation or guarantee is made that the disturbance can or will be reduced. Also, it is anticipated but not guaranteed that certain aprons, runways, taxiways, and taxilanes will be shut down to aircraft operations for limited periods at the times required by the Contractor. In any event, however, aircraft operations shall always have priority over any and all of the Contractor's operations.
- 3.) Should the Contractor be specifically directed to suspend operations or be directed as hereinafter described, and if solely because of such direction 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.
 - a. Should aprons, runways, taxiways or taxilanes be required for the use of aircraft and should the Engineer solely deem the Contractor to be too close to the portion used by aircraft, the Contractor may be directed to suspend operations, remove personnel, plant, equipment and materials to a safe distance and stand by until the aprons, runways, taxiways or taxilanes are no longer required for use by aircraft, at which time the Contractor shall immediately resume operations in the vacated areas when so directed by the Engineer.
- 4.) The Contractor, subcontractors, materialmen, deliveryman or other persons over whom the Contractor has control shall not enter upon or allow any plant or material to be located upon any part of the Air Operations Areas without specific prior approval of the Engineer.

- 5.) The Contractor, employees of the Contractor, subcontractors, materialmen and all other persons over whom the Contractor has control shall comply with the following:
- a. Clearly display on their person an identification tag indicating their name and company before entry upon any Air Operations Area. The Contractor shall provide tags and holders for such identification. The Contractor is advised that security requirements are subject to change and will be addressed further in the pre-construction meeting.
 - b. Do not enter upon any Air Operations Area unless accompanied by a representative of the Authority designated by the Engineer to escort the Contractor and equipment to and from the point or points of operation within the limits of such areas, and do not traverse back and forth between points within such areas unless accompanied by said Authority representative.
 - c. Do not enter or remain upon or allow any plant or materials to be brought or to remain upon any part of the Air Operations Areas if in the opinion of the Engineer they would create a hazard to aircraft or airport operations.
 - d. Smoking is not permitted in the Air Operations Area.
- 6.) No two adjacent taxiways shall be closed at the same time unless otherwise directed by the Engineer.
- 7.) Materials tracked onto movement areas shall be removed continuously during each work period.
- a. "Movement Areas" means areas within the AOA comprised of the runways, taxiways and other areas of the airport that are used for taxiing or hover taxiing, takeoff, and landing of aircraft, exclusive of loading ramps and aircraft parking area. The Air Traffic Control Tower or Ground Control typically controls these areas.
- 8.) At the end of each work period, remove plant, materials, equipment and any other obstructions away from the work area to a non-AOA site as designated by the Engineer.
- 9.) Information on Visual Flight Rules (VFR) or Instrument Flight Rules (IFR) weather conditions or Category II operations at the airport is available to the Contractor at the Operations Supervisor's Office of the airport. Category II operations only apply at EWR and JFK.
- At the following Air Operations Area locations, conform to the following requirements:
- a. Approach to Runways: When a runway is active, keep obstructions due to Work below or outside the VFR and IFR approach surfaces.
 - (i) "Obstruction" shall be defined as any obstacle exceeding the obstruction standards specified by 14 CFR Part 77, subpart C.
 - b. Adjacent to Runways:
 - (i) When a runway is active, no construction activities shall be permitted within 250-feet from the runway centerline. Place barricades in accordance with the Section herein entitled "Barricades."

- (ii) During VFR weather conditions, obstruction mark all construction equipment, material, or debris penetrating a surface originating along a line 250-feet from the runway centerline at runway elevation, and extending upward and away from the runway at a slope of one foot vertically for every seven feet horizontally, in accordance with the paragraph herein entitled "Obstruction Marking and Lighting". In addition, all penetrations above runway elevation between 200-feet and 250-feet from the runway centerline shall be obstruction lighted with omni-directional lenses.
- (iii) During IFR weather conditions; in addition to obstruction marking, provide obstruction lights on fixed obstructions, construction equipment, materials, or debris penetrating a surface originating along a line 500-feet from the runway centerline at runway elevations, and extending upward and away from the runway at a slope of one foot vertically for every seven feet horizontally. For such lighting, provide, locate and operate in accordance with the paragraph herein entitled "Obstruction Marking and Lighting". In addition, all penetrations above runway elevation between 250-feet and 500-feet from the runway centerline shall be obstruction lighted with omni-directional lenses.
- (iv) When Category II landing operations are being conducted on runways during IFR weather conditions, as defined by Federal Aviation Administration United States Terminal Procedures, no construction operations, equipment, materials or debris shall be within the Category II Touchdown Area, the Missed Approach Area and Transitional Surfaces as hereinafter defined.
 - (a) "Touchdown Area" means an area longitudinally centered on the runway centerline, extending from a point 200-feet in advance of the runway approach threshold (normal or displaced) for a distance of 3,200-feet in the direction of landing, and having a total width of 1,000-feet.
 - i. "Threshold" is defined as the beginning of that portion of the runway available for landing. In some instances, the landing threshold may be displaced.
 - ii. "Displaced Threshold" is the portion of pavement behind a threshold that may be available for takeoffs in either direction or landing from the opposite direction.
 - (b) "Missed Approach Area" means an area, which begins at the end of the touchdown area at the height of the runway and extends upward at a slope of one foot vertically for each 40-feet horizontally. In plan view, it has the same width as the touchdown area at the point of beginning with the width increasing uniformly to 3,100-feet at 6,000-feet from the point of beginning.
 - (c) "Transitional Surfaces" means surfaces sloped at 7:1 extending outward and upward from the edges of the touchdown area or the missed approach area to a height of 150-feet above the elevation of the runway centerline or the end of the Touchdown Area.
- (v) Perform Work so that when the runway is being made available for aircraft operations, the maximum grade difference in any paved surface within the Safety Area shall not exceed 1 inch on runway surface and 3 inches within any part of the Safety Area.

- (a.) "Runway Safety Area" means surfaces within 250-feet measured from and parallel to the centerline of the runway, and extending 1,000-feet beyond and parallel to the end of the runway. It is a defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway, in accordance with AC 150/5300-13.
- (vi) On active runways, open excavations, debris, construction equipment, personnel or materials are not permitted within the Safety Area.
 - (a.) "Open Excavation" means any trench in unpaved areas exceeding 6" in width or 3" in depth; and in paved areas, a drop of 3" or greater within a 6" horizontal measure.
- (vii) Do not permit material capable of being dislodged by aircraft blast within 250-feet from the runway centerline. Remove or stabilize such loose materials in this area as approved by the Engineer.
- c. Adjacent to Taxiways (T/W) or Taxilanes (T/L):
 - (i) Neither construction activity nor personnel are permitted within the Object Free Area (OFA),
 - (a.) "Object Free Area" means an area on the ground centered on the runway, taxiway, or taxilane centerline provided to enhance safety of aircraft operations by having the area free of objects except for those objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes.
 - (ii) Perform Work within the specified limits shown in Table I below only when the taxiway/taxilane is closed to air operations.
 - (iii) Open excavations as close as the edge of the taxiway are permitted provided they are delineated by placing obstruction marked and lighted collapsible barricades, in accordance with "Barricades" hereof, along the edge of the taxiway.
 - (iv) Do not permit loose material capable of being dislodged by aircraft blast and becoming a hazard within the Taxiway Safety Area (TSA), shown in Table I when the T/W or T/L is active. Remove or stabilize such loose materials in this area as approved by the Engineer.
 - (a.) "Taxiway Safety Area" means a surface alongside the taxiway prepared or suitable for reducing the risk of damage to an airplane unintentionally departing the taxiway.

(v) Waste and loose material shall not be placed in active movement areas.

Table 1					
	TEB	LGA	EWR	SWF	JFK
T/W OFA	186 feet	259-feet	320-feet	320-feet	320-feet
(From centerline)	(93 feet)	(129.5-feet)	(160-feet)	(160-feet)	(160-feet)
T SA	118 feet	171-feet	214-feet	214-feet	214-feet
(From centerline)	(59 feet)	(85.5-feet)	(107-feet)	(107-feet)	(107-feet)
T/L OFA	162 feet	225-feet	276-feet	276-feet	276-feet
(From centerline)	(81 feet)	(112.5-feet)	(138-feet)	(138-feet)	(138-feet)

C. Construction Site Conditions Outside Airport Operations Areas:

- 1.) During the time the Contractor is performing the Work, it may at times be necessary because of emergency or abnormal traffic conditions to suspend the Contractor's operations, or to postpone the time at which traffic lanes, parking or other areas become available for performance of Work. Should the Contractor be specifically directed to suspend operations in traffic lanes, parking or other areas, and remove personnel, and obstructing plant, equipment and materials from such lanes or areas, or should such lanes or areas not be available by the times specified, and if solely because of such suspension of operations or late availability of traffic lanes, parking, or other areas 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.) Limit the maximum height of construction equipment to 25-feet unless otherwise shown on the Contract Drawings or expressly approved by the Engineer, obstruction light in accordance with the paragraph herein entitled "Obstruction Marking and Lighting" and obstruction mark and light that portion of equipment which exceeds 25-feet in height in accordance with FAA Advisory Circular 70/7460-1K Change 1.
- 3.) Perform such duties as the Engineer may direct and as may be necessary in the opinion of the Engineer for the rerouting of traffic in the performance of the Work.
- 4.) Restrict smoking to areas designated by the Engineer for this purpose.

D. Obstruction Marking and Lighting:

- 1.) Material, temporary construction and facilities for obstruction marking and lighting constitute temporary facilities that are and shall remain the property of the Contractor unless otherwise shown on the Contract Drawings or specifically directed by the Engineer to be turned over to the Port Authority.
- 2.) Provide new materials, or undamaged previously used materials in serviceable condition conforming to the requirements specified herein.
- 3.) In Air Operations Areas or airport areas where obstructions occur within navigable airspace provide obstruction lights, Model UF-60-7-75A-PE-BI as manufactured by Julian A. McDermott Corp., Ridgewood, N.Y., or approved equal.
 - a. Unless otherwise shown on the Contract Drawings, mount an obstruction light on the highest point of construction equipment or obstruction.
 - b. Ensure that obstruction lights are maintained in proper operating condition throughout Work of this Contract, and operate at night seven (7) days a week and during IFR weather conditions.
 - (i) "Night" means the time between the end of evening civil twilight, and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time.

E. Paving and Surfacing in Air Operations Areas:

- 1.) Paving and Surfacing in Air Operations Areas are designed to meet stringent requirements for aircraft operations. Exercise extreme care in machine and hand placing material to achieve the finished elevations shown on the Contract Drawings within the tolerances specified elsewhere herein.
- 2.) When applying tack coat, sealcoat, or pavement marking paint near or around edge lights and any in-pavement lights, provide temporary covers to protect glass fixtures. Remove covers prior to resuming air operations.
- 3.) Deactivate and adjust elevation of all existing edge lights and all in-pavement lights prior to paving operations in any given area and reactivate them prior to resuming air operations.
- 4.) Prior to reactivating a runway or a taxiway, any portion of a raised manhole, catch basin hand hole, edge light, or subsurface structure, located within 250 feet of a runway centerline or within the Taxiway Safety Area (TSA) shown in Table 1, protruding by more than three inches shall be ramped in accordance with details shown on the Contract Drawings or, if not shown, as directed by the Engineer.
- 5.) In areas that are to be opened to aircraft prior to completion of paving top course, ramp all lifts which exceed a maximum of one inch in depth. Ramp in accordance with details shown on the Contract Drawings or, if not shown, as directed by the Engineer. When paving operations are resumed, cut and trim ramp to expose unsealed or granular surface for a depth of one inch, paint the edge of the lift with a thin coat of hot asphalt cement and place fresh asphalt against the edge of the lift and compact.

- 6.) Remove sand and other debris from the taxiway, runway, apron, taxilanes, and restricted service road surfaces crossing air traffic lanes. Completely sweep with a power driven sweeper and flush with water on an ongoing basis so that such surfaces are ready for use by aircraft as required.

F. Night Illumination of Paving and Surfacing Operations:

- 1.) Paving and surfacing operations conducted at Night shall, in addition to the requirements of the paragraph entitled "Obstruction Marking and Lighting" hereof, conform to the following requirements:
 - a. In Air Operations Areas, locate and shield night illumination to prevent interference with air traffic control or impairment of safe aeronautical operations.
 - b. Outside Air Operations Areas, locate and shield night illumination to prevent interference with motorists and pedestrians or impairment of traffic and pedestrian movement.
- 2.) Illumination of Area of Work: Provide and operate portable floodlight units similar and equal to "Maxi-Lite 695" as manufactured by Allmand Brothers Inc., Holdredge, NE.
- 3.) Equipment Illumination: Provide and operate electric beam lights with a capacity of not less than 3,000 watts affixed to paving machines, rollers, distribution trucks and other vehicles to provide not less than twenty foot candles of illumination on the following horizontal surfaces:
 - a. During operation of paving machines, an area 12-feet by 12-feet immediately behind the machine;
 - b. During operation of rolling equipment, an area 12-feet wide by 30-feet long immediately in front of and behind the machine; and
 - c. During application of tack coat, an area 12-feet by 12-feet on the area being coated.

G. Existing Airport Lights in Air Operations Areas:

- 1.) Various types of lights are installed in the areas in which the Work is to be performed. Prior to the commencement of operations, note the exact number and location of lights in such areas and provide adequate protection therefor. Any light fixture which is damaged by the Contractor, whether negligently or not, during the performance of the Work shall be repaired or replaced in an approved manner before the end of each work period. Should the Contractor not repair or replace any such damaged lights by the end of each work period, the Authority will undertake such restoration and the cost thereof, as determined by the Engineer, will be deducted from the Contractor's compensation hereunder. The number and locations of lights shown on the Contract Drawings are approximate only and the Authority does not guarantee their accuracy.

H. Subsurface Structures:

- 1.) Attention is called to the fact that some of the manholes, chambers or other subsurface structures, in which Work is to be performed under this Contract, contain energized high and low voltage cables, and that various insects, snakes, spiders and rodents may be present.
 - 2.) Apply to the Engineer in writing at least 24-hours in advance of the time of: a. entry into existing manholes, handholes, or other subsurface structure or, b. interruption or disruption of utility services. Perform interruptions of electrical services, and entry into subsurface structures in accordance with the provisions of the Section hereof entitled "PERMIT AND REQUIREMENTS FOR ELECTRICAL DISTRIBUTION WORK". Service shall not be cut off on existing installations until all operations have been completed except for connections or reconnections to power source of wiring to be installed under this Contract. Notice to the Engineer shall specifically state which utilities will be affected and the time and the duration of such interruption. Keep all such interruptions to a minimum. No interruption of utility services shall be made without approval of the Engineer whose decision in all cases shall be final.
 - 3.) Test each subsurface structure for combustible, toxic or otherwise harmful, gases or vapors in accordance with NFPA No. 328 "Recommended Practice for the Control of Flammable and Combustible Liquids and Gases in Manholes, Sewers and Similar Underground Structures" before permitting personnel to enter. If such gases or vapors are detected, ventilate the subsurface structure until the gases have dissipated to an acceptable level as determined by the OSHA Air Quality regulations prior to entry.
 - 4.) Manholes and other subsurface structures in which Work is to be performed under this Contract may contain water. Remove water encountered in such locations and keep the floors of such locations free of standing water at all times workers are in such locations.
 - 5.) Verify the exact locations of underground utilities and subsurface structures in the field, and assume all risks of whatever nature, if any, as to the locations of such utilities and structures.
- I. 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.

104. PERMIT AND REQUIREMENTS FOR ELECTRICAL DISTRIBUTION WORK

- A. Notify the Engineer at least 24 hours prior to the commencement of operations at the construction site which in any way may affect existing electrical circuits or require entry into any electrical manhole at the airport, and obtain from the Engineer, Authority Form PA 2497A entitled, "Electrical Work Permit". Execute such form in triplicate each morning prior to commencement of Work on existing electrical circuits or entry into manholes. The Authority will issue this form to the Contractor without payment of a fee.

- B. Allow sufficient time for loads to be transferred to other circuits from the circuits upon which Work is to be performed and for lock out of circuits which are within existing load centers. Comply with other requirements contained on the back of the "Electrical Work Permit" insofar as they are applicable to the Work to be performed under this Contract. In any event, reconnect and place back in operation electrical circuits activating parking field, roadway, runway operations, apron and taxiway lights prior to the close of operations on each day, and in any event before sunset of each day. Overtime operations or premium time required to be paid by the Contractor for or in connection with this numbered Section shall be borne by the Contractor without separate or additional compensation therefor.

105. AIRPORT CONSTRUCTION SAFETY REQUIREMENTS

A. General Safety Requirements:

- 1.) The Contractor shall adhere to all safety precautions described in the current edition of the U. S. Department, Federal Aviation Administration Advisory Circular AC 150/5370-2, Operational Safety on Airports During Construction. The Contractor is to strictly conduct all activities as not to violate safety standards contained in said Advisory Circular.
- 2.) Throughout the construction period, the following safety and operational practices shall be followed:
 - a. Operational safety shall be a standing agenda item during work progress meetings throughout the duration of the Contract.
 - b. The Contractor shall perform onsite inspections of the construction site throughout the duration of the Contract, with immediate remedy of any safety deficiencies.
 - c. The Contractor, employees of the Contractor, subcontractors, materialmen or any other support workers over whom the Contractor has control, who are required to enter the Aircraft Operations Area will be required to wear a reflective safety vest, day or night.
 - d. Construction that is within the safety area of an active runway, taxiway, or apron must be performed when the runway, taxiway, or apron is closed or use-restricted and initiated only with prior permission from the Engineer.
 - e. The Engineer may order the Contractor to suspend operations and move personnel, equipment, and materials to a safe location at any time he deems it necessary.

B. Maintenance of Construction Site:

- 1.) Inspect all construction and storage areas as often as necessary to be aware of conditions.
- 2.) Promptly take all actions necessary to prevent or remedy any unsafe or potentially unsafe conditions as soon as they are discovered.
- 3.) Provide continuous clean-up operations including a mechanical sweeper for all haul operations or other related traffic to and from the construction site.

- 4.) The Contractor, at the direction of the Engineer, may be required to provide and maintain an emergency response route through the work area, for Airport Emergency Vehicles. Construction vehicles accessing this road will give way to emergency vehicles at all times. Parking or staging of any construction equipment or stockpiling of materials blocking the road or access to the road will not be permitted.
- C. Approach Clearance to Runways:
- 1.) Runway thresholds must provide an unobstructed approach surface over equipment and materials. (Refer to Contract Drawings for construction clearance surfaces.)
 - 2.) Ensure all personnel, materials, and/or equipment are clear of the applicable runway end slope criteria (Refer to Contract Drawings for construction clearance surfaces.)
- D. Runway and Taxiway Safety Area (RSA and TSA):
- 1.) Limit construction to outside of the approved RSA and TSA, as defined elsewhere in this section—unless the runway is closed or restricted to aircraft operations, requiring a lesser standard RSA that is equal to the RSA available during construction.
 - 2.) Procedures for Protecting Runway Edges:
 - a. Limit construction to no closer than 250 feet from the runway centerline—unless the runway is closed to aircraft operations.
 - b. Personnel, material, and/or equipment shall not penetrate the Obstacle Free Zone (OFZ) as defined in the U. S. Department, Federal Aviation Administration Advisory Circular AC 150/5300-13 Airport Design, Paragraph 306, "Obstacle Free Zone"
 - (i) "Obstacle Free Zone" means the airspace below 150 feet above the established airport elevation and along the runway and extended runway centerline that is required to be clear of all objects, except for frangible visual Navaids that need to be located in the OFZ because of their function, in order to provide clearance protection for aircraft landing or taking off from the runway and for missed approaches.
 - 3.) Procedures for Protecting Runway Ends.
 - a. Maintain the RSA as it existed before construction activity—unless the runway is closed to aircraft operations.
 - b. Prevent personnel, material, and/or equipment, from penetrating the OFZ.
- E. Closed Runways:
- 1.) For work that necessitates the closure of a runway or runways, the Contractor shall furnish and install and subsequently remove or relocate a lighted "X" as per FAA Advisory Circular 150/5345-55 "Lighted Visual Aid to Indicate Temporary Runway Closure", at each end of the closed runway on or near each of the runway designation numbers as directed by the Engineer. The Contractor shall be responsible for the storage, mobilization, and demobilization of the lighted "X's" for each runway closure period and they remain the property of the Contractor unless otherwise noted on the Contract Drawings.

- 2.) The lighted "X's" shall be the Sweepster Lighted Runway Closure Marker Model LXD06, or approved equal conforming to NTSB Safety Recommendation A-03-05 and 06.

F. Barricades

- 1.) Use barricades to indicate construction locations in non-movement areas, which no part of an aircraft may enter. Barricades may be of different shapes and made from various materials, including railroad ties, sawhorses, jersey barriers, or barrels and shall be marked with diagonal, alternating orange and white stripes. During reduced visibility or night hours, supplement the barricades with red lights, flashing or steady burning, meeting the luminance requirements of the State Highway Department.
 - a. "Non-movement areas" are areas within the AOA not controlled by the Air Traffic Control Tower or Ground Control. These areas are typically aircraft ramp and parking areas as well as vehicular service roads.
- 2.) Indicate construction locations in movement areas in which aircraft may enter with orange traffic cones, red lights (either flashing or steady burning), and collapsible barricades marked with diagonal, alternating orange and white stripes. All barricades, temporary markers, and other objects left in the safety area associated with the open runway, taxiway, and taxi lanes must be as low as possible to the ground, of low mass and easily collapsible upon contact with an aircraft or any of its components. The barricade shall be properly weighted or attached to the surface to prevent displacement by prop wash, jet blast, wing vortex or other surface wind currents. If affixed to the surface, they must be frangible at grade level or as low as possible, not to exceed 3-inches in height. Barricades shall be Neubert Aero Corp., Model NACPC2410 or Model NACPVC2310, Multi-Barrier Safety Barricade Corp., Model AR-10X96, YODOCK APC or an approved equal.
- 3.) Barricades shall be spaced no greater than 10 feet apart.

G. Temporary Lighting and Markings

- 1.) The Contractor will be required to provide and maintain temporary pavement markings, remove existing markings and remove temporary markings, all in accordance with the Contract Drawings and Specifications.

H. Airport Air Operations Area Access and Control

- 1.) The Contractor, staff, employees, subcontractors, delivery and haul operators, or anyone required to enter the Air Operations Area related to the Contract Work, shall produce valid government issued photo identification.
- 2.) The Contractor shall supply daily lists of all workers as well as list of all planned or anticipated deliveries. All vehicle operators must have, in their possession and produce on request, a valid drivers license.
- 3.) Individual Contractor Identification is required for each worker. Identification badges are to be displayed on their outermost garment at all times. The Contractor Identification Badge shall be a minimum of 2" x 2" in size and include the following:
 - a. Minimum 1" x 1" current color photo of the individual

- b. Laminated
- c. Company name (and/or subcontractor where applicable)
- d. Person's name
- e. Unique badge number
- f. Expiration date in accordance with the Contract

I. Vehicle Operation Marking and Control

- 1.) All Contractor vehicles (including equipment, subcontractors, delivery vehicles, etc.) that must enter the Air Operations Area for the required Work of the Contract, must be escorted and properly identified. To operate during daylight hours, construction equipment must have a 3' x 3' orange and white "Airfield Vehicle" identification flag (ANNIN & Co. NYL-GLO #319733 or approved equivalent) or flashing beacon. Any vehicle operating on the movement areas during hours of darkness or reduced visibility must be equipped with a flashing amber beacon light. In addition, vehicles must display permanently affixed company identification media acceptable to the Authority.
- 2.) Neither the Contractor nor any construction support personnel will be permitted access to the AOA or work site in a private or personal vehicle. There is no employee parking on the Air Operations Areas.
- 3.) At Air Operations Areas provide obstruction marking flags equipped with approved stiffeners as follows:
 - a. For Marking of Equipment, Material and Debris: 3-feet by 3-feet colored orange and white in a checkerboard pattern, mounted on a staff of not less than 8-feet in length. Maintain flag in a vertical position at all times and display on each fixed obstruction, truck or other piece of equipment, and at each separate group of workers and material or debris stack.

J. Navigational Aids

- 1.) The Contractor shall not conduct any construction activity within navigational aid critical areas or affect the visual signal, transmitted signal or power supply of any navigational aid. Navigational aid restricted areas affected by the area of work are depicted on Contract Drawings. Work in these restricted areas is subject to availability based on runway configuration and weather conditions at the time, and may be cancelled by the Engineer without advance warning based on the aforementioned conditions. If the Contractor is specifically directed by the Engineer to suspend his operations in these areas, the Contractor will be compensated as stipulated in the provisions of the Contract concerning compensation for emergency delays.
- 2.) Navigational aids include instrument landing system components and very high-frequency omni-directional range, airport surveillance radar.
- 3.) Do not operate ultrasonic, X-ray, radio-type transmitter, magnetic or similar electromagnetic devices, which affect or may affect the operation of airport navigational aids, unless the Engineer has granted specific prior approval for their operation or use.

K. Limitations on Construction

- 1.) The Contractor shall obtain Authority permits for open-flame welding or torch cutting operations and electrical power shut-downs prior to start of the work.
- 2.) All site storage of supplies and equipment requires approval by the Engineer. All site storage must be in containers and must have company name and 24 hour contact telephone number clearly displayed.

L. Radio Communications

- 1.) The Contractor is not required to have two-way radio communications with the Engineer.
- 2.) The Contractor is prohibited from having any communications, including two-way radio, with the Airport Air Traffic Control Tower. All movements within the AOA shall be escorted by the Facility Staff.

106. NOT USED

107. HOURS OF WORK AND CONSTRUCTION STAGING

A. Hours of Work

- 1.) The Contractor shall be permitted to perform the work of this Contract without restriction as to Work Hours, with the following exceptions:
 - a. All utility and building system shutdowns/tie-in (electrical, water, chilled water, hot water, etc) shall be performed between the hours of 11:00 PM and 5:00 AM, the following day.
 - b. Off Peak Hours, as noted on the Contract Drawings, shall be defined as 8:00 PM to 6:00 AM, the following day.
- 2.) The Contractor shall submit to the Engineer, at least a week in advance, his scheduled Hours of Work for each week, and required permits.
- 3.) Do not perform Work at the construction site on a Federal legal holiday or a holiday of the State of New Jersey, unless otherwise permitted by the Engineer.

B. Construction Staging

- 1.) A Stage is defined as a sequence or work area, as identified by the Construction Staging Plan Contract drawings, CS001 – CS009.
- 2.) Sub-stages are to be developed by the Contractor and submitted to the Engineer at least a week in advance, see Hours of Work Note 2. A sub-stage is defined as a stage divided into multiple tasks to aid in the management and construction of a stage.
- 3.) Construction Staging shall be in accordance with the Contract Drawings and requirements stated herein.

- 4.) Contractor shall work on one stage at a time and in the order designated in the Contract Drawings. The contractor shall request approval from the Engineer prior to performing work that is out of sequence of stages shown on the CS drawings. A maximum of two (2) stages may be worked on concurrently.
 - a. Contractor may work on multiple sub-stages at a time within one given Stage.
 - b. All work within each stage shall be completed prior to proceeding to the next stage.

108. 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.) "Nighttime" shall mean the local time period between 1/2 hour after sunset to 1/2 hour before sunrise.
- 4.) "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.
- 5.) "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. Plastic Delineator Drums.
 - c. Type III Barricades.
 - d. Vehicle-strong Barriers.
 - (i) Precast Concrete Barrier
 - (a.) Type 4.
 - (ii) Water-filled Barrier Sections: As manufactured by Energy Absorption Systems, Inc., Chicago, IL; or approved equal;
 - e. 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;
 - f. Temporary Timber Curbs and Concrete Barriers: Conform to the Contract Drawings and Specification Section 02842 "Temporary Traffic Barriers";

- g. **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 "JCC" 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;
- h. **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".
- i. **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.
- j. 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.) 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. 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-foot 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 Contact 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 Contact 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.

(End of Section)

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Not Used

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 B.

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 1.03 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. Provide temporary interior and exterior shoring, bracing and/or support as required to 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

- 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.

END OF APPENDIX "A"

DIVISION 2

SECTION 02070

**REMOVAL OF UNDERGROUND PETROLEUM STORAGE TANKS AND
ANCILLARY EQUIPMENT AND MATERIALS**

PART 1. GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for removal of underground petroleum storage tanks and ancillary equipment and materials registered with the New Jersey Department of Environmental Protection (NJDEP) or the New York State Department of Environmental Conservation (NYSDEC).
- B. Existing underground petroleum storage tanks, ancillary equipment and materials scheduled for removal under this Contract shall become the property of the Contractor and be disposed of away from Port Authority property in accordance with local, State and Federal governmental rules and regulations.
- C. Secure all required United States Environmental Protection Agency (EPA), NJDEP, NYSDEC and United States Department of Transportation (USDOT) identification numbers, manifests and placards for off-site transportation and disposal of removed equipment and materials.
- D. Supply USDOT approved drums or containers for filling with materials, which may include but are not limited to: residual product extracted from underground tanks; residue from washing/cleaning of tanks; product contaminated adsorbent materials used in tank cleaning; product contaminated sorbent materials from on-site spill control procedures; rinse water from decontamination of equipment and materials; and personal protective equipment. Place filled drums or containers in drum/container impoundment area as specified hereinafter.
- E. Place excavated soil that is excess and/or unsuitable, as determined by the Engineer, in soil impoundment area as specified hereinafter. Notify Engineer immediately of a product leak or spill or if groundwater contamination is detected or suspected.
- F. 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.
- G. Decontaminate equipment and materials that have come in contact with soil described in 1.01 E in the decontamination area as specified hereinafter.
- H. Work by the Authority

The following Work will be performed by the Authority:

1. Removal of useable product from underground tanks down to its lowest draw-off level.
2. Installation of soil borings and monitoring wells; collection and laboratory testing of soil and groundwater samples.
3. The preparation and submittal of Underground Storage Tank (UST) Closure, Site Investigations reports including associated forms, UST registration documents and Regulatory Agency UST closure notification.

1.02 REFERENCES

Comply with the latest edition of all of the applicable industry codes, standards, and practices, including the following, and supplement these references with any available, appropriate material.

American Petroleum Institute (API)

API RP 1604	Closure of Underground Storage tanks, latest edition
API Publication 2217A	Work in Inert Confined Spaces in the Petroleum Industry
API Publication 2219	Safe Operating Guidelines for Vacuum Trucks in Petroleum Service
API Std 2015	Safe Entry and Cleaning of Petroleum Storage Tanks
RP 2003	Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents

New Jersey Department of Environmental Protection (NJDEP) for work performed in New Jersey

NJAC 7:26E	Technical Requirements for Site remediation
NJAC 7:14B	New Jersey Underground Storage Tank Regulations
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

New York State Department of Environmental Conservation (NYSDEC) for work performed in New York

6 NYCRR 612-613	New York Petroleum Bulk Storage Regulations
DER-10	Technical Guidance for Site Investigation and Remediation

New York City Administrative Code for work performed in New York City (NYC)

NYCAC Title 29	NYC Fire Code, Chapter 1 FC 3404.213
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Underwriters Laboratories, Inc. (UL)

National Fire Protection Association (NFPA)

NFPA 10	Standard for Portable Fire Extinguishers
NFPA 30	Flammable and Combustible Liquids Code
NFPA 30A	Code for Motor Fuel Dispensing Facilities and Repair Garages
NFPA 70	National Electric Code
NFPA 70B	Electrical Equipment Maintenance
NFPA 326	Safe Entry of Underground Storage Tanks
NFPA 327	Standard Procedure For Cleaning or Safeguarding Small Tanks and Containers
NFPA 329M Section 1-3.5	Guide to Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids

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 172	Transportation of Hazardous Materials
40 CFR Part 260- 265 et. Seq.	General Regulations for Hazardous Waste Management
40 CFR Part 280 et. Seq.	Underground Storage Tank Regulations

1.03 QUALIFICATIONS

Verify that all entities, including sub-contractors and personnel performing the Work of this section, have at least three years demonstrable experience in removal of underground petroleum storage tanks and are certified as required in the state in which the Work is to be performed. Experience shall include removal, transportation and disposal of underground storage tanks and associated piping in conformance with section 1.02 references and all applicable safety, rules and regulations

1.04 JOB CONDITIONS

- A. Contractor will notify local and County health and fire officials prior to the performance of any Work. Contractor shall obtain local Fire Department permits and/or licenses as required for all Work of this Section.
- B. Display or have available at all times on the site a Health and Safety Plan (HASP). The site-specific HASP shall be approved by a certified Industrial Hygienist and signed by all affected personnel as described in 1.05 SUBMITTALS.
- C. Ensure that a "Safety Officer" as described in 1.05 SUBMITTALS is present at all times during the Work.
- D. Condition of Adjacent Construction:
 - 1. Prior to start of Work of this Section, make an inspection with the Engineer to determine physical condition of existing adjacent construction and structures that will remain.
 - 2. Prepare and submit to the Engineer a written description of such construction and structures for approval, including photographic documentation, if requested by the Engineer.
 - 3. Furnish and install sheeting as specified in Section entitled 02221 EXCAVATION, BACKFILLING AND FILLING, where shown on the Contract Drawings, and where required to ensure that movement, settling or damage to existing adjacent construction or structures does not occur.
- E. Utility Services and Product Lines
 - 1. Do not interrupt any existing utility or other service without prior approval from the Engineer.
 - 2. Give the Engineer 5 days notice in advance of performance of any Work on existing utility lines or service lines. Identify capped, plugged, sealed or rerouted underground lines.
- F. A designated area will be provided to the Contractor as shown on the Contract Drawings for the purpose of soil and drum/ container impoundment and decontamination of equipment and materials.
- G. Establish and maintain a surface impoundment area within the designated area indicated on the Contract Drawings for on-site storage of soil described in Item 1.01 E.
- H. Establish and maintain a surface impoundment area within the designated area indicated on the Contract Drawings for on-site storage of drums and containers filled under Item 1.01 D.
- I. Provide sorbent pads, pillows, booms and blankets to contain and clean product spills at all areas of product pumping, transfer and holding; tank cleaning, and decontamination.
- J. Provide, operate, maintain and calibrate combustible gas indicators (CGI), portable photoionization devices (PID), and percent oxygen indicators to assess gas/ vapor concentrations in tanks 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 1.05 A.3 to perform such testing is mandatory.
- K. Use of flame cutting and operations that may create sparks are prohibited, unless permitted by the Engineer. Such operation may be permitted only when the tank is inert and the surrounding area is free of flammable vapors to the extent necessary to begin dismantling of the tank.
- L. Equipment used 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.
- M. Use of CO₂ fire extinguishers for inerting of tanks is prohibited.
- N. Use of an eductor-type air mover for purging of the tanks is prohibited.
- O. Perform excavation and backfilling in accordance with Section 02221 EXCAVATION, EACKFILLING AND FILLING.
- P. Perform tank cleaning and removals in accordance with API Bulletins 1604 and 2015 and the requirements of this Section.

1.05 SUBMITTALS

- A. Within 5 calendar days after the acceptance of the Proposal, submit:
1. Certification of tank closure and proof of tank closure training for employees.
 2. For the entity performing tank removal hereunder, a demonstration of previous underground tank removal experience by submission of a list of tank removal contracts performed during the past three years including: the names, addresses, and telephone numbers of owners for whom projects were performed; and the cost, year of work, and description of work of each such project.
 3. The name and qualifications of the Industrial Hygienist responsible for reviewing and approving the Health and Safety Plan.
 4. The name and qualifications of the Safety Officer proposed for use in performing the Work. The Contractor, however, 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), or equivalent, within the last 12 months.
 - c. Certification of completion of the OSHA (29 CFR 1910.120) training course for Site Management and Supervision, or equivalent, within the last 12 months.

- d. Documented experience as a Safety Officer on at least one project of similar size and scope.
 5. Identify, within the designated area shown on the Contract Drawings, specific dimensions and locations for soil and drum/container staging and decontamination.
- B. Within 5 calendar days after the acceptance of the Proposal, submit the site-specific Health and Safety Plan (HASP), bearing confirmation of review and approval by an Industrial Hygienist possessing valid certification by the American Board of Industrial Hygiene, proposed for use in performing the Work to 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 site
 4. Include site entry and exit procedures.
 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. Set forth a program for monitoring for vapors and hazardous conditions in the tanks. List and describe equipment to be used.
 9. Identify Confined Space entry and perform its entry in accordance with the facility standard protocol and as directed by the Engineer.
- C. Provide a UST closure plan that includes the following:
 1. An excavation and material handling plan that describes the methods, means, equipment, sequence of operations and schedule to be employed in excavation, transport, handling, and stockpiling of soil during UST removal, shoring requirements, and lists the phases of dealing with contaminated soil and water as it relates to the proposed UST(s) and piping removal.
 2. A tank and piping removal and disposal plan that include the following: Describes the methods, means, and sequence of operations and schedule to be employed in the pumping, cleaning, de-vaporizing, cutting, removal and disposal of the UST(s) and its associated piping.
- D. Provide a comprehensive spill and discharge control plan that addresses contingency measures for potential spills and discharges from handling and transporting contaminated soil and water.

- E. Provide clean fill documentation in accordance with section 3.06
- F. Contractor shall submit the above for approval 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. As required, obtain local, State, or Federal permits and licenses that directly affect the Contractor's ability to perform the Work prior to commencing UST removal operations
- B. All Work shall be performed in conformance with the HASP.
- C. Contractor shall install visible barricades around Work area. Barricades shall be maintained throughout entire contract duration.
- D. Contractor shall verify that all appropriate utilities are disconnected, locked out, and tagged prior to starting Work on that utility. Locations of utilities are shown on the Contract Drawings.
- E. 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.
- F. Contractor shall construct the impoundment areas described in 1.04 JOB CONDITIONS as follows:
 - 1. Furnish and install hay bale berm around the perimeter of impoundment area. Allow sufficient space for vehicle access.
 - 2. Place 10-mil polyethylene sheet barrier membrane of the largest practical size to cover the impoundment area and extend over the perimeter of the berm with a minimum of joints. Overlap sheet joints at least 8" and seal with a double layer of duct tape. Secure polyethylene sheet to the outer limits of the berm perimeter.
 - 3. Completely cover impounded soils and materials with a 10 mil thick well-secured polyethylene sheet in order to prevent contaminants from being released into the surrounding soil, surface water, or groundwater.
 - 4. When stored within the same impoundment area, soils and drums shall be separated from each other by an impervious barrier.
- G. Deploy sorbent pads, pillows, booms and blankets as required to prevent surface water or product run-off from area of Work.

3.02 PRE-REMOVAL

- A. Place hay bales or other barricades around surrounding drain inlets to prevent accidental discharge into other utility systems. Take precautions to avoid any spillage from removal activities and maintain spill clean-up materials on site.
- B. Excavate exploratory trenches as necessary to determine tank location, limits and the location of ancillary equipment. Remove drop tubes and check valves from tanks, if present. Drain and flush with water all piping back into the tank being careful to avoid any spillage to the surrounding area.
- C. Remove and haul any remaining product from tank utilizing a vacuum tank truck with explosion proof or air driven pumps. Alternatively remove the remaining product via a temporary closed system into USDOT approved drums or containers. After filling drums or containers, seal closed, identify contents (See 1.03 F) and store in the impoundment area.

The vacuum truck operator should be trained to identify or recognize hazards connected with truck operations including spills, hose failures, and discharges of toxic and flammable vapor.

The vacuum truck operator shall be provided with and trained in the use of all required personal protective equipment. In addition the tank operator must be knowledgeable of potential flammable conditions, fire prevention, first aid and of the use of portable fire extinguishers.

- D. Operate Vacuum truck upwind of any pick up point and outside path of vapor travel.
- E. Drums or containers shall be labeled as follows:

- SPECIFIC WORK SITE (e.g., JFK Building 110 UST)
- DRUM (CONTAINER) NUMBER (in increasing sequence as filled)
- CONTENTS (e.g., rinse water from tank cleaning)
- THE START AND END DATES OF WASTE ACCUMULATION.

Maintain a written inventory of drums and containers

- G. Where indicated on the Contract Drawings, remove cover materials over tank and piping, and excavate additional soil as required to expose top of tanks, fittings and product lines. Disconnect and remove all piping, except vent line. Place excavated soil specified in 1.01 E within prepared soil impoundment areas. Separately stockpile remaining soil for use as backfill at a location directed by the Engineer. Concrete and asphalt shall be properly disposed of off Authority site.
- H. Cap or plug all tank openings, except vent line.

3.03 TANK CLEANING AND REMOVAL

- A. Purge tank of vapors and oxygen by one of the following methods:
1. Displacement with bottled, inert gas (e.g. CO₂).
Pressure in the tank shall not exceed 5 pounds per square inch gauge. Use a minimum of one 75 lb. cylinder of CO₂ gas per 2000 gallons of tank volume. Exercise care to prevent buildup of any static charge. The nozzle must be bonded or grounded and the gas introduced slowly to reduce static.
 2. Displacement with dry ice (minimum 1.5 lbs. per 100 gallon of tank capacity).
Crushed dry ice shall be distributed evenly inside of the tank to promote rapid dissipation and removal of ignitable vapors.
- B. Vent all of the vapors from the tank at a minimum height of 12 feet above grade and 3 feet above any adjacent roof level.
- C. Remove non-enterable tanks from the excavation in order to gain access to the interior for cleaning.
- D. Gain access to tank interior by careful use of a cold cut with a cement/concrete saw, or equivalent. The cut shall be wetted with water to reduce the propagation of sparks.
- E. Clean inside of tanks in accordance with API 2015 using high-pressure water rinse. Use as little water as possible for proper cleaning. Remove and containerize wash water, residual liquids, sediment (sludge) and debris. After filling disposable containers, seal closed mark and placard contents in accordance with USDOT standards and place in the impoundment area.
- F. Provide tank removal/lifting equipment of a size adequate to safely remove tank. Front-end loaders and backhoes cannot be used for lifting unless they are equipped with a factory attached hook designed with adequate lift capacity for the tank and the tank does not exceed the published lifting capacity for the equipment. Remove the tank from the excavation and place in a level surface. Use wooden blocks to prevent movement of the tank after and prior to loading on a truck for transportation. Remove external scale and attached soil from the tank.

3.04 DISPOSAL OF TANK AND ANCILLARY EQUIPMENT

- A. Permanently and legibly label each tank with letters not less than 2 inches high as follows:

TANK HAS CONTAINED (Name material, e.g., "gasoline")
NOT VAPOR FREE
NOT SUITABLE FOR STORAGE OF FOOD OR LIQUIDS INTENDED FOR
HUMAN OR ANIMAL CONSUMPTION
DATE OF REMOVAL (month, day, year)

- B. In addition, for tanks that have either stored leaded motor fuel or whose use history is unknown, permanently and legibly label each such tank with letters not less than 2 inches high as follows:

TANK HAS CONTAINED LEADED GASOLINE. LEAD VAPORS MAY BE RELEASED IF HEAT IS APPLIED TO TANK SHELL.

- C. Comply with State of New Jersey requirements for additional labeling of the tank specifying the site of origin, ultimate destination site and the substance(s) that were stored in it during its use as a storage tank
- D. Prior to off-site transportation of tanks, perform a final flammability test in accordance with API procedures of any residual vapors within the tank. Ensure that tank vapors do not contain more than 10 percent of the Lower Explosive Limit specific to the product stored in the tank.
- E. Ensure tank is unfit for further use by drilling or puncturing multiple holes in all surfaces.
- F. Transport and dispose of tanks, ancillary equipment and materials away from Authority property in accordance with all applicable regulations and guidelines.
- G. If the excavation is to remain open during breaks or after the Contractor leaves the site, protect the excavation perimeter with a fence 6' high and secure entry with a padlock to prevent unauthorized personnel access.

3.05 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. Prior to their removal from the site, decontaminate all recoverable equipment and materials, which have been in contact with excavated soil described in 1.01 E. 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, as determined by the Engineer.
- C. Furnish and install 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. Deposit non-liquid, non-recoverable materials into USDOT containers described in 1.01 D, as directed by the Engineer.
- F. Deposit rinse fluids into USDOT containers described in 1.01 D, as directed by the Engineer.
- G. Mark and placard drummed decontamination materials and place in the impoundment area.

3.06 CLOSE-OUT

- A. When directed by the Engineer, place backfill in excavation and compact in accordance with Section 02221 EXCAVATION, BACKFILLING, AND FILLING.
- B. In the State of New York, backfilling requirements shall comply with DER-10 Technical Guidance for Site Investigation and Remediation Section 5.4 [3(c) 2(i) thru (iv)].
- C. In the State of New Jersey, backfill material used to restore a site shall comply with NJAC 7:26E-6.4 New Jersey Underground Storage Tank Regulations Post Remedial Actions Requirements.
- D. Restore pavement, if any, as shown on the Contract Drawings at no cost to the Authority.
- E. Submit one copy of bill of lading (or Certificate of Destruction) for disposing of tank, piping, equipment, and materials. Such bill of lading (or Certification of Destruction) shall include the Contractor's acknowledgement that he assumes all liability for disposal of the tanks, piping, equipment, and materials removed.

END OF SECTION

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. Job Conditions
 - 1. Except for items designated to be relocated or salvaged, remove and transport off Authority property all portions of the existing construction and appurtenant structures shown on the Contract Drawings to be removed in accordance with Division 1 clause entitled "Recycling of Construction Debris Material".
 - 2. Prior to start of work, make an inspection accompanied by the Engineer to determine physical condition of adjacent construction that is to remain.
 - 3. Protect all existing and new construction including utilities, finishes and equipment from water, damage, weakening or other disturbance.

1.03 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

All materials used for patching shall be new. Patching materials shall match in every respect adjacent portions of the existing construction.

PART 3. EXECUTION

3.01 CUTTING, PATCHING AND REMOVAL

- A. Perform all cutting, patching and removal as shown on the Contract Drawings and in accordance with 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. Protect finished surfaces at all times and repair or replace, if damaged, to match existing construction to the satisfaction of the Engineer.
- E. Do not allow removed materials and debris to accumulate at the site; remove them daily. Keep all areas adjacent to, and leading to and from the site, free of removed materials and debris.

END OF SECTION

SECTION 02073
CUTTING, PATCHING AND REMOVAL
APPENDIX "A"
SUBMITTALS

- A. Submit materials to be used for patching of:
1. Gravel Mulch
 2. Flexible Pavement
 3. Concrete Sidewalk
 4. Concrete Curb
 5. Concrete Pavement
 6. Concrete Slabs
- B. Submit plans, methods, equipment and procedures as applicable for cutting, patching and removal of:
1. Gravel Mulch
 2. Flexible Pavement
 3. Concrete Sidewalk
 4. Concrete Curb
 5. Concrete Pavement
 6. Concrete Slabs

END OF APPENDIX "A"

DIVISION 2
SECTION 02145
DEWATERING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for dewatering construction excavations.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Job Conditions

1. Take all steps necessary to acquire familiarity and 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. Verify locations of existing underground structures and utilities.
3. Furnish and install a dewatering system that does not interfere with existing structures, utilities or with the construction.

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 subgrade 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.
3. Dewatering shall include control of all ice and snow.
4. 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 subgrade and maintain this condition during construction.

1.03 QUALITY ASSURANCE

Entities performing the Work of this Section shall have been engaged in such Work for at least the last five years, have satisfactorily completed at least three dewatering projects involving complexities similar to those required under this Contract and 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 will not relieve the Contractor of responsibility for the adequacy of the design to achieve the performance requirements, as specified in 1.02 of this Section.
- B. The Engineer will provide ground water monitoring well data to the Contractor for use to determine the extent of ground water lowering.
- C. Intercept and divert storm water runoff, surface water, and groundwater away from excavation through the use of dikes, curb walls, ditches, pipes, sumps or other means.
- D. Design and carry out dewatering operations that prevent loss of fines through the well points and pumping system.
- E. Locate system elements so as to achieve a continuous dewatering operation without interfering with the permanent construction. Where portions of the dewatering system are located in the areas of permanent construction, submit to the Engineer for his approval details of the method proposed for installing the permanent construction in these locations.

3.02 OPERATIONS

- A. Activate the dewatering system sufficiently in advance of excavation, so that the water level is maintained below the surface of the excavation during all stages of construction.
- B. Unless otherwise approved by the Engineer, operate the dewatering system on a twenty-four hour per day basis, seven days per week, and provide standby pumping facilities to maintain the continued effectiveness of the system. Do not discontinue dewatering operations without the prior written approval of the Engineer.
- C. Maintain the water level a minimum of two feet below the subgrade, unless otherwise permitted by the Engineer. Maintain the water level at said elevation until no danger to any structure under construction can occur from buildup of excessive hydrostatic pressure.

- D. 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.
- E. If ground water is encountered within the excavation at higher elevations than are observed from previous groundwater monitoring well data, it shall be lowered to meet the requirements of this Section.
- F. If, in the opinion of the Engineer, 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.
- G. Put standby equipment in immediate operation in the event that any part of the system becomes inadequate or fails.

3.03 WATER MANAGEMENT

- A. Manage water removed from excavations in a manner to avoid endangering public health, property, and portions of Work under construction or completed. Manage water in a manner to avoid inconvenience to others engaged in Work about the construction site. Furnish and install sumps, silt boxes and other flow control devices as required.
- B. Unless otherwise shown on the Contract Drawings, all pumping equipment shall discharge into existing drainage facilities as approved by the Engineer.
- C. Treat water removed from excavations to meet the Authority's New Jersey Pollution Discharge Elimination System (NJPDES) Discharge to Surface Water permit and Newark Bay Discharge to Surface Water Quality limitations as shown in Contract Drawings.

3.04 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. Patch as required in accordance with the requirements of the Section of these Specifications entitled "CUTTING, PATCHING AND REMOVAL".

END OF SECTION

SECTION 02145

DEWATERING

APPENDIX A

SUBMITTALS

A. Submittals

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. Prepare drawings at 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.

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.

- 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, which-ever 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 grades.

1.02 REFERENCES

American Society for Testing and Materials (ASTM)
ASTM D 422 Standard Test Method for Particle - Size Analysis of Soils
ASTM D 1556 Standard Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D 1557 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
ASTM D 2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2922 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318 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. Install sheet piling or sheeting held in place by waling and bracing members. Top of sheeting shall extend at least six inches above ground.
 - b. Do not excavate below the bottom of sheet piling or sheeting except as necessary to install 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 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 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 matter, conforming to the following NJIEC Standard Soil Aggregate Gradations:

	<u>Total Percent Passing by Weight</u>		
	<u>NJIEC Designation</u>		
	<u>I-7</u>	<u>I-10</u>	<u>I-12</u>
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

B. Backfill

1. Unless otherwise shown on the Contract Drawings, material shall conform to the requirements for I-12 designation, subject to 2.01 B.2 below.
2. Where the entire backfill is above the water table, material conforming to the requirements for I-10 designation may be used in lieu of I-12 designation, except under foundations, aircraft pavement and utilities.

C. Sources

1. When fill and backfill material are provided by the Authority, the location of the stockpile and NJIEC Designation (if applicable) are shown on the Contract Drawings. Samples of material will not be required for testing.
2. Material excavated at the construction site shall be used for fill or backfill to the extent that it conforms with the requirements specified in 2.01 A.1 and 2.01 B.1 as noted on contract drawings. Samples shall be submitted for testing by the Engineer for conformance with the requirements of this Section.
3. If sufficient quantities of material are unavailable from sources described in 2.01 C.1 and 2 above, furnish material from sources off site.

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 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 segregated as suitable and unsuitable and stockpiled as shown on the Contract Drawings.
 2. When excavation of bedrock (ledge rock) is required as shown on the Contract Drawings, the provisions for removal are specified in the Section entitled "ROCK EXCAVATION".
 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.
 5. Should 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 to 1-12 designation defined in 2.01 A.1.
 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.

7. All debris and all material either unsuitable for or in excess of that required for backfill or fill, shall be recycled, reused, or disposed of away from the construction site. See Division I Contract Requirement for the Recycling of Construction Debris Material.

B. Dewatering

1. 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.
2. 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. When excavating in soft soils which may be subject to lateral movement or bottom heave conform with requirements shown on the Contract Drawings.

- D. Disposal of Excavated Material** All debris and all material either unsuitable for or in excess of that required for backfill or fill, shall be disposed of away from the construction site.

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. Compaction Requirements

Backfill and fill shall be compacted to achieve a density of 95 percent of the maximum density as determined by Procedure C of ASTM D 1557, except where alternate density requirements are approved by the Engineer or shown on the Contract Drawings.

C. Subgrade, Excavated and Existing Surfaces Compaction of subgrade, excavated and existing surfaces will consist of a proof-rolling 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.
2. In areas where surface consists of a fine grained soil, compact with a minimum of six passes of an approved pneumatic-tired roller.
3. Overlap passes of roller a minimum of six inches.
4. In areas where use of a roller is impractical, compact surface while at or near optimum moisture content with mechanical tampers.

D. 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 D 1557.
2. Backfill, conforming with I-12 gradation, and fill, conforming with I-7 and I-12 gradation, shall be placed in 14-inch, loose layers and compacted with a minimum of six passes of an approved vibratory roller operated at a speed not to exceed three miles per hour.
3. Passes shall be overlapped a minimum of six inches.
4. Backfill and fill, conforming with I-10 gradation, shall be placed in 12-inch, loose layers and compacted with a minimum of six passes of an approved pneumatic-tired roller.
5. 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.
6. In areas adjacent to structures and utilities as shown on Contract Drawings, compaction equipment shall be restricted and as directed by the Engineer.
7. In areas where use of a roller is impractical, place fill in maximum 8-inch, loose layers and compact with approved mechanical tampers to specified density.
8. Compact backfill as specified in 3.03 D.6 above for fill. In pipe trenches, each layer of backfill shall be not more than eight inches in thickness before compaction. Backfill shall be placed on both sides of the pipe, simultaneously.
9. 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.

10. 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 perform Quality Assurance testing on delivered field samples of material submitted from each source, for conformance with 2.01. Gradation and maximum density will be determined in accordance with ASTM D 422 and Procedure C of ASTM D 1557, respectively. If deemed appropriate by the Engineer, Atterberg Limits will be determined on fine-grained soils in accordance with ASTM D 4318.
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. 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 24 hours prior to start of filling or backfilling to allow the Engineer time to make provisions for such testing.
5. 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 D 1557.
6. 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.
7. The Engineer will check conformance to elevations shown on the Contract Drawings and required tolerance for surface straightness.
8. Provide labor and equipment to take samples as directed and to assist the Engineer in other tests.

B. Testing Requirements for Fill and Backfill

1. Control Tests

Fill and backfill material field samples will be tested in the laboratory by the Engineer as part of the Quality Assurance program. These control tests consist of determining maximum density and optimum water content by Procedure C of ASTM D 1557, and gradation by ASTM D 422. When deemed appropriate by the Engineer, Atterberg Limits will be determined on fine-grained soils.

2. In-Place Density Tests

Quality Control consisting of in-place density testing, as a minimum, shall be performed by the Contractor to determine densities achieved after compaction efforts. An in-place Quality Control plan shall be submitted to the Engineer for review and approval. This plan should address, as a minimum, items such as in-place test type and frequencies for different materials; equipment type, calibration and maintenance; operator identity and qualifications, etc.

Quality Assurance testing will be performed by the Engineer after compaction operations, at the standard frequencies already established by Port Authority testing bulletins. Test methods may either sand-cone (ASTM D 1556), rubber balloon (ASTM D 2167), or nuclear device (ASTM D 2922), with moisture content for nuclear method determined by ASTM D 3017. Tests will measure the density of the layer immediately below each compacted layer and the density of the uppermost or final layer.

C. Proofrolling in Pavement areas or under footings

1. After excavation has been performed to the elevation of pavement subgrade, proofroll the area shown on the Contract Drawings with two passes of a pneumatic-tired roller in the presence of the Engineer.
2. If, in the sole determination of the Engineer, the proofrolling produces noticeable weaving of the surface, excavation of unsuitable material may be required below pavement subgrade, within the limits and to the depth ordered by the Engineer.
3. In no case will the depth of such removal of unsuitable material exceed three feet below the pavement subgrade.
4. Remove all such unsuitable material and replace it with suitable backfill material in accordance with the requirements of 2.01 B.
5. The Contractor will be reimbursed for any ordered excavation of unsuitable material below the elevation of pavement subgrade or under footings and subsequent backfilling (but not for the proofrolling specified in 3.04 C.1) 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 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

- 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.

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:

<u>American Society for Testing and Materials (ASTM)</u>	
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 and C 136) 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 2.01 B.
 3. 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 Using Virgin Aggregate

Gradation 1 test per Lot

Moisture-Density

Proctor Test 1 test per Lot

A Lot shall be defined as one day's production but no more than 400 cubic yards.

Aggregate Base Course Using Recycled Concrete Aggregate

Gradation 4 tests per Lot (one test from each subplot)

Moisture-Density

Proctor Test 4 tests per Lot

Composition 4 tests per Lot

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.	<u>Sieve Size</u>	<u>Percentage Passing By Weight</u>	
		<u>DGABC</u>	<u>OGABC</u>
	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 Stockpile Approval:

RCA will be sampled from lots as specified in 1.04 E.2. Each subplot of each lot shall meet all applicable test requirements of this Section. If any one subplot 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 and 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 or 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.

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 |
| | <u>American Society of Testing and Materials (ASTM)</u> |
| 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 Survivability 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

- A. Submit manufacturer's certificates of compliance with all requirements for materials specified in this Section.
- B. 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.
- C. 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 Eric Street, Jersey City, NJ 07310-1397. The type, quantity and purpose of such samples shall be as shown on the Contract Drawings.

END OF APPENDIX "A"

DIVISION 2
SECTION 02363
STEEL PIPE PILES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for concrete-filled, closed-end, steel pipe piling.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Nondestructive Testing, Inc. (ASNT)

ASNT SNT-TC-1A Recommended Practice No. SNT-TC-1A.

American Society for Testing and Materials (ASTM)

ASTM A 36 Specification for Carbon Structural Steel.

ASTM A 53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

ASTM A 252 Specification for Welded and Seamless Steel Pipe Piles.

ASTM A 615 Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

American Welding Society (AWS)

AWS D1.1 Structural Welding Code – Steel.

AWS D1.5 Bridge Welding Code.

AWS QC1 Certification of Welding Inspectors.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Job Conditions

1. Do not drive piles until excavation or filling in the area they are to occupy has been completed to the design grades shown on the Contract Drawings.
2. Do not drive piles until the mudline is clear of debris or other materials that may interfere with pile driving.
3. When concrete is less than 7 days old, do not drive piles closer to the concrete than the distance computed by the formula below:

$$D = 1/7 \sqrt{E}$$

Where: E = Energy of pile hammer (in foot pounds)
D = Distance (in feet)

4. Do not drive piles until the Engineer has approved sequence of driving for all piles.
5. Protect existing structures, including overhead and buried utility lines.

B. Alignment and Tolerances

1. After splicing, the alignment of the centering of the undriven portion of the pile shall not deviate from the alignment of the centering of the driven portion of the pile by more than 3/8 inch in 40 feet.
2. Alignment deviation is defined as the horizontal offset of the centerline of the pile at the top of the pile divided by the length over which the offset is measured. After installation, the alignment deviation of the pile centerline shall not exceed two percent from vertical for vertical piles and two percent (shallower or steeper) from the batter shown on the Contract Drawings for batter piles.
3. Horizontal deviation is defined as the difference in horizontal position of any point on the centerline of the pile below the pile top from the design horizontal position of the corresponding point as shown on the Contract Drawings. After installation, the horizontal deviation of any point shall not be greater than an amount equal to four percent of the vertical distance from the cut-off elevation to the point in question, unless otherwise shown on the Contract Drawings.
4. A light source lowered to the bottom of the pile shall remain visible. However, if eye contact with the light source is lost, a measurement will be made by the Engineer with an inclinometer to determine if the pile meets the requirements of this Section.
5. Piles at cut-off elevation shall not deviate laterally from required location by more than the tolerance shown on the Contract Drawings. Piles shall not be pulled into location by more than amount shown on the Contract Drawings.

1.04 QUALITY ASSURANCE

A. Welding and Splicing

1. Comply with applicable provisions of AWS D1.1 and AWS D1.5.
2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and if pertinent, has undergone recertification.

B. The Authority will perform Quality Assurance testing to ensure quality workmanship. Notify the Engineer in writing 15 days prior to the start of fabrication and provide a detailed schedule for the duration of fabrication. The schedule shall include, at a minimum, the start and end dates for ordering material, cutting material, fabricating material and shipping material. If the schedule changes, submit a revised schedule.

C. Supply equipment and personnel, at no additional cost to the Authority, to assist in moving members as necessary for adequate access by the Authority for Quality Assurance inspections and testing.

D. Fabrication performed without prior approval of the following items will not be accepted. Ensure that a copy of all signed approvals, including the following supporting documentation, is in the possession of the fabrication shop prior to the commencement of fabrication and is available to the Engineer's Quality Assurance inspector at all times.

1. Shop Drawings.

2. Welding Procedure Specifications (WPS).
3. Procedure Qualification records (if applicable).
4. Welder qualifications.
5. Mill test reports.
6. Names and qualifications of Quality Control personnel, including an AWS Certified Welding Inspector (CWI) who meets AWS QC1 standards, and of nondestructive testing personnel who meet ASNT SNT-TC-1A Level II qualifications.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Steel Pipe Piles

ASTM A 252, Grade 2, unless otherwise shown on the Contract Drawings. Pipe piles shall be either seamless pipe or full penetration electric resistance butt welded with straight or spiral seams. Pipe shall be welded in a manner that welding shall not crack or fail when the pile is subjected to its intended use, including during driving. Arrange for the weld seam of each length of pipe to be ultrasonically tested by the manufacturer in accordance with the provisions for Nondestructive Electric Test of Weld Seam of ASTM A 53. Diameter and wall thickness shall be as shown on the Contract Drawings.

B. Concrete

Concrete shall be as shown on the Contract Drawings and as specified in Division 3 Section entitled "Portland Cement Concrete, Long Form".

C. Grout

Grout shall be cementitious and proportioned as 94 pounds of cement and 5 gallons of water.

D. Reinforcing Bars

ASTM A 615, Grade 60, as specified in Division 3 Section entitled "Concrete Reinforcement".

E. Steel Shapes and Plates (for tip closure or pile point)

ASTM A 36, unless otherwise shown on the Contract Drawings.

2.02 SHOP PAINTING

A. Coating Steel Piles

1. For coating requirements for construction on land, see Contract Drawings and Division 2 Section entitled "Protective Coating for Steel Piling".
2. For coating requirements for marine construction, see Contract Drawings and Division 2 Section entitled "Zinc-Rich Epoxy/Coal Tar Epoxy Coating System for Steel Piling".

PART 3. EXECUTION

3.01 INSTALLATION

A. Pile Driving Equipment

1. Use rigid frame, fixed-lead type driving equipment capable of supporting the pile firmly in a vertical position or to the required batter.
2. Leads shall be of sufficient length so that use of a follower will not be necessary, unless otherwise approved by the Engineer.
3. Use an approved driving head designed to properly fit the head of the pile or a cast steel, outside type drive sleeve to prevent damage to the top of the pile during driving.
4. Use an approved cap block cushion consisting of alternating plates of phenolic laminate and aluminum designed to prevent damage to the piles while also transmitting the amount of transferred energy to the pile top required by the Contract Drawings. The phenolic laminated plates shall be either "Micarta" as manufactured by Westinghouse Electric Corp., 304 Hoover Street, North Hampton, SC 29924, or "Conbest" as manufactured by Penn State Metal Fabricators, 124 Newton Street, Brooklyn, NY 11222. Substitutes not employing phenolic laminate will not be permitted.
5. Do not use wood chips, small wood blocks, shavings or any extraneous material to absorb the energy of the hammer.
6. If piles cannot be installed using fixed-lead type driving equipment due to inaccessibility, use of hanging leads may be considered if the following provisions are complied with:
 - a. Furnish a plan showing the piles that are considered inaccessible and that will not be driven using fixed-lead type driving equipment. The determination of the acceptability of using hanging leads will be made solely by the Engineer.
 - b. Use a driving frame template or false work to maintain location tolerance and orientation (batter) requirements specified in 1.03 B and on the Contract Drawings.
 - c. Specify the type of piles or other method of support and minimum tip elevation of piles used to support frame template and false work.
 - d. Specify the methods of retaining the driven piles in place upon removal of the frame template and prior to cap construction.

- e. Prior to driving piles at each bent or cap, furnish the following to the Engineer:
 - (1) Sequence of installation for all inaccessible piles.
 - (2) Survey of frame location and elevation at each bent or for each row of piles.
- f. Survey location and orientation of piles upon completion of all piles in a bent or cap prior to driving piles in next bent or cap. Furnish access for the Engineer to perform visual inspection of piles.
- g. Pile driving analyzer (PDA) measurements will be performed by the Engineer at the start of pile driving as indicated on the Contract Drawings. If, as a result of using hanging leads, the Engineer determines that additional PDA measurements are required to verify the consistent performance of driving system, the number and frequency of additional testing shall be as determined by the Engineer. Provide access and assistance to the Engineer for the additional testing, as required on the Contract Drawings. The Contractor will be compensated for the cost of additional assistance on a "net cost" basis.

B. Pile Hammer

- 1. Use a pile hammer complying with the requirements shown on the Contract Drawings. Hammer used shall be subject to prior approval by the Engineer.
- 2. Keep hammer in good mechanical condition and operate it at the speed and pressure recommended by the manufacturer.
- 3. During pile driving operations, the Engineer may make occasional measurements of the velocity of the hammer ram using a Hammer Performance Analyzer (radar gun device), manufactured by Pile Dynamics, Inc., Cleveland, Ohio, to be furnished by the Authority. If the energy per blow computed on the basis of the measured ram velocity at impact is less than 80 percent of the rated energy per blow as specified by the manufacturer of the pile hammer, make all necessary repairs so as to improve the energy output to a value of at least 80 percent of the rated energy per blow or, alternatively, replace the pile hammer.
- 4. Use air compressor or hydraulic pump that meets minimum requirements for capacity or horsepower, as recommended by hammer manufacturer.

C. Welding and Splicing

- 1. Perform welding in accordance with requirements for shielded metal arc welding of AWS D1.1 for buildings and other structures or AWS D1.5 for bridges.
- 2. Have all welds visually inspected by an AWS Certified Welding Inspector (CWI).
- 3. Nondestructively test all full penetration welds for 100 percent of the weld length by radiographic or ultrasonic methods, as approved by the Engineer.
- 4. Coordinate the Work and timely notify the Engineer to ensure compliance with all testing and inspection procedures required by the Engineer.
- 5. Notify the Engineer 24 hours prior to performing field welding.
- 6. Close pile tips with a steel plate or an angle-fin point, as shown on the Contract Drawings, continuously welded to the pipe so that no portion of the plate or point extends beyond the outside diameter of pipe.

7. Unless stricter requirements are shown on the Contract Drawings, pile splice shall be as follows:
 - a. Splices within the top 20 feet from pile cut-off elevation or design grade, whichever is lower, shall be full penetration butt welds.
 - b. Splices below the top 20 feet, as described above, may be made with Advance Splicer Sleeve S-18000, manufactured by Associated Pile & Fitting LLC, Clifton, NJ or approved equal, provided both pipe ends are square cut and seated to bear. The sleeve shall be continuously welded as shown on the Contract Drawings. All shop splices shall be done as full penetration butt welds.
 - c. An approved jig or alignment device shall be used to maintain the required straightness of pipe specified in 1.03 B.1.
 - d. For splices made during pile installation, rigid frame pile leads may be used as a jig in a manner approved by the Engineer.
8. Unless otherwise permitted by the Engineer based on field conditions, the number and location of splices shall comply with the following limitations:
 - a. No more than three splices per pile over 100 feet long.
 - b. No more than two splices per pile up to 100 feet long.
 - c. No splice closer than 25 feet from the tip.

D. Pile Driving

1. Perform driving operations only in the presence of the Engineer.
2. Maintain top of pile normal to the driving force. Maintain accurate alignment of the pile, hammer and leads to minimize bowing of pile during impact of the hammer ram.
3. Where groups of piles are required, drive the center pile of the group first and then drive the remaining piles in the group, progressing outward from the center.
4. Drive piles to the minimum tip penetration(s) and to the driving resistance shown on the Contract Drawings. Take corrective action, if required, to prevent observable impact bowing of pile at final driving resistance.
5. Drive piles without interruption from the first hammer blow until required penetration and driving resistance have been attained, unless otherwise approved by the Engineer. If interruption of driving is necessitated by job requirements as approved by the Engineer, upon resuming driving, overcome friction due to the stoppage and drive or use other approved means of advancing the pile to the approximate tip elevation of immediately adjacent piles and to the required driving resistance shown on the Contract Drawings.
6. When resistance to driving makes it impossible to advance the pile to the required minimum tip penetration, spud, jet, jet and drive or use such other means as necessary to permit advancement to required minimum tip penetration, and then drive to the resistance shown on the Contract Drawings. Jetting will be permitted only with approval of the Engineer and within the limits specified by the Engineer. If jetting is performed, immediately re-drive adjacent piles to the required driving resistance shown on the Contract Drawings.

7. Pre-drilling or pre-augering a hole of maximum diameter two inches smaller than the pile diameter may be used to advance the pile to a penetration no deeper than the required minimum tip penetration, subject to approval of the Engineer, providing the pile is driven to the required driving resistance shown on the Contract Drawings. In granular soils below the ground water level, stabilize the hole by use of drilling fluids as approved by the Engineer.
8. At the completion of the driving operation on a pile, the pile shall be undamaged, free of leaks and other defects and in compliance with the requirements of this Section.
9. Cut piles off at cut-off elevation shown on the Contract Drawings as soon as practical after driving and any required re-driving as specified in 3.01 F.
10. When required, install indicator piles in locations and sequence shown on Contract Drawings.

E. Corrections of Deficiencies

1. Notify the Engineer immediately in writing of the failure of a pile to meet any requirement of this Section. Include all information required for the evaluation of remedial measures, including information required for redesign.
2. If the Engineer determines that a pile does not meet the requirements of this Section due to encountering an obstruction, then the following shall apply:
 - a. The Contractor will be compensated on a net cost basis as defined by 3.01 E.9 for all remedial work associated with the deficient pile, including changes to concrete and reinforcement steel, as directed by the Engineer.
 - b. If the Engineer determines that a pile does not meet the requirements of this Section for any reason other than encountering an obstruction, the Contractor shall perform all remedial work associated with the deficient pile, including changes to concrete and reinforcement steel, at no cost to the Authority.
 - c. An obstruction shall be defined as any natural or man-made object which does not permit the pile to be advanced by driving or driving and spudding with the approved pile driving hammer. Soils with naturally high driving resistance shall not be considered to be an obstruction.
 - d. It shall be the sole determination of the Engineer as to whether or not an obstruction has been encountered during pile driving.
3. If a pile fails to comply with the alignment or location requirements of 1.03 B, 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-driven" alignment and locations. If the calculation indicates that the loading on that pile or, if in a pile group, on any pile in that pile group, exceeds 110 percent of the design load, then perform such remedial work as the Engineer in his sole discretion may approve, including but not limited to re-driving piles, furnishing and driving additional piles at locations approved by the Engineer and modifying concrete or reinforcement steel.

4. In the case of a pile with some deficiency that affects load capacity, the Engineer will calculate the load capacity requirements of that pile, based on its actual, "as-driven" location and alignment. If the calculation indicates that the loading on the pile exceeds some reduced allowable loading less than the design load, including a zero loading, as determined in the sole judgment of the Engineer, then perform such remedial work as the Engineer in his sole discretion may approve, including but not limited to redriving piles, furnishing and driving additional piles at locations approved by the Engineer and modifying concrete or reinforcement steel.
5. If a pile fails to comply with the requirements of this Section and the Engineer determines that modification to concrete or reinforcement steel or the driving 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 within the time shown on the Contract Documents.
6. The Contractor, at his option and at any time that he determines that a pile will not satisfy the requirements of this Section for a reason other than encountering an underground obstruction and subject to the provisions of 3.01 E.1, may abandon such pile and replace it with a new pile or piles rather than await direction or approval from the Engineer. However, in exercising this option, the Contractor assumes the risk that such replacement pile or piles have not 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. Such abandonment shall be for the Contractor's convenience at no cost to the Authority and subject to all applicable provisions of the Contract.
7. Abandoned piles shall be cut off one foot below the elevation of the bottom of the pile cap as shown on the Contract Drawings and filled with sand. If directed by the Engineer to fill an abandoned pile with concrete, the Contractor will be compensated for the difference between the cost of sand and concrete for the volume of concrete used to fill the pile.
8. All work performed by the Contractor in accordance with 3.01 E.3, E.4, E.5 and E.7 shall be performed at no additional cost to the Authority, except as otherwise noted.
9. "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 regarding 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 net cost work shall not be charged against the total amount of compensation authorized for extra work.

F. Redriving Piles

1. Unless otherwise shown on the Contract Drawings, take optical survey measurements to establish the elevation of the top of each pile immediately after driving (or redriving) and, subsequently, after driving (or redriving) the entire pile group. Redrive piles that the Engineer determines have heaved or uplifted 0.25 inch or more from their original elevations and piles immediately adjacent thereto as directed by the Engineer.
2. Redrive until both the original tip elevation and the driving resistance shown on the Contract Drawings have been obtained, except that if original tip elevation cannot be reached, driving may be discontinued at a resistance of 150 percent of that shown on the Contract Drawings.

3. Perform redriving at times approved by the Engineer.
4. Equipment for redriving shall be as specified for original driving except that use of a free hanging hammer will be permitted.
5. Do not cut off piles until the Engineer has determined that no further redriving is required.

G. Concrete Core

1. Fill piles approved by the Engineer with concrete in conformance with the requirements of Division 3 Section entitled "Placement of Portland Cement Concrete".
2. Do not place concrete in piles for an individual pile group until all piles for that pile group have been driven and approved by the Engineer.
3. Cover piles not immediately filled with concrete with caps to prevent any material from entering the piles.
4. Before concreting, remove water and other materials from each pile to achieve a clean, dry pile.
5. The Engineer will reinspect all piles immediately prior to filling with grout and concrete. After each pile is approved, immediately place two cubic feet of grout deposited in a manner to optimize coating the inside surface of the pile and fill the remainder of the pile with concrete in one continuous operation by methods that will prevent the segregation of ingredients. Adjust the rate of concrete placement as necessary to prevent void formation.
6. Place concrete into the pipe piles using a hopper with a spout having a cross sectional area of no more than 50 percent of the cross sectional area of the interior of the pipe pile. Position the hopper above the top of the pile to permit the escape of air during the concreting operations.
7. Temperature and other conditions for the depositing of concrete shall conform to the requirements of Division 3 Section entitled "Portland Cement Concrete, Long Form".
8. Where reinforcing is to be placed within a pile, stop placing concrete at the elevation of the bottom of the reinforcing, immediately place the reinforcing, and resume placement of concrete.

3.02 FIELD TESTS

A. Inspection

1. Cooperate with the Engineer and furnish services as he may require for inspecting and obtaining data. Typical of these services shall be the measurement of length of piles, painting footmarks on piles, furnishing light and ladder if required, and moving materials or equipment as required to provide access to and clear observation of the piles.
2. After all piles for each pile group have been driven, the Engineer will inspect each pile by means of a light source lowered to the bottom. If eye contact with the light source is lost in any pile, that pile will be further tested by the Engineer with an inclinometer provided by the Authority as required by 1.03 B.4.

3. The Engineer will keep a record of each pile driven. This record will include the following data:
- a. Date of driving.
 - b. Pile number.
 - c. Type and size of pile.
 - d. Type, number and location of splices.
 - e. Pile length before driving.
 - f. Length of cut-off.
 - g. Elevation of pile top and tip to nearest 0.1 inch immediately after driving.
 - h. Elevation of pile top after driving entire pile group to the nearest 0.1 inch to determine amount of heave.
 - i. Final elevation of pile tip after required re-driving of entire pile group.
 - j. Lower limit (elevation) of pile coating after driving.
 - k. Hammer type and size.
 - l. Hammer speed.
 - m. For impact hammers, blows per foot of driven length, and blows per inch where driving resistance exceeds 75 blows per foot.
 - n. Blows per 1/2 inch of re-drive.
 - o. The time pile driving is started, interrupted, resumed and stopped.
 - p. Description of any unusual circumstances affecting the driving of the particular pile.
 - q. Sounded length of each pile.
 - r. Slope of pile.
 - s. Lowest elevation at which light source is fully visible and elevation at which eye contact with light source is lost.

END OF SECTION

SECTION 02363
STEEL PIPE PILES
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. Certified mill test reports, including ultrasonic testing results of the weld seams, for steel pipe piles.
- C. A complete description of each pile hammer, including operational characteristics, rated energy, date of purchase and date and description of last overhaul.
- D. A complete description of the driving equipment including caps, leads, cap block cushion and guides.
- E. The proposed procedure for splicing piles, including a plan for positioning all field and shop splices to meet requirements specified in 3.01 C.8, and detailed procedures for performing field splices.
- F. Verification of welder qualifications.
- G. Welding Procedure Specifications (WPS).
- H. Procedure Qualification Records (if applicable).
- I. Certifications and qualifications for AWS Certified Welding Inspector (CWI) meeting AWS QC1 standards, nondestructive 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.
- J. Notification, in writing, 15 days prior to commencing fabrication of steel sheet piling.
- K. Detail schedule for the duration of fabrication at each shop.
- L. Welding inspection and test results within five calendar days.
- M. The proposed sequence for driving all piles and proposed procedure for placing the concrete pile core.
- N. Details of jetting, pre-drilling or pre-augering operations, if required to advance piles.
- O. Proposed concrete mix as specified in Division 3 Section entitled "Portland Cement Concrete, Long Form," and method of concrete placement as specified in Division 3 Section entitled "Placement of Portland Cement Concrete".
- P. Plan for installing indicator piles, including sequence of installation, if indicator piles are shown on the Contract Drawings or if Contractor elects to drive indicator piles.

- Q. As-built drawing(s) showing the exact location of all piles driven and identifying abandoned piles.
- R. Submit the following if hanging leads type driving equipment is used:
1. Plan showing inaccessible piles which will be driven using hanging leads.
 2. Plan and section showing components of the driving frame template or false work.
 3. Drawing showing type of piles and minimum tip elevation of piles used to support frame template.
 4. Drawing showing the means of retaining the driven piles at location and orientation upon removal of the frame template.
 5. Written description of the procedure to transmit required survey data specified in 3.01 A.6.e and 3.01 A.6.f.

END OF APPENDIX "A"

DIVISION 2

SECTION 02391

PROTECTIVE COATING FOR STEEL PILING

PART 1. GENERAL

1.01 SUMMARY

This Section and Appendix A to this Section specify requirements for shop application of protective coating.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM A 950	Fusion Bonded Epoxy Coated Structural Steel H-Piling and Sheet Piling
ASTM D 3359	Standard Methods for Measuring Adhesion by Tape Test
ASTM D 4417	Method C
ASTM D 4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D 4285	Standard Test Method for Indicating Oil or Water in Compressed Air
ASTM G 8	Cathodic Disbondment

U.S. Army Corps of Engineers (ACOE)

Paint Specification C-200A

Steel Structures Painting Council (SSPC)

SSPC-SP 1	Solvent Cleaning
SSPC-SP 5	White Metal Blast Cleaning
SSPC-SP 10	Near-White Blast Cleaning
SSPC-SP 11	Power Tool Cleaning to Bare Metal
SSPC-PA 1	Shop, Field and Maintenance Painting
SSPC-PA 2	Measurement of Dry Paint Thickness with Magnetic Gages
SSPC-VIS 1	Visual Standard for Abrasive Blast Cleaned Steel

American Welding Society (AWS)

AWS D1.5	Guidelines
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1.03 SUBMITTALS

See Appendix "A" for Submittals requirements.

PART 2. PRODUCTS

2.01 ABRASIVES

- A. Abrasives shall be dry and free of oil, grease, corrosion producing chemicals, or other deleterious contaminants. Do not use silica sand.
- B. Abrasives shall be shaped and sized to produce a sharp, angular 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 the approved coating manufacturer.

2.02 COATINGS

- A. Fusion Bonded Epoxies
 - 1. Scotchkote 206N, manufactured by 3M, St. Paul MN
 - 2. Pipe Clad 2000, manufactured by Lilly Industries, Inc. North Kansas City, MO
 - 3. Nap-Gard 72500, manufactured by Dupont Powder Coatings, Houston, TX
- B. Coal Tar Epoxies
 - 1. Bitumastic 300 M, manufactured by Carboline, St.Louis,MO
 - 2. Hempel 119US-19990, manufactured by Hempel Coatings (USA), Inc. Houston, TX
 - 3. Coal Tar Epoxy Series 9000, manufactured by Mercury Paint Corp., Brooklyn, NY
 - 4. Sigma 3307 Coal Tar, manufactured by Sigma Coatings, Harvey, LA
- C. Touchup coatings for repair of coating defects and damage, as recommended by the approved coating manufacturer.

PART 3. EXECUTION

3.01 SURFACE PREPARATION

- A. Weld Spatter, Sharp Edges, and Holes
 - 1. Remove slag, flux deposits, weld spatter, and surface irregularities such as slivers, tears, fins, and hackles; all within AWS D1.5 Guidelines. Grind all resulting burrs smooth, including burrs around holes. Do not remove any weld material that will weaken weld strength.

2. Prior to preparation, break sharp edges such as those created by flame cutting and shearing. The rolled edges of angles, channels, and wide flange beams do not normally require further rounding unless specifically shown on the Contract Drawings.

B. Compressed Air Cleanliness

1. Compressed air shall be free from moisture and oil contamination.
2. Use the white blotter test in accordance with ASTM D 4285 to verify the cleanliness of the compressed air. Conduct the test at the start of each shift for each compressor system.
3. If testing indicates contamination, soiling or discoloration visible on the paper, 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 reblast such surfaces at no additional cost to the Authority.

- C.** Prior to 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 Solvent Cleaning.

D. Abrasive Blasting

1. All steel surfaces to be coated shall have SSPC-SP 10 Near White Blast Cleaning. Blast cleaning shall be accomplished using abrasive as stipulated in 2.01 herein.
2. For all steel surfaces to be coated provide a sharp, angular, uniform anchor pattern with a profile height of 2-3 mils, unless the requirements of the coating manufacturer are more restrictive. Peak counts per square inch shall be 80 or greater, when tested in accordance with ASTM D 4417, Method C.
3. SSPC-VIS 1 shall be used as an aid in determining the quality of cleaning.

3.02 PAINT STORAGE, MIXING AND HANDLING

- A.** Store materials not in actual use in tightly covered containers at a minimum ambient temperature of 45 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 where necessary.

B. Mixing and Thinning of Coal Tar Epoxies

1. Do not use coating materials that have exceeded their shelf life.
2. When required by the approved manufacturer, warm paints stored at less than 50oF to above 50oF prior to mixing.
3. Mix all coatings in accordance with the requirements of the approved coating manufacturer using mechanical equipment such as a jiffy mixer.
4. Mix only complete kits of multi-component materials. Mixing of partial kits is not allowed.

5. Do not use two component materials beyond the pot life established by the approved manufacturer's written instructions.
6. Do not thin any coatings unless approved in writing by the manufacturer and the Engineer. If thinning is required and authorized, use only those types, brands, and amounts of thinner stipulated by the coating manufacturer.

3.03 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 coating. Reclean deficient areas. Do not apply coating unless the prepared surface is inspected and approved by the Engineer.
2. Apply the first coat within 12 hours of cleaning to bare metal. If the bare substrate is allowed to remain uncoated for more than 12 hours, or rerusting is evident, reclean the surface prior to painting.

C. Surface Cleanliness Prior to Coating and Between Coats:

1. Do not perform coating 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, and other deleterious materials. Pay particular attention to the removal of detrimental residue from surfaces such as corners and pockets. Clean the surfaces by vacuuming or blowing down with compressed air.
3. 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-SP 1 prior to the application of the next coat. Use a solvent that is acceptable to the coating manufacturer.

D. Ambient Conditions During Coating Application of Coal Tar Epoxies:

- i. Apply coatings under the following conditions unless the requirements of the coating manufacturer are more restrictive:
 - a. Surface and Air Temperatures - Between 50oF and 100oF.
 - b. Relative Humidity - Less than 90%.
 - c. Dew Point - Surface temperature at least 5oF above the dew point temperature of the surrounding air.

- d. Frost/Rain - Do not apply coatings to surfaces containing frost or free standing water, or during rain, fog, or similar detrimental weather conditions.
 2. Remove and replace any coating that is exposed to unacceptable conditions (e.g. rain or dew) prior to adequate curing.
- E. Methods of Application:
1. For fusion bonded epoxies, coat exposed surfaces of steel piles within limits shown on the Contract Drawings with electrostatically-applied, fusion-bonded epoxy to a minimum dry coat thickness of 18 mils, as tested in accordance with SSPC-PA 2. Follow the coating manufacturer's printed instructions regarding handling, mixing, preheating, application, post-baking and curing.
 2. For coal tar epoxies, coat exposed surfaces of steel piles within limits shown on the Contract Drawings using spray application to a minimum dry film thickness of 18 mils, as measured in accordance with SSPC-PA 2. Apply one or two coats as recommended by the approved manufacturer to achieve the required dry film thickness.
- F. Performance Requirements
1. The cured coating shall be of uniform gloss and thickness and shall be free of blisters, pinholes, fisheyes, sags, runs and any other irregularities.
 2. Test for continuity of coating with a holiday tester of 100 volts or less and repair all holidays detected to meet such test.
 3. 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 shall be obtained by the Contractor from the coating manufacturer and submitted for approval by the Engineer. Remove all defective coating and reblast and recoat such areas in accordance with this Specification.
 4. Maintain all quality control records on the results of all inspections and submit all results to the Engineer as stipulated in Appendix "A".
- G. Repair of Damaged & Unacceptable Coatings Before and After Driving:
1. Based upon results of the tests stipulated in 3.03 F. herein, repair coating as follows:
 - a. Surface preparation of defective area.
 - (1) Prepare the surface by cleaning in accordance with SSPC-SP 1 Solvent Cleaning followed by SSPC SP-3 Power Tool Cleaning. Use a solvent that is acceptable to the approved coating manufacturer.
 - (2) If the damage exposes the substrate, remove all loose material and prepare the steel in accordance with SSPC SP 11.

b. **Coating Application in Repair Areas**

- (1) When the bare substrate is exposed in the repair area, reapply all coats of the system to the specified thickness.
- (2) When the damage does not extend to the bare substrate, reapply to only the affected coats.
- (3) Maintain the thickness of the system in overlap areas within the specified total thickness tolerances.
- (4) For field touch-up after driving, use touch-up coatings as recommended by the approved coating manufacturer.

3.04 INSPECTION

- A. Inspection will be performed in accordance with the Section of Division 1 entitled "Inspections and Rejections".

3.05 HANDLING

- A. Use nylon slings to handle coated steel piles during handling, shipment and delivery to the construction site.
- B. Do not handle or move coated steel piles until the coating has cured.

END OF SECTION

DIVISION 2

SECTION 02391

PROTECTIVE COATING FOR STEEL PILING

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:
 - a. For specific products listed in 2.02 A., B. and C. of this Section, submit the following for each product:
 - (1) Manufacturer's printed Technical Data Sheets and Material Safety Data Sheets (MSDS).
 - (2) Manufacturer's printed product label and application instructions.
 - b. For products other than those expressly listed in 2.02 A., B. and C. of this Section, submit the following for each product:
 - (1) Information adequate for the Engineer to compare the specified product and the proposed substitution; including, but not limited to, technical specifications, test data, references to product use in existing installations, or any other data required by the Engineer.
 2. Surface Preparation/Coating Plan:
 - a. Written procedures for conducting the Work of this Section including but not limited to, the preparation of surfaces, abrasive "work mix" analysis; coating mixing, application, and repair; recoat times and cleaning between coats; and specific details for the preparation and coating of welds.
 - b. A comprehensive listing of the equipment that will be used for surface preparation and coating. 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. Steel Test Panel:
 - a. Submit one 8" x 8" blasted steel test panel for approval by the Engineer. The panel shall be prepared using the same procedures, equipment, and abrasive "work mix" described in A.2. herein. The approved test panel shall be used by the Engineer as a standard of judgment for approval of production operations.

- b. 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 coating manufacturer.
4. Quality Control Inspection Plan - Submit the quality control inspection plan that will be followed to confirm that all work under this Contract complies with the requirements of this Section. The plan shall include the following at a minimum:
- a. Inspection organization chart including lines of authority and the experience, training, and qualifications of all quality control personnel.
 - b. 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.
 - c. Documentation procedures including samples of the actual inspection forms that will be used for Work of this Section.
 - d. Written description of equipment to be used for surface preparation and coating application inspection, calibration procedures, frequency of calibration, and the methods for handling equipment that is found to be out of calibration.
5. Inspection Log or Report:
- a. Submit one copy of the log or report form package to the Engineer each seven calendar days.

END OF APPENDIX A

DIVISION 2
SECTION 02501
SILANE SEALER

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for silane sealer for use on concrete surface.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM C 642 Test Method for Specific Gravity, Absorption, and Voids in Hardened Concrete

National Cooperative Highway Research Program (NCHRP)

REPORT 244 Concrete Sealers for Protection of Bridge Structures

1.03 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply sealer if rain is forecast within 12 hours of the completion of sealer application.
- B. Do not apply sealer to a wet surface. Surfaces must dry at least 24 hours following rain, water cleaning or other moisture.
- C. Do not apply silane sealer when ambient or pavement temperature is 40 degrees F, or below, except where the manufacturer establishes a lower limit for application.
- D. Do not apply silane sealer in direct sunlight when ambient or pavement temperature is 90 degrees F, or higher.

1.04 QUALITY CONTROL/ASSURANCE

- A. At locations determined by the Engineer, the Contractor shall perform one test installation to demonstrate his ability in performing the Work in strict compliance with the requirements of this section and to the satisfaction of the Engineer. The Contractor shall submit the plan for the 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.

- B. The Engineer will take 2" diameter core samples, one core for every 500 square feet of surface sealed. For acceptance the cores shall show evidence of 0.1 inch minimum surface penetration and 85% reduction in Water absorption, per ASTM C 642 entitled "Test Method for Specific Gravity, Absorption, and Voids in Hardened Concrete". Core holes shall be patched by the Contractor in an approved method and finished to match adjacent surfaces to the satisfaction of the Engineer.
- C. Where results from test installations or Engineer's sampling 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.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver silane sealer to the construction site in its original, 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 silane sealer to be used.
- B. Store silane sealer at ambient temperatures in accordance with the manufacturer's recommendation.
- C. Silane sealer which has been in storage more than the time recommended by the manufacturer shall not be used and shall be removed from the construction site immediately.

1.06 SUBMITTALS

See Appendix "A" for submittals requirements.

PART 2. PRODUCTS

2.01 MATERIALS

Breathable penetrating silane sealer (40% solids content, minimum) such as:

	<u>Brand Name</u>	<u>Supplier/Location</u>
A.	Chem-Trete BSM 40 VOC3	Huls America/Piscataway, NJ
B.	Dynasytan BH-N3	Huls America/Piscataway, NJ
C.	Isoflex 6183	Harry S. Peterson, Inc./Berea, OH
D.	Klereseal 940-S3	Pecora Corporation/Harleysville, PA
E.	Masterseal SL 403	Master Buildings, Inc. /Streetsboro, OH

	<u>Brand Name</u>	<u>Supplier/Location</u>
F.	Sil-Act ATS 423	Advanced Chemical Technologies/Oklahoma City, OK
G.	Weather Worker S-100 (J-29A)	Dayton Superior /Pine Plains, NY
H.	Enviroseal 403	Harris Specialty Chemicals, Inc./Jacksonville, FL
I.	Approved equal	

Requests for an approved equal shall include laboratory data showing at least a 94% reduction in absorbed chlorides when tested in accordance with the procedures of NCHRP Report 244, "Concrete Sealers for Protection of Bridge Structures", Series IV, Southern Exposure, and 75% weight gain reduction due to water absorption in accordance with Series II.

PART 3. EXECUTION

3.01 PREPARATION

- A. Clean substrate surface, in accordance with the Section entitled "ABRASIVE BLASTING OF PAVEMENTS", to remove substances which may interfere with the penetration of the sealer into the concrete matrix.
- B. Vacuum surfaces after cleaning to remove all residue, dirt, sand and grit. Dispose of material off of Authority property.
- C. Protect adjoining construction from spillage or over-spray of sealer prior to commencement of application. Mask manholes, drains and other construction not to be sealed.
- D. Do not seal freshly placed concrete until it has cured a minimum of 30 days.

3.02 APPLICATION

Apply sealer on surfaces to be sealed in two complete applications where shown on the Contract Drawings. Horizontal surfaces shall be soaked with the sealer and the application shall continue until the surface ponds for a minimum period of five seconds. Roll out any excess sealer that does not penetrate. Comply with the manufacturer's instructions and recommendations, using the manufacturer's recommended application method and rate.

END OF SECTION

SECTION 02501

SILANE SEALER

APPENDIX "A"

SUBMITTALS

- A. Submit to the Manager, Materials Engineering Division, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, one quart sample of silane sealer for approval.
- B. Submit the manufacturer's specifications, installation instructions and general recommendations in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS.
- C. Submit to the Manager, Materials Engineering Division, certification of compliance with the Volatile Organic Compounds (VOC) regulations of the state or city in which the application will occur. If application under this contract will take place in both states, the more stringent regulation shall apply for the entire contract.

END OF APPENDIX "A"

SECTION 02515

PRECAST CONCRETE BLOCK PAVERS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for furnishing and installing Uni Eco-Stone precast concrete unit pavers over prepared sub-base material.
- B. Definition

Herein, the term Concrete Block Paver shall mean Uni Eco-Stone pre-cast concrete unit paver.

1.02 REFERENCES

American Society of Testing Material (ASTM):

1. C936 Specification for Solid Interlocking Concrete Paving Units.
2. C140 Method of Sampling and Testing Concrete Masonry Units.
3. C136 Method for Sieve Analysis for Fine and Coarse Aggregate.
4. C33 Specification for Concrete Aggregates.

1.03 ENVIRONMENTAL REQUIREMENTS

- A. Cold-Weather Protection:

Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace concrete block paver Work damaged by frost or freezing.

- B. Weather Limitations:

Protect concrete block paver Work against freezing when atmospheric temperature is 40 degrees F. and falling. Heat materials and provide temporary protection of completed portions of unit paver Work. Comply with International Masonry All-Weather Council's "Guide Specification for Cold-Weather Masonry Construction," Section 04200, Article 3.

C. Precipitation:

Do not install concrete block pavers during heavy rain or snowfall.

1.04 QUALITY ASSURANCE

A. Qualifications

1. Verify that the entity performing the Work of this Section has a minimum of three years experience and has completed concrete block paver installations similar in material, design and extent to that shown on the Contract Drawings.
2. Verify that the entity performing pesticide applications is licensed as a commercial applicator by the state in which the Work is being performed.

C. Certification

1. Arrange for the entity performing the Work of this Section to be certified in writing by the manufacturer, Unilock, Inc., that the entity is an approved installer of their product and that the method of installation of this Work fully meets the manufacturer's requirements.
2. Verify that the entity performing pesticide applications is licensed as a commercial pesticide applicator by the state in which the Work is being performed.

D. Field-Constructed Mock-up:

Prior to installation of concrete block pavers, install a 10' x 10' mock-up for the form and pattern of paver required to verify selections made under sample submittals. Build mock-up to comply with the following requirements, using materials and same base construction including any special features, sizes, laying patterns, color, concrete curb edge restraints, geotextile fabric, open graded aggregate base course, sand setting bed materials, stabilized crushed screenings for unit paver joints and contiguous work as shown on the Contract Drawings and specified herein for final unit of Work.

1. Locate mock-up within the Work area and obtain the Engineer's approval of the site location.

2. Notify Engineer and Unilock, Inc. a minimum of one week in advance of the dates and times when the mock-up will be erected.
3. Demonstrate quality of workmanship that will be produced by the entity performing the installation and obtain Unilock Inc's acceptance of the mock-up in writing.
4. Obtain Engineer's acceptance in writing of the mock-up before start of final Work.
5. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed Work. Accepted mock-ups in undisturbed condition at time of issuance of a Certificate of Final Completion may become part of completed unit of Work.

D. General Requirements for Operations and Products

1. Products listed in PART 2 – PRODUCTS shall be subject to Engineer's written approval prior to delivery to the construction site.
2. After delivery to the construction site, allow the Engineer, at his discretion, to take representative samples of any item listed in PART 2 – PRODUCTS for analysis. Products that fail to comply with these specifications shall be immediately removed from the construction site and replaced with products that comply at no cost to the Authority. No concrete block work will be permitted until the non-complying product is removed from the construction site and replaced with product that complies with these Specifications.
1. 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.
2. Pesticide
 - a. Use the pesticide manufacturer's recommended formula, application rate and safety instructions at all times.
 - b. Dispose of spills and surplus products away from Authority property.
 - 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. All herbicide applications will be subject to inspection by the Engineer. The Engineer may at any time, suspend and reschedule an herbicide application when, in the Engineer's determination, weather conditions are unfavorable, facility operations would be hampered or the Contractor's methods or materials fail to comply with these specifications

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver concrete block pavers to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by fork lift or clamp. Unload pavers at construction site in such a manner that no damage occurs to the product. Damaged concrete block pavers will not be accepted.
- B. Cover sand with a waterproof covering to prevent exposure to rainfall or removal by wind. Secure covering in place.
- C. Protect concrete block pavers and sand during storage and construction against wetting by rain, snow or ground water and against contamination or intermixture with earth or other types of materials.
- D. Deliver all products in the manufacturer's unopened containers bearing the trade name, manufacturer's name, weight and analysis.
- E. Store products away from moisture and extreme temperatures and in such a manner that their effectiveness will not be impaired.

1.06 SUBMITTALS

See Appendix "A" for Submittal requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete Block Pavers
 - 1. Pavers shall meet the following requirements set forth in ASTM C936:
 - a. Minimum average compression strength of 8000 psi (55MPA).
 - b. Maximum average absorption of 5% when tested in accordance with ASTM C 140.

- c. Resistance of 50 freeze thaw cycles, when tested in accordance with ASTM C 67.
- 2. Furnish and install concrete block pavers of the following manufacturer, no substitutions permitted:
 - a. 'Uni Eco-Stone' precast concrete unit paver, 11.5 cm width x 23 cm length x 8 cm thick, as manufactured by Unilock, Inc., Brewster, NY 10509, telephone (800)-864-5625.
 - b. Uni Eco-Stone precast concrete unit paver colors and finishes shall conform to the following:

	<u>Paver Color:</u>	<u>Paver Finish:</u>	<u>Unilock Item #:</u>
1.)	Red	washed	#GT 024 C
2.)	Green	washed	#TE 001 B
3.)	Grey	light-wash	#GT 085

B. Herbicide

- 1. 'Casoron 4G' as manufactured by Uniroyal Chemical Co., Middlebury, CT 06749, or 'Acme Norosac 4G Dichlobenil Herbicide' as manufactured by PBI/Gordon, Kansas City, MO 64101, or an approved equal.

C. Geotextile

Geotextile shall be "Mirafi 1160N" manufactured by TenCate GeoSynthetics, tel. (800)-685-9990; "Geotex 1601" manufactured by Propex Geosynthetics, tel. (800)-621-1273; "FX-160HS" manufactured by Carthage Mills, tel. (800)-543-4430 or an approved equal.

D. Sand

Sand shall be clean, washed concrete sand conforming to the following gradations:

<u>Sieve Size:</u>	<u>% Passing:</u>
3/8"	100
No. 4	90-96
No. 100	10-30

E. Stabilized Crushed Screenings

1. For Stabilized Crushed Screenings see Specification Section 02732.

F. Open Graded Aggregate

1. See Section 02231 – Aggregate Base Course

PART 3 – EXECUTION

3.01 Site Inspection

- A. Verify gradients and elevations of base area in reference to finished grades of pavement surfaces.
- B. Verify location, type, installation and elevations of edge restraints around the perimeter of the area to be paved.

3.02 General

- A. Ensure that all concrete block pavers delivered to the construction site conform with styles, colors and finishes of paver samples approved by the Engineer.
- B. Ensure that concrete block pavers are free of foreign materials before installation.
- C. Do not use concrete block pavers with chips, cracks, voids, discoloration or other visible defects.
- D. Cut concrete block pavers with a wet, diamond tip, masonry table saw to achieve clean, sharp unchipped edges. Hammer cutting will not be accepted. Cut units to fit adjoining edge restraints neatly. Use full uncut paver units to the greatest extent possible.
- E. Furnish and install edging restraints as shown on the Contract Drawings. Install edging prior to placing concrete block pavers.

3.03 Preparation

- A. Excavate and remove existing soils, pavers and sub-base materials to depth required for installing open graded aggregate base course as shown on the Contract Drawings.
- B. Compact existing sub-soils, as per the manufacturer's recommendations, with approved mechanical tampers providing a smooth, uniform surface.
- C. During herbicide application operations the following shall apply:

1. Applicator shall be properly licensed and attired with protective clothing, gloves and other equipment as required.
2. Equipment shall be clean, safe, leak-free and in good working order.
3. Secure the area from pedestrian and vehicular traffic by roping off the area and placing signs as directed by the Engineer.
4. Provide workers to supervise the operation and to keep pedestrians from approaching within 50 feet of the area.

D. Sustainable Measures

Remove all debris resulting from excavation and paver cutting operations promptly. Thoroughly clean the Work area to the satisfaction of the Engineer. Remove and transport off Authority property all debris materials resulting from salt splash base preparations and paver cutting waste in accordance with Division 1 clause entitled "Recycling of Construction Debris Materials".

3.04 Installation

A. Herbicide

1. Apply granular herbicide as per manufacturer's recommendations.
2. Apply granular herbicide to compacted subsoil immediately prior to placing open graded aggregate base course.
3. Apply chemicals only when the wind velocity does not exceed 5 mph; drift hazard is negligible, 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 forecast for 12 hour period after application.
4. Do not begin herbicide treatment until all locations to be treated and method(s) of eradication are approved by the Engineer in writing.
5. Failure to notify the Engineer prior to applying herbicide(s) shall mean the Contractor accepts full responsibility for

replacement in kind with a 'weed free' surface within one year from the date of rendition of the Certificate of Final Completion.

B. Geotextile

1. Install geotextile fabric as shown on the Contract Drawings. Place fabric to ensure proper slack to completely wrap open graded aggregate base course with a six-inch overlap at fabric joints

C. Open Graded Aggregate Base Course

1. Install open graded aggregate base course over geotextile to subgrade elevations shown on the Contract Drawings.
2. Compact open graded aggregate base course to not less than 95% of the maximum density as determined by the Modified Proctor Test ASTM D 1557. Compact to depth shown on the Contract Drawings.
3. Overlap passes of roller a minimum of six inches.
4. In areas where the use of a roller is impractical, compact open graded aggregate base course with approved mechanical tampers to specified density.
5. Fold geotextile fabric over the top of the open graded aggregate base course, overlap six inches and pull fabric taut, securing through both layers of fabric into the base course material. Cut and remove any excess geotextile fabric and achieve a smooth surface elevation free of depressions, ridges and/or bunched fabric, prior to placement of the setting bed course.
6. Obtain the Engineer's approval of the open graded aggregate base course preparation prior to commencing with screeding the setting bed course.

D. Setting Bed

1. Sand Setting Bed

- a. Prior to placement of sand setting bed course, furnish and install geotextile fabric as shown on the Contract Drawings and as follows:

- 1.) Install geotextile fabric to provide a continuous run of fabric under the sand setting bed course and return the geotextile fabric 4" up the side of adjacent concrete curb edge restraints.
 - 2.) Overlap geotextile fabric a minimum of 6" at all joints; pull taut and secure.
 - 3.) Cut and remove any excess geotextile fabric to achieve a smooth surface elevation, free from depressions, ridges and/or bunched fabric prior to placement and screeding of sand setting bed course.
- b. Spread sand setting bed course loosely to a uniform depth of 1"- 1½" and screed to grade and profile shown on the Contract Drawings. Sand setting bed depth shall not exceed 1½".

E. Setting Concrete Block Pavers

1. Lay the unit pavers in the pattern(s) shown on the Contract Drawings.
2. Place concrete block pavers with hand tight joints. Maintain uniform joints, accurate alignment and uniform top surface as shown on the Contract Drawings.
3. Seat and level pavers by compacting with a low amplitude, high frequency plate vibrator capable of 3000 to 5000 pounds centrifugal compaction force to vibrate the pavers.
4. Sweep joints and fill drainage voids with stabilized crushed screenings until pavement joints and drainage voids are tightly packed with stabilized crushed screenings as follows:
 - a. Verify that pavement surface is completely dry before spreading stabilized crushed screenings.
 - b. Spread and cover pavement with stabilized crushed screenings and, using a brush, sweep stabilized crushed screenings into pavement joints and drainage voids until joints and drainage voids are tightly packed with screenings.
 - c. Compact pavement a minimum of two times with an approved plate compactor.

- d. Fog the pavement surface with water to settle and compact stabilized crushed screenings within joints and drainage voids.
5. Leave all work within three feet of the laying face fully compacted with screenings-filled joints and drainage voids at the completion of each day.
6. Sweep off excess screenings when the concrete block paver work is complete.
7. The final surface elevations shall deviate not more than 3/8-inch under a 10 foot long straight edge.
8. The surface elevation of concrete block pavers shall be 1/8 to 1/4 inch above adjacent drainage inlets, manhole covers, concrete collars or channels.

END OF SECTION

SECTION 02515

CONCRETE BLOCK PAVER

SUBMITTALS

APPENDIX "A"

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 and its workers performing the Work of this Section to the Engineer. Include names of clients, telephone numbers and contract amounts for work performed in the last three (3) years and experience records of workers performing the Work of this Section.
2. Submit qualifications of the entity performing pesticide application. Include a copy of a valid state pesticide applicator's license.

B. Products:

1. Product Data: Submit manufacturer's technical data for each manufactured product listing in this Section, including certification that each product complies with specified requirements.
2. Submit shop drawings showing layout of pavers and setting details, including all sizes, dimensions, patterns and profiles.
3. Samples for Verification Purposes: Submit samples made up of 4 actual pavers in each color, finish and type. Include in each set of samples the full range of exposed color and texture to be expected in the completed Work.
4. Submit to the Engineer one copy of the US Department of Labor Material Safety Data Sheets (MSDS) for all hazardous chemicals utilized during the Work of this Section.
5. Submit to the Engineer the method of herbicide treatment, herbicide and schedule of treatment prior to application.

C. Mock-up:

1. Submit for inspection by Unilock, Inc. and the Engineer a 10' x 10' paver area mock-up for paver pattern shown on the Contract Drawings.

D. Certification:

1. Submit the name of the Pesticide Applicator performing the Work and a copy of valid certificate of the certified pesticide applicator from the State in which the Work is being performed.
2. Submit the name of the entity installing the concrete unit pavers and a valid certification that the entity is an approved Unilock Inc. installer.

END OF APPENDIX 'A'

DIVISION 02

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	Test Method for Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)
AASHTO T315	Test Method for Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)
AASHTO T048	Flash and Fire Points by Cleveland Open Cup
AASHTO T240	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 Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	Test Method for 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 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	Mineral Filler for Bituminous Paving Mixtures
ASTM D 692	Coarse Aggregate for Bituminous Paving Mixtures
ASTM D 979	Practice for Sampling Bituminous Paving Mixtures
ASTM D 995	Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D 1073	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	Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials
ASTM D 4125	Test Methods for Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4402	Method for Viscosity Determinations of Unfilled Asphalt Using the Brookfield Thermosel Apparatus
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	Type I Polymer Modified Asphalt Cement for Use in Pavement Construction
ASTM D 6084	Method for Elastic Recovery of Bituminous Materials by Ductilometer (Method A)
ASTM D 6307	Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method
ASTM D 6926	Test Method 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 Asphalt Institute – Manual Series
ASTM E 950	Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Internal Profile Reference
ASTM E 1274	Test Method for Measuring Pavement Roughness Using a Profilograph <u>Asphalt Institute – Manual Series</u>
MS-2	Mix Design Methods for Asphalt Concrete, and Other Hot-Mix Types
MS-20	Asphalt Hot-Mix Recycling

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 not less than 310°F when the base surface temperature is 50°F, or less and not less than 275°F when the base temperature is greater than 50°F. The asphalt concrete temperature will be measured in the truck, at the paver.
4. For asphalt mixes containing Rosphalt 50, the minimum laydown temperature is 350°F, regardless of the base surface temperature. The asphalt concrete temperature will be measured in the truck, at the paver.
5. The minimum allowable base temperature for a lift thickness is shown in the following table:

<u>Nominal Lift Thickness (inches)</u>	<u>Minimum Allowable Base Temperature (Degrees F)</u>
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°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. Arrange for a technical representative of Rosphalt 50 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

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.

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 40² 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

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.

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).

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

7. Do not heat the asphalt concrete mixture or its components to a temperature outside the limits specified in 3.02 A.
8. For top and bottom courses and bridge deck membrane, 100 percent of the material in each lot shall satisfy 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.

9. 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 will 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 may 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

* 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.

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. Arrange for a technical representative of Rosphalt 50 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 shall 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 demonstrate no 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 shall be 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).

b. In-Place Joint Density

The target for in-place joint density with be 97 percent or better (96 percent for pavement on roadway structures). Acceptance with be on a lot basis as set forth in 1.04 E.6. The acceptance of each lot with be based on the Percent of Material Within Tolerance Limits (PWL), as set forth in 4.03 B.5. Adjustment to Contract compensation with 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.

- c. 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:

<u>Course or Combination of Courses</u>	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	--

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 demonstrate no 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% 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. In-place air voids will be tested by the Engineer in accordance with 1.04 E.7. When material fails to meet the requirements, make corrections for deficiencies in accordance with 3.03 B.

* All measurements for this purpose shall be to the nearest 1/8th inch

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 the Contractor (suppliers) mixes, plant quality control, field quality control, tack coat, control strip, requirements for mat and joint densities, equipment - 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.

Make arrangements, at no additional cost to the Authority, for the following to be present at every segment of the paving operations:

 - (1) Asphalt Producers Quality Control Manager
 - (2) Contractors representative for site quality control testing
 - (3) Paving crew foreman
 - (4) Smoothness testing personnel
 - (5) Survey crew chief
 - (6) The Engineer(s)
 - (7) the project superintendent
 - b. Minutes of the meeting shall be recorded and typed by the Contractor and distributed 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. 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.
4. Perform quality control sampling, testing, and inspection during all phases of the work and perform them at a rate sufficient to ensure that the work conforms to the Contract requirements, and at minimum test frequencies required by 1.04D.

B. Quality Control Plan

1. Develop 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 otherwise ensure the quality of the product. For Contracts requiring 1,000 tons of asphalt concrete or greater, the Plan is required. For Contracts requiring less than 1,000 tons of asphalt concrete, the Plan is recommended.
10. Describe the Plan in a written document. Submit the written Plan to the Chief of Materials Engineering Unit and the Engineering Materials Laboratory for review at least 28 calendar days prior to the start of paving operations.
11. In the absence of an approved Quality Control Plan the Authority will make no payments for materials which are subject to specific quality control.
12. The Plan may be operated wholly or in part by the Contractor or an independent organization. However, the Plan's administration, including compliance with the Plan and its modification, shall remain the responsibility of the Contractor.
13. Plan Contents: Organize the Plan to address at least:
 - 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 taken 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 the criteria to be utilized to correct unsatisfactory production processes and construction practices, when tests indicate materials are failing to meet specification for the following:
 - (1) Aggregate gradation
 - (2) Mat and joint density
 - (3) Marshall air voids
 - (4) Surface smoothness
 - (5) Grades
14. 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

15. 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 comparable size and scope. 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 the Plan on more than one project provided that he can upon request be at the construction site within one hour.

(2) Quality Control Technicians

The Contractor shall 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.

16. Testing Laboratory.

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.

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°F ± 5°F.

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.

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.

Upon the Engineer's request, promptly 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 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. Arrange for the material supplier (under observation by the Engineer) to obtain samples of the hot bin materials for job mix formulation. Identical samples will be obtained by for verification of the job mix formulation by the Authority's Engineering Materials Laboratory. The Engineer may require the proposed mix formulation to be batched at the asphalt plant and tested in his presence.
- 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.
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 a minimum of six representative samples, each at least 7 pounds, from each stockpile. Stockpiles shall not exceed 3000 tons. Sample in accordance with ASTM D 75, and under the Engineer's observation. Take duplicate samples and submit 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. Stockpiles of reclaimed asphalt pavement and of new aggregate shall be located 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. Determine locations and timing of random sampling 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 shall 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 subplot) 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 subplot will be defined as a quarter of a lot based on the initial production forecast for the mix. Maximum lot size shall be 2000 tons. If a day's production is forecast over 2000 tons, divide the forecast quantity 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 subplot sizes as initially calculated. If one or two additional sublots are produced add them to that day's lot with $n=5$ or 6 for sublots. If three or more additional sublots are produced in a day, establish an additional lot 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, from a lot three sublots ($n=3$). Should actual production constitute only one or two sublots, add the sublots either to the previous lot or the next production lot, whichever is closer in time. Each subplot 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 subplot, determine the maximum theoretical density in accordance with ASTM D 2041.

Compute voids filled with asphalt, for each plant sample 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

P_b = Percentage by weight of asphalt

G_{mb} = Bulk specific gravity of compacted mixture

G_b = 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 by heating an approximately 4 pound sample of the freshly mixed materials for one hour in an oven at 280 degrees F 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 the 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, take a second sample and test 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 determine the moisture content of aggregate used for production a minimum of once per lot in accordance with ASTM C 566.

h. Moisture Content of Mixture

Determine the moisture content of the mixture once per lot in accordance with the procedure given in Section 1.04.D.1.f. (1). The moisture content in the freshly mixed asphalt concrete shall not exceed 0.5%. If the moisture content is 0.5% 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

<u>Sieve</u>	<u>Action Limit</u>	<u>Suspension Limit</u>
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)

<u>Sieve</u>	<u>Suspension Limit</u>
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 under 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 Port 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 verify 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 shall be 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 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 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 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 is made 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. Such device shall be calibrated 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**
 - a. 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 and 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. He will take samples 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:

<u>Performance Grade</u>	<u>Temperature Degrees F°</u>
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, arrange up request for the Engineer to 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 subplot 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, re-seal the locations 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 shall 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:

$$\text{S.G.} = \frac{W}{12.87 d^2 h}$$

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.

- 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 subplot in-place density readings obtained from a lot and dividing the total by the number of sublots. The in-place density from each subplot will be obtained using a core reading taken from each subplot on a random basis and dividing by the Marshall bulk density (ASTM D 6926 and D 2726) taken for that subplot. 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.

* Average of 5 equally spaced measurements around the core

6. Joint Density

The Engineer will take one joint core from each subplot 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 subplot 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.5b 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 only visual inspection. 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) The contractor shall 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

At the completion of paving, and in the presence of the Engineer, the Contractor shall thoroughly cover the pavement with water using a water distribution vehicle. In areas that do not adequately drain the water from the surface, or otherwise hold water, the Contractor shall remove and replace the deficient area as approved by the Engineer and in accordance with 3.03 A.

11. Final Surface Grade

The grades of the final surface of each lot will be measured 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. The Contractor shall perform the survey jointly with the Engineer.

12. The Engineer will perform acceptance testing of modified asphalt to determine if 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°F will be rejected (excluding mixes that contain Rosphalt 50 additive). For mixes containing Rosphalt 50 additive, any load produce with temperature exceeding 500°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 if the asphalt concrete meets the Tensile Strength Ratio (TSR) requirements of this paragraph. For each lot of asphalt concrete, defined in 1.04 D.1a, 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%. Submit a plan to the Engineer for approval indicating how the problem will be corrected and ensure that TSR values greater than 80% will be consistently produced before commencing production once again.

1.05 SUBMITTALS

See Appendix "A" for submittals requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

- A. Obtain asphalt cement from a manufacturer who is 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 substitution is permitted.
1. Stylink - Koch Materials; Gloucester City, NJ
 2. Vestoplast "S" Modifier - Creanova, Inc.; Somerset, NJ

3. Kraton - Shell Chemical Co.; Houston, TX
 4. Citgoflex SP - Citgo Asphalt Refining Co.; Paulsboro, NJ
 5. Polykote - Suite - Kote Corp.; Cortland, N.Y.
 6. Elvaloy RET - E. I. DuPont Co.; Wilmington, DE
- C. Rosphalt 50 Additive - Chase Construction Products/Royston Division of Chase Corporation; Pittsburgh, PA. No substitutions permitted.

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 New York State Department of Transportation (NYSDOT) or the New Jersey Department of Transportation (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 a sand which when tested in accordance with ASTM C 1252, Method A, and results in uncompacted voids greater than 45.0 percent. Do not use sand that has a low texture value and slag.

4. Mineral filler shall conform to ASTM D 242 and 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 Contract Drawings.

2. **Modified Asphalt**

Modified Asphalt shall be one of the following. No Substitution is permitted.

- a. "Stylink", "Kraton (SEBS)", "Polykote", "Elvaloy RET" or "Citgoflex 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. **Rosphalt 50 Additive**

Rosphalt 50 additive shall be added to the asphalt concrete mixture at a rate of 2.25% by weight of total mix.

C. Tack Coat

Unless otherwise shown on Contract Drawings, tack coat shall be asphalt cement as specified in 2.02 B.1 above.

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

<u>PERFORMANCE GRADE (PG)</u>	<u>64-22</u>	<u>70-22</u>	<u>76-22</u>	<u>82-22</u>
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These Tests Performed on Original Binder:

Flash Point Temperature (AASHTO T48): 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 R28): 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

<u>Sieve Size</u>	<u>Bottom Course</u>	<u>Top Course</u>						<u>Bridge Deck Membrane</u>
	<u>I-2A</u>	<u>I-4A</u>	<u>PA-5</u>	<u>PA-5 with Rosphalt 50</u>	<u>I-5A</u>	<u>I-5A with Rosphalt 50</u>	<u>I-6A</u>	
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
<u>Asphalt, Weight by Percent of Total Mixture</u>								
	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. Rosphalt 50 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

<u>Sieve Size</u>	Plant Mix Macadam	
	<u>Base Course</u>	<u>Top Course</u>
	<u>I-1</u>	<u>I-4</u>
1 1/2"	100	-----
1"	90-100	100
3/4"	60-80	95-100*
1/2"	-----	75-95*
3/8"	15-40	65-85*
No. 4	0-10	35-65
No. 8	-----	25-50*
No. 16	-----	18-40
No. 30	-----	12-30
No. 50	-----	10-23*
No. 100	-----	-----
No. 200	-----	3-6*
	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. Determine the maximum density line by plotting the gradations on a .45 power graph paper and by 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. Verify that the laboratory used to develop the job mix formula meets 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 provide 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. Arrange for the minus 200 fraction to 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 C 128 for fine aggregate. Arrange for the aggregate to 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 and submit 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 by removing the necessary amount of pavement to achieve 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 will not be required when a course is placed beyond the time frame mentioned above.
 - 3. Unless otherwise shown on the Contract Drawings, apply tack coat at a 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. Pave or protect all tack coated surfaces prior to opening the area to traffic.
- E. Mixing Plant Requirements for Recycled Asphalt Concrete
 - 1. Verify that Batch Plants have an appropriately located metering device for adding the reclaimed asphalt pavement to the heated new aggregate and that they 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. 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 & 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

8. Any deviation from these temperatures must be approved by the Chief of Materials Engineering. Use of storage silos will be permitted provided such silos are approved as specified in 1.04 D.4.

B. Delivery, Placing and Spreading

9. 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, lightly coat the truck beds 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 to protect the mixture from adverse weather which shall be securely fastened.
10. Load trucks using a minimum of three drops. About 40 percent of the total weight of the mix to be hauled 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.
11. Schedule deliveries 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.
12. Spread evenly, screed and finish each course to tolerances and requirements specified in this Section.
13. 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.
14. 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 string line (wire) set to grade
 - c. Laser beam set to grade.

15. Before commencing each day's paving, clean the paver of any material left from previous paving operations.
16. Place in minimum of 10-foot wide strips, except that the last strip may be a lesser width if necessary.
17. 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.
18. 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.
19. When starting paving operations at transverse joints, provide four starting block strips under full length of paver screed. Blocks should be of a thickness appropriate for the lift being placed.
20. Keep the paver's hopper half full throughout the paving day. Do not empty the wings until the end of the paving day. Dispose of residual material off the Port Authority property.
21. Do not broadcast raked asphalt concrete material back onto the pavement mat. Raked material shall be placed back in the paver hopper or disposed of.
22. Use hand placing and finishing methods, as approved by the Engineer, in small areas where use of power equipment is impractical. Use lutes for hand spreading.
15. After density requirements have been met, and a minimum of one hour after completion of rolling, reduce mat temperature by the controlled application of water, as directed by the engineer. The compacted mat shall be allowed to cool to 140°F before opening to vehicular traffic.

C. Grade Control

23. Remove grade stakes just prior to rolling of the plant mix macadam base course.
24. The Engineer will provide bench marks and alignment controls adjacent to each area of construction, which shall be checked and maintained by the Contractor.
25. 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.
26. Establish and maintain required lines and grades, including crown and cross slope, for each course during paving operations.
27. Use only qualified surveyors licensed in the State in which work is being performed.

D. Compaction Equipment

28. 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.
29. Use types and quantities of equipment as necessary to meet all quality and production requirements of this Section.

30. Do not use steel rollers with pits, flat spots or grooves worn into rolling surface. Roller shall be capable of reversing without backlash.
31. 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 be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be immediately corrected by the Contractor.
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 shall 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°F and 140°F.

F. Joints

1. Form all joints in such a manner as to ensure a continuous bond between the courses and 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, cut back the tapered edge 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

Make corrections as specified below at no cost to the Authority in the event of the following:

Longitudinal Smoothness for roadways where paving lane lengths equal or exceed 500 linear feet

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&I.

Longitudinal and transverse direction for parking lots and port container storage areas.

In areas that do not adequately drain the water from the surface, or otherwise hold water.

Longitudinal direction for roadways where paving lane length is less than 500 feet

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.10b

Any deviations exceeding 1/4 inch when tested with a 10-foot straightedge.

The area of deficiencies in surface smoothness and/or surface grade tolerance shall be 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 shall be determined by the Engineer based on the results of the test specified in 1.04 E.10.c.

1. 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.
2. 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. Existing pavement shall be removed as necessary to provide square joints for the full depth of the overlay.
3. 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.
4. Diamond grinding equipment shall be as approved by the Engineer and shall have a minimum grinding head of 36 inches and at least 5 blades per inch of shaft. Do not perform diamond grinding when the temperature of the asphalt concrete surface exceeds 80 degrees Fahrenheit. Slurry produced from grinding operations shall be properly disposed of off Authority property.
5. Where corrections are required, correct the entire width of the paving lane by the length of defective area. 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.

6. 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.
6. With the exception of bridge deck membrane, any pavement subplot 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 subplot 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 4.01G.
 7. For bridge deck membrane, any pavement subplot 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
- D. 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, the Contractor shall determine the reason and take corrective action immediately. If the PWL is below 80 percent for either parameter, the Contractor must stop production and make adjustments to the mix.
- E. 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&I.
 2. When any individual measurement exceeds a grade tolerance of plus or minus 0.06 foot the Contractor shall 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.
- F. E. Deficiencies in the Performance Grade Requirements of Modified Asphalt
- Remove and replace 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 4.01G.
- 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 4.01G.

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 will be determined by applying percentages, calculated as specified in 4.03 B, to the assigned unit price of sixty dollars (\$60.00), one hundred sixty (\$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), one hundred sixty (\$160.00) for mixes containing Rosphalt 50, per ton of asphalt concrete.
- F. The percentage adjustment to the unit price specified in 4.01E for Marshall air voids, mat density and joint density of the surface course shall be as follows, except as set forth in 4.01G:
 - When all values calculated in accordance with 4.03B are 100 percent or greater, the highest value will be used to adjust Contract compensation.
 - When all values calculated in accordance with 4.03B are less than 100 percent, the lowest value will be used to adjust Contract compensation.
 - When values calculated in accordance with 4.03B are both greater and less than 100 percent, the product of the highest and lowest value 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 4.01E 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, 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 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.

- 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 4.04 E.4. Plant mix thickness for the area of the entire lot will be the average of the four cores.²⁾ 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

²⁾ 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.

Thickness of each course, excluding overlay, will be the average of the four cores in the lot for each course². 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:

<u>Amount of Minus Deficiency (inches)</u>	<u>Amount of Payment Deduction (Dollars per Square Yard)</u>
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 subplot in-place density determinations from cores of the area covered by the lot specified in 1.04 D.1.a.
 - b. In-place joint density specified in 1.03 D.2.b will be evaluated for Section compliance using the average of random subplot 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 subplot 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)". Each lot will be approved with an adjustment to Contract compensation made in accordance with the tables entitled "Adjustments to Contract Compensation For In-Place Mat Density and Marshall Air Voids", and "Adjustments 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 (\bar{X}).
 - d. Find the standard deviation (S_n) by use of the following formula:

² 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.

$$S_n = \sqrt{\frac{d_1^2 + d_2^2 + d_3^2 + \dots + d_n^2}{n-1}}$$

Where:

S_n = standard deviation of the number in the set

d_1, d_2, \dots = deviation of the individual sample values

X_1, X_2, \dots from the average value \bar{X} that is,

$d_1 = (X_1 - \bar{X}), d_2 = (X_2 - \bar{X}), \dots, d_n = (X_n - \bar{X})$

n = number of sublots

- e. Find the Lower Quality Index (Q_L) by subtracting the lower tolerance limit (L) from the average values (\bar{X}) and dividing the result by standard deviation (S_n).

$$Q_L = \frac{\bar{X} - L}{S_n}$$

- f. Find the Upper Quality Index (Q_U) by subtracting the average value (\bar{X}) from the upper tolerance limit (U) and dividing the result by standard deviation (S_n).

$$Q_U = \frac{U - \bar{X}}{S_n}$$

- g. 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 entering the "Table For Estimating Percent of Lot Within Tolerance Limits - PWL (Standard Deviation Method)" with Q_L and Q_U , 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 P_L or P_U .

- 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 P_L . 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).

**ADJUSTMENTS 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	15

- 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 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 3.03 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 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	.02
16.1 - 17.0	.04
17.1 - 18.0	.06
18.1 - 20.0	.08
20.1 - 22.0	.10
22.1 and up	Corrective work required as specified in 3.03A

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 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	$0.25 \times PWL + 77.5$
65 - 80	$PWL + 17.5$
Below 65	

⁹ 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	.9939	.9900	.9785	.9715	.9672	0.9643
82	.9749	.9600	.9452	.9367	.9325	0.9281
81	.9550	.9300	.9123	.9025	.8966	0.8928
80	.9342	.9000	.8799	.8690	.8625	0.8583
79	.9124	.8700	.8478	.8360	.8291	0.8245
78	.8897	.8400	.8160	.8036	.7962	0.7915
77	.8662	.8100	.7846	.7716	.7640	0.7590
76	.8417	.7800	.7535	.7401	.7322	0.7271
75	.8165	.7500	.7226	.7089	.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)					
	<u>n=3</u>	<u>N=4</u>	<u>n=5</u>	<u>n=6</u>	<u>n=7</u>	<u>n=8</u>
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	0.3222	0.2700	0.2537	0.2461	0.2418	.2391
58	0.2872	0.2400	0.2254	0.2186	0.2147	.2122
57	0.2519	0.2100	0.1971	0.1911	0.1877	.1855
56	0.2164	0.1800	0.1688	0.1636	0.1613	.1592
55	0.1806	0.1500	0.1408	0.1363	0.1338	.1322
54	0.1447	0.1200	0.1125	0.1090	0.1070	.1057
53	0.1087	0.0900	0.0843	0.0817	0.0802	.0792
52	0.0725	0.0600	0.0562	0.0544	0.0534	.0528
51	0.0363	0.0300	0.0281	0.0272	0.0267	.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 subplot 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 a cost 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 4.04C, provided that the Contract requires a total of 500 tons or more of asphalt concrete and plant mix macadam base course.

B. 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, arrange for a producer's representative to 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 tared and when the loaded truck departed from the plant. Time and date may be printed automatically by a time clock. However, ensure that the net weight is documented on each delivery ticket by a certified weigh master.

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 licensed repairman.

Submit a weigh ticket for each truckload. Material will not be accepted unless accompanied by a weigh ticket, which shall be legible and shall 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.

Tack coat will be measured by the gallon.

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:

$$A_c = (MA - BA) \times T$$

Where A_c = Asphalt Cement Price Adjustment, in dollars

MA = Monthly Asphalt Cement Price Index⁴, in dollars per ton

BA = Basic Asphalt Cement Price Index⁵, in dollars per ton

T = Tons of New Asphalt Cement⁶

2. The asphalt price adjustment for tack coat will be determined on a monthly basis using the following formula:

$$A_t = (MA - BA) \times (C) \times (G) \times 0.003986$$

Where A_t = 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

MA = Monthly Asphalt Cement Price Index⁴, 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 Index⁵, 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 Project without written approval from the Engineer.

⁴ The Monthly 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.

⁵ 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.

⁶ 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.

4. Should a monthly Asphalt Price Index decrease from the Basic Asphalt Price Index, payments will be decreased accordingly.
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.

END OF SECTION

SECTION 02553
ASPHALT CONCRETE PAVING
SUBMITTALS
APPENDIX "A"

- A. 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 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.
- B. 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.
- C. 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. |
- D. Submit for each type asphalt cement 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 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 one-quart samples of the asphalt cement.
- Resubmit the above data each time asphalt cement from a different source is proposed.
- E. Submit for each additive proposed for use to the Chief of Materials Engineering, Materials Engineering Unit, the following for approval:
4. The name and location of the supplier(s).
 5. An analysis of such additive by the supplier, certifying the chemical properties and compliance with this Section.
 6. If requested, submit a sample of the additive, in the manufacturers original sealed bag or container.
- F. 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 be submitted to them in their laboratory to develop or verify the Job Mix Formulae.
- G. In lieu of submitting samples of aggregates, asphalt cement and/or additives, the Engineer may verify the Job Mix Formulae at the plant.

-
- H. 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.
 - I. Submit to the Chief of Materials Engineering, Engineering Materials Laboratory, the name of the supplier and an analysis of the asphalt tack coat to be used on the Contract.

End of Appendix A

DIVISION 2

SECTION 02569

RUBBERIZED COAL TAR EMULSION SEALCOAT

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for rubberized coal tar emulsion sealcoat.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

Federal Specifications

R-P-355	Pitch, Coal-Tar Emulsion (Coating for Bituminous Pavements) <u>American Society for Testing and Materials (ASTM)</u>
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 490	Road Tar
ASTM D 1073	Fine Aggregate for Bituminous Paving Mixtures

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

- A. The sealcoat shall consist of a mixture of coal tar emulsion, latex rubber, mineral aggregate (as applicable) and water; the ingredients are to be proportioned in accordance with 2.02 A of this Section, mixed and spread over a properly prepared surface. The completed slurry seal shall leave a homogeneous mat, adhere firmly to the prepared surface, and have a skid resistant surface texture.
- B. Apply sealcoat in dry weather and only when the pavement and atmospheric temperatures are 50 degrees F or above and is expected to remain so for 24 hours. Do not apply when precipitation is anticipated before the film would dry to a rain-resistant condition, or when temperature and humidity conditions will not allow proper curing.
- C. Design sealcoat job mix formulae based on the Table specified in 2.02 A of this Section.
- D. The following are adhesive promoter proportions to be used for the areas shown on the Contract Drawings:
 1. For Asphalt Concrete Surfaces
 - 1 part adhesive promoter
 - 1 part water

2. For Portland Cement Concrete Surfaces

- 1 part adhesive promoter
- 2 parts water

E. The following are sealcoat designs for designated areas shown on the Contract Drawings:

1. Refueling Areas

A four-coat application with each coat containing two to four pounds aggregate per gallon of concentrated coal tar emulsion.

2. Parking Areas

A three-coat application with the first two coats containing four to six pounds aggregate per gallon of concentrated coal tar emulsion in each coat and with the third coat containing two to four pounds aggregate per gallon of concentrated coal tar emulsion.

3. Aircraft Operation (Taxiways, Taxilanes and Aprons)

A four-coat application with the first coat containing two to four pounds aggregate per gallon of concentrated coal tar emulsion; with the second and third coat containing four to six pounds aggregate per gallon of concentrated coal tar emulsion in each coat; and with the fourth coat (the top coat) containing two to four pounds aggregate per gallon of concentrated coal tar emulsion.

4. Other Miscellaneous Traveled Wearing Courses

Number of applications and ratio of aggregate per gallon of concentrated coal tar emulsion shall be as shown on the Contract Drawings.

5. Runways shall not be sealcoated.

1.04 QUALITY ASSURANCE

A. Laboratory Tests

1. Before Work commences, tests of the slurry mix design proposed to be used on the Contract shall be performed by a qualified laboratory and reports shall be prepared on the tests. Previous laboratory test reports covering the exact materials to be used, including water, may be accepted provided they were made during the calendar year. Once the materials are approved, no substitution will be permitted unless first tested and approved by the laboratory preparing the mix design.

2. Theoretical Coal Tar Emulsion

The laboratory shall determine if a mineral filler is required, and if so, how much should be used.

B. Source and Type of Aggregate

1. Precautions shall be taken to ensure that stockpiles of aggregates do not become contaminated with oversize rock, clay, silt, or excessive amounts of moisture. The stockpile shall be kept in areas that drain readily. Segregation of the aggregate will not be permitted.

2. The aggregate shall be compatible with the specified coal tar pitch emulsion. Unless otherwise shown on the Contract Drawings, the aggregate shall be natural, crushed sand, angular in shape.
 3. When specifically shown on the Contract Drawings, the aggregate for the slurry seal to be used shall meet the following requirements:
 - a. The aggregate shall conform to ASTM D 1073 and shall have a minimum wear of 30 percent as tested by the procedure of ASTM C 131.
 - b. The aggregate shall be:
 - (1) Stone sand trap rock obtained from:
Haverstraw, NY
New Haven, CN
Another approved source
 - (2) Blast furnace slag obtained from:
Warner Company of Morrisville, PA
C.J. Langenfelder of Baltimore, MD
Maryland Slag Co. of Baltimore, MD
Another approved source
 - (3) Bauxite obtained from:
AMSAT Corp. of East Greenville, PA
Another approved source.
- C. Calibration of Slurry Mixing Unit
- Each slurry mixing unit shall be calibrated, using approved job mix materials, in the presence of the Engineer prior to use to assure that it will produce and apply a mix that conforms to the job mix design. Previous calibration documentation covering the exact materials to be used with the unit may be accepted provided they were made during the calendar year. The documentation shall include an individual calibration of each material at various settings, which can be related to the machine's metering device(s). No slurry mixing unit shall be used until the calibration has been completed and accepted by the Engineer.

D. Engineer's Sampling and Testing

1. Prior to full production, the Contractor shall prepare a sufficient quantity of mixture in the proportions shown in the job mix formulae to place a test section of approximately 250 square yards minimum at the application rate shown on the Table. The area to be tested will be designated by the Engineer and will be located on the existing pavement. The test section shall be used to verify the adequacy of the mixture and to determine the application rate. The same equipment and method of operations shall be used on the test section as will be used on the remainder of the Work. If the test section should prove to be unsatisfactory by the Engineer, the necessary adjustments to the mix composition, application rate, placement operations, and equipment shall be made. Additional test sections shall be placed and evaluated to the requirements specified in 1.03 of this Section. Material shall be placed by the distributing unit at a controlled speed and rate that will achieve the required application rates specified in 2.02 A.3. Once established, the distributing unit speed shall not be changed without the Engineer's approval.
2. The Engineer will take spot samples at intervals of the emulsion and abrasive materials actually delivered for use in the Work under this Contract and will perform laboratory tests of samples to determine whether or not they comply with requirements of this Section.
3. Any materials that fail to comply with the requirements of this Section shall not be incorporated in the Work and shall be immediately removed from the construction site and replaced with materials that do satisfy such requirements.
4. The Engineer will inspect all operations for quality control.
5. The surface will be tested for skid resistance by:
 - a. A British Portable Tester and shall have a minimum reading of 60.
 - b. A Mu-Meter in wet pavement conditions and shall have a minimum reading of 0.50.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver coal tar pitch emulsion in 55-gallon drums clearly identified with manufacturer's name and name of the product.
- B. Bulk delivery may be permitted subject to advance approval by the Engineer of the bulk delivery containers. If delivered in bulk submit to the Engineer the following information:
 1. Date of shipment
 2. Type of emulsion
 3. Solids content
 4. Ash content
- C. The emulsion shall be continuously agitated from the time it had been mixed until its application on the pavement surface.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Coal Tar Emulsion

1. Coal tar emulsion shall be prepared from a high-temperature, coal tar pitch (Grade RT 11 or 12) conforming to the requirements of ASTM D 490. Oil and water gas tar shall not be used even though they comply with ASTM D490. The coal tar emulsion shall also conform to all requirements of Federal Specification R-P-355, except that the water content shall not exceed 50 percent. The emulsion shall be manufactured by a colloid mill with 50 percent or more solids and an ash content of 35-38 percent of these solids.
2. Manufacturer of coal tar emulsion shall be one of the following:
Monsey Products Co., Kimberton, PA.
Gardner Asphalt Corp., Tampa, FL.
Approved equal

B. Adhesive Promoters

The adhesive promoter shall be a highly modified coal tar emulsion and shall be "Tarloc Adhesive Promoter" manufactured by Southern Emulsions, Holt, AL. or "Oil Spot Primer #061" manufactured by Gardner Asphalt or approved equal.

C. Additives

1. Latex rubber shall be a copolymer latex containing 51-70 parts butadiene and 30-49 parts acrylonitrile or styrene with a minimum solids content of 40 percent with silicone at 3 percent of the rubber content. The average particle size shall be between 300 and 1500 angstroms and the rubber shall be compatible with the coal tar emulsion. The rubber shall mix homogeneously with the coal tar emulsion, water, and aggregate in the proportions shown on the Table specified in 2.02 A of this Section to produce a mixture that will adequately suspend the aggregate during mixing and application.
2. The latex rubber shall be "Tarmax R-100" manufactured by Southern Emulsions, "Perma Tuff" manufactured by Monsey Products, or approved equal.

D. Aggregate

The aggregate shall either be a natural, crushed sand or the manufactured product specified in 1.04 B.3 of this Section and shall be composed of clean, hard, durable, uncoated particles, free from lumps of clay and all organic matter. The aggregate shall meet the following gradation when tested in accordance with ASTM C 136.

<u>Sieve Size (Square Opening)</u>	<u>Percentage By Weight Passing Sieves</u>
No. 8	100
No. 16	97-100
No. 20	85-100
No. 30	15-85
No. 40	2-15
No. 100	0-2

E. Water

The water used in the mix design shall be clear, fresh potable water having a temperature of 50 degrees F or higher. The pH of the water shall conform to the requirements of the coal tar emulsion manufacturer.

2.02 MIXES

A. Mix Design Table

1. The following quantities shown on the Table below shall apply to mixing and application of the slurry.
2. The number of applications for the designated areas specified in 1.03 E of this Section shall be based on the Table below.
3. If required by 1.03 D of this Section, an adhesive promoter shall be applied at a rate of .025 to .05 gallons per square yard of diluted material prior to application of the slurry.

Number of Application	Coal Tar Emulsion (Gallons)	Water, Maximum (Gallons)	Aggregate ¹ (Pounds)	Latex Rubber ² (Gallons)	Application Rate of Mix (Gal/Sq.yd)
1st (primer)	100	40			0.10 - 0.15
2 nd	100	40-50			0.25 - 0.30
3 rd	100	40-50			0.25 - 0.30
4 th	100	40-50			0.10 - 0.15

PART 3. EXECUTION

3.01 SURFACE PREPARATION

- A. Remove all vegetation growing in the cracks and joints of the pavement to be seal coated and treat the joints and cracks with a mixture of Urox "B" Water Soluble Concentrate weed killer as manufactured by the Allied Chemical Company/General Chemical Division, Morristown, New Jersey, or approved equal. Mix the weed killer with water prior to its application, in the amount of one gallon of Urox "B" for each one hundred gallons of water.
- B. Prior to placing the sealcoat, the surface of the pavement shall be clean and free from dust, dirt, or other loose foreign matter, grease, oil, or any type of objectionable surface film. Clean the existing surfaces with a power blower, rotary brooms, and wire brushes.
- C. Cracks wider than 3/4 inch shall be filled with compatible crack filler, prior to placing the sealcoat. Areas that have been subjected to fuel or oil spillage shall be wire-brushed to remove any dirt accumulations. The area shall then be primed with shellac, a synthetic resin or adhesive promoter to prevent the sealcoat from de-bonding.

¹ As specified in 1.03 E of this Section.

² As per manufacturer's recommendation.

- D. Prior to application of slurry seal coat, as required, dampen pavement surfaces with a fine spray of water at a minimum of 125 pounds per square inch pressure by means of a water spray bar attached to the distributor truck. No standing water shall remain on the surface.
- E. Do not water flush areas where considerable cracks are present in the pavement surface.
- F. Bituminous pavement surfaces which have been softened by petroleum derivatives or have failed due to any other cause shall be removed to the full depth of the damage and replaced with new bituminous concrete similar to that of the existing pavement at no additional cost to the Authority. Areas of the pavement surface to be treated shall be in a firm consolidated condition. They shall be sufficiently cured so that there is no concentration of oils on the surface. This can usually be determined by pouring water on the surface to be treated. If the water, after standing for a short period, picks up a film of oil, then that surface is not sufficiently cured for the application of the sealcoat.
- G. If sealcoat is to be applied to a newly paved asphalt surface, the pavement shall be sufficiently cured so that there is no concentration of oils on the surface. Unless otherwise permitted by the Engineer, a minimum period of 90 days with daytime temperatures of 70°F shall elapse between the placement of a new bituminous surface course and the application of the sealcoat. The Engineer may permit sealer application of seal coat after determining the pavement has cured adequately by pouring a cup of water on the pavement surface and observing if any oils appear in the standing water. If oils appear, the surface is not sufficiently cured to accept a seal coat.

3.02 APPLICATION

A. Slurry Mixing and Application Equipment

- 1. Pressurized Distributor Truck
- 2. The pressurized distributor truck shall be approved by the Engineer and shall meet the following requirements as a minimum:
 - a. A self-propelled vehicle having pneumatic tires and a capacity of not less than 1100 gallons. The tank shall be equipped with a manhole of the hinged pressure type having a diameter opening of not less than sixteen inches, to provide for the charging of the emulsion with aggregate and the inspection of the sealer.
 - b. The distributor shall be equipped with the following:
 - (1) An agitator covering the full length of the sealer tank, power driven and independent of all other functions of the distributor, so that agitation of the sealer may be continuous. The paddles of the agitator shall be arranged in such a way as to move the sealer to the tank outlet.
 - (2) A spray capable of applying the sealer a minimum of ten feet wide and equipped with a positive- displacement pump able to produce sufficient constant pressure at all nozzles so as to form an overlapping spray.
 - (3) Power operated positive shut-off at the spray bars so as to prevent spillage or drippings extending beyond the limits of the pavement to be sealcoated.
 - (4) Tachometers, pressure gauges and volume-measuring devices so that the operator shall have full control over the rate of application and to provide a uniform rate of coverage.

- (5) A hand spray with a minimum of 25 feet of hose and positive shut-off at the spray gun.
 - (6) Water storage and a water spray bar located at least two feet in advance of the sealer spray bar with pressure at the nozzles and positive controls to enable the operator to dampen the surface in a uniform manner prior to the application of the sealcoat.
 - c. The distributor shall be capable of applying sealcoat uniformly under 125 psi minimum pressure through cone nozzles to ensure complete coverage.
 - d. The distributor shall operate with no or minimal nozzle clogage.
 - e. The distributor shall be capable of spraying accurate and predetermined proportions of emulsion, abrasive material and water onto the pavement surface.
 - f. Demonstrate to the Engineer's satisfaction prior to its use that the equipment is in good operating condition and that it has performed satisfactorily on other job sites.
3. **Mixing Equipment**
- The mixing machine shall have a continuous flow mixing unit capable of accurately delivering a predetermined proportion of aggregate, water, emulsion and rubber, and of discharging the thoroughly mixed product on a continuous basis.
4. **Spreading Equipment**
- a. Attached to the mixing machine shall be a mechanical-type squeegee distributor, equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor. It shall be maintained to prevent loss of slurry on varying grades and adjusted to assure uniform spread.
 - b. There shall be a lateral control device and a flexible strike-off capable of being adjusted to lay the slurry at the application rate shown on the Table specified in 2.02 A of this Section. The spreader box shall have an adjustable width. The box shall be kept clean; emulsion and aggregate build-up on the box shall not be permitted.
- B. **Application of Adhesive Promoter**
- If required by 1.03 D of this Section, the diluted adhesive promoter shall be applied in accordance with the manufacturer's instruction at the rate shown on the Table specified in 2.02 A of this Section.
- C. **Application of Emulsion Tack Coat**
- If recommended by the emulsion manufacturer, the emulsion shall be applied at a uniform rate with a distributor at the rate of 0.05 to 0.10 gallons/square yard of surface. When it is necessary to dilute the emulsion in order to aid application, the emulsion may be diluted with water up to 3 parts water to 1 part emulsion.
- D. **Application of Slurry**
- 1. When the emulsion, aggregate, water and rubber are blended, the material shall be premixed to produce a homogenous mixture of uniform consistency. The quantities of materials to be combined in each batch shall be in accordance with the approved mix design.

2. The materials shall be proportioned accurately and mixed by mixing equipment specified in 3.02 A.2 of this Section. The emulsion and the water shall first be charged into the mixer and blended to a desired consistency. Aggregate shall then be added at a slow and uniform rate while the mixing is continued. The latex rubber shall then be added. After all the constituents are in the mixer, the mixing shall continue for approximately five minutes or longer, if necessary. The mixing shall produce a smooth, free flowing homogeneous mixture of uniform consistency.
3. Slow mixing shall be continuous from the time the emulsion is placed into the mixer until the slurry is applied by distributor truck or poured into the spreading equipment.
4. During the entire mixing process, no breaking, segregating, or hardening of the emulsion or balling, lumping, or swelling of the aggregate will be permitted.
5. The slurry shall be applied at a uniform rate to provide the desired application rate. A sufficient amount of slurry shall be fed in the spreader box to keep a full supply against the full width of the squeegee, so that complete coverage of all surface voids and cracks is obtained.
6. In areas where a spreader box or distributor truck cannot be used, the slurry shall be applied by means of a hand squeegee.
7. Upon completion of the Work, the sealcoat shall have no pinholes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement. The finished surface shall present a uniform texture.
8. Each application shall be allowed to dry thoroughly before the next coat is applied.

E. Curing

Adequate time shall be allowed for each application to dry thoroughly prior to the next application. The pavement shall be cured in sufficient time to allow for foot and/or vehicular traffic. Upon completion of sealcoating, all traffic shall be excluded from the area for a minimum period of 24 hours or longer if the Engineer so directs. Remove previously placed cones or barricades as directed by the Engineer.

END OF SECTION

SECTION 02569

RUBBERIZED COAL TAR EMULSION SEALCOAT

SUBMITTALS

APPENDIX "A"

- A. Submit to the Engineer certificates from the manufacturers stating that each consignment of emulsion and latex additive shipped meets the requirements of 2.01 A and 2.01 C, and that the latex and coal tar emulsion are compatible with each other and with the water and aggregate. However, the manufacturer's certifications may not be satisfactory as a basis for final acceptance. All certificates shall be subject to verification by Engineer's testing of samples delivered for use under this Contract as specified 1.04 D.2 of this Section.
- B. Submit to the Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, a representative sample of each material from each source proposed for use under this Contract subject to the following:
 - 1. Submit sample in sturdy containers or bags that do not permit loss of any of the material. Samples shall be 50 lbs. minimum for aggregate and 1 quart minimum for emulsion, latex and water.
 - 2. Clearly label each container or bag of the sample with the Contract location, title and number, the name of the material supplied and location of the source.
 - 3. The Engineer will approve or disapprove within 7 days of receipt of a sample.
 - 4. Do not deliver material from any source to the construction site until the Engineer has approved a sample from that source.
- C. Submit to the Engineer a complete laboratory analysis and test report of the slurry mix design accompanied by abraded and unabraded slurry test samples. Obtain Engineer's approval prior to start of Work.

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. Promptly remove any material so deposited.

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, make immediate repairs 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, the use of 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, do not operate equipment at an angle exceeding 45 degrees relative to the pavement surface.
- G. Where milled pavement is not required to be overlaid, accomplish milling 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. Promptly remove all debris resulting from removal operations. Thoroughly clean the Work area to the satisfaction of the Engineer.
 - 1. Use hand brooms, mechanical sweepers or vacuum equipment for cleanup immediately before the end of each work period.
 - 2. Remove and transport off Authority property all materials resulting from milling operations in accordance with Division 1 clause entitled "Recycling of Construction Debris Material".

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 Crafcro 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 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:

- A. Rubberized Asphalt Sealant - 10 pounds from each lot.
- B. Silicone Sealant - one 10.3-fluid ounce cartridge.
- C. 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 Glass Beads Used in Traffic Paints.
 AASHTO M 249 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

Test Standard No. 595 Colors used in Government Procurements.

National Board of Fire Underwriters

1.03 QUALITY ASSURANCE

- A. The quality and workmanship of the completed marking installation shall conform to 3.02 C.4.
- B. 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 substantial 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. 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:

<u>Component</u>	<u>Percentage by Weight</u>	
	<u>White</u>	<u>Yellow</u>
Binder	18.0 Min.	18.0 Min.
Titanium Dioxide	10.0 Min.	---
Glass Beads	30 - 40	30 - 40
Calcium Carbonate & 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. Yellow thermoplastic composition, as placed, shall be yellow, free from dirt, and shall match Federal Test Standard No. 595 – 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 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

After heating for 240 ± 5 minutes at 425 ± 3 degrees F, 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 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 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 (Pre-Mix 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 crushing resistance of the spheres shall be 30-lbs. Minimum spheres retained on No. 40 sieve.
4. The glass spheres shall have the following gradation when tested in accordance with ASTM D 1214.

<u>U.S. Standard Sieve</u>	<u>Mass % Passing</u>
No. 20	100
No. 30	75-95
No. 50	15-35
No. 100	0-5

5. Glass spheres for drop-on shall be treated with a moisture-proof coating meeting the flow requirements of AASHTO M 247 Section 4.4.2, 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.

2.03 Primers will be subject to approval by the Engineer prior to use. Requests for approval shall be accompanied with technical data including brand name, instructions for use, hazard warnings and 1 qt. sample of the primer material.

- A. Primer previously approved by the Engineer may be accepted at the construction site on the basis of the brand name labeled on the container.
- B. 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 Manual on Uniform Traffic Control Devices.
 - 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. Applicators shall be equipped and constructed in such a manner as to satisfy the requirements of the National Board of Fire Underwriters.

5. 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 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.
6. 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 and capable of monitoring the thermoplastic material temperature throughout the marking operation.
7. Applicator equipment including separate "supply" kettles shall be constructed to provide continuous mixing and agitation of 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 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.
8. 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.
9. 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.
10. 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 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/or holding the thermoplastic material at an indicated 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 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 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 gauge 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 Manual on Uniform Traffic Control Devices.
 2. Before any pavement marking Work is begun, 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. Thermoplastic pavement markings shall be placed upon 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 the primer shall be tack-free.
- C. Application
1. Apply a primer to all pavement surfaces (new and existing) to be marked. Apply primer to bituminous concrete and/or Portland cement concrete pavements 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 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 an adherent 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:

A. Product Data

Detailed catalog cuts, manufacturer's specifications and test data of products to be used demonstrating conformance to the requirements of this Section.

END OF APPENDIX "A"

DIVISION 2

SECTION 02582

PREFORMED REMOVABLE RETRO-REFLECTIVE PAVEMENT MARKING TAPE

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the following:

- A. Preformed removable retro-reflective pavement marking tape for lane lines, stop lines, crosswalks, traffic arrows, symbols, and legends.
- B. Removal of existing 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)

Manual for Signing and Pavement Markings of the National System for Interstate and Defense Highways

American Society for Testing and Materials (ASTM)

ASTM D 638	Test Method for Tensile Properties of Plastics
ASTM D 1535	Method for Specifying Color by the Munsell System
ASTM E 303	Using the Brit Pendulum Test and Method for Measuring Surface Frictional Properties

Federal Highway Administration (FHWA)

Manual on Uniform Traffic Control Devices for Streets and Highway

1.03 QUALITY ASSURANCE

- A. 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.

1.04 SUBMITTALS

For Submittal Requirements, see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

- A. Material for preformed removable retroreflective pavement marking tape shall consist of white or yellow 3M Scotch-Lane Brand #5710 (white) and #5711 (yellow) tape for line Work, and Series SMF-270 for symbols and legends, or approved equal.
- B. Prefabricated legends, symbols and line markings shall conform to the applicable shapes and sizes specified in FHWA Manual on Uniform Traffic Control Devices for Streets and Highway and shall be fabricated from maximum width material to provide the least number of contiguous pieces.
- C. Prefabricated lines, legends and symbols shall be precoated with a pressure-sensitive adhesive which is compatible with bituminous concrete and portland cement concrete, and which adheres securely to the roadway.
- D. The removable retro-reflective film shall not contain metallic foil and shall consist of high quality preformed plastic materials and pigments, with glass beads uniformly distributed throughout its cross-sectional area and shall have a retro-reflective layer of glass beads bonded to the top surface. A non-metallic medium such as fiberglass, shall be incorporated into the film to facilitate removal.
- E. The surface of the retro-reflective preformed plastic film shall provide a minimum skid resistance value of 50 BPN units when tested in accordance with ASTM E 303.
- F. The preformed plastic film shall provide a neat and durable marking that will not flow or become distorted due to temperature. The preformed plastic film shall be weather resistant, shall show no appreciable fading, lifting or shrinkage throughout the life of the marking and shall show no significant tearing, roll back, movement or other signs of poor adhesion.
- G. The thickness of the retro-reflective preformed plastic film without adhesive shall be not less than 60 mils and not more than 90 mils.
- H. The film shall conform to roadway surface contours, breaks and faults during the action of traffic. The film shall have the characteristic of fusing with itself and previously applied marking film of the same composition.
- I. The film shall have a minimum tensile strength of 100 psi of cross section when a 1.0-inch wide strip is tested in accordance with ASTM D 638 at a temperature between 70 and 80 degrees F and a jaw speed of 0.25 inch per minute.
- J. A sample measuring 1 inch by x 3 inches shall be able to support a dead weight of 4 pounds for not less than 5 minutes at a temperature between 70 and 80 degrees F.
- K. The marking film shall be tested for adhesive shear strength in accordance with ASTM D 638.

- L. Pigments shall be compounded to maintain the original film color throughout the expected life of the film. White film composition, as placed, shall be white, free from dirt or tint. Yellow film composition, as placed, shall be yellow, free from dirt or tint, and shall be a reasonable visual match to Munsell book notation 10YR8/14 in accordance with ASTM D 1535.
- M. The preformed plastic film shall have a minimum of 20 percent by weight of glass beads with a minimum of 2 percent of the beads adhered to the top of the film.
- N. The marking film shall be removable from bituminous concrete and portland cement concrete intact or in large pieces, either manually or with a roll-up device, at temperatures above 40 degrees F without the use of heat, solvents, grinding or blasting.
- O. All pavement marking materials shall be manufactured and packaged in accordance with the manufacturer's recommendations and in a manner to permit storage for a period of not less than one year from date of purchase.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

- 1. Pavement markings shall be applied at the locations and in accordance with the patterns and dimensions shown on the Contract Drawings and the FHWA Manual on Uniform Traffic Control Devices for Streets and Highway.
- 2. Give 48 hours advance notice to the Engineer of the time when pavement marking and striping are to be performed.
- 3. When pavement markings are applied under traffic conditions, provide all necessary qualified personnel, and traffic control devices to maintain and protect traffic, and to protect marking operations and the new markings until thoroughly set. 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.

B. Cleaning and Preparation of Pavement Surfaces

- 1. Cleaning and surface preparation shall be confined to the surface area shown on the Contract Drawings for the application of new pavement marking material; and the surface area of existing pavement markings that are shown on the Contract Drawings for removal.
- 2. Surface preparation Work shall include cleaning for lines or cleaning for letters and symbols. Lines include: broken line; dotted line; solid line; channelizing line; barrier lines; stop lines; crosswalk lines; and crossbars. When lines are installed, the area of preparation shall be at least the width of the new pavement marking, or existing line, plus 1 inch on each side. When letters and symbols are installed the area of preparation shall be sufficiently large to accommodate the new marking, or to remove the existing marking. Materials used for cleaning pavement of existing marking and any new spills, spatter, or overspray shall not damage the paved surface.

3. Whenever a marking area is cleaned by grinding, scraping, or sandblasting, the cleaning Work shall 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. When such cleaning Work is completed, the pavement surface shall be thoroughly blown-off with compressed air to remove residue and debris resulting from such Work.
4. On new concrete pavements, cleaning operations shall not begin until sufficient cure time has elapsed after the placement of concrete unless otherwise approved by the Engineer. New concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, pavement markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting Work shall be to clean and prepare the concrete surface such that:
 - a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.
 - b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.
 - c. All remaining curing compound is intact; all loose and flaking material is removed.
 - d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.
5. Existing pavement markings shall be removed for the purpose of preparing the pavement surface for the application of new pavement markings in the same location as the existing markings, or to remove existing markings that are in good condition which, if allowed to remain, will interfere with or otherwise conflict with newly applied marking patterns as determined by the Engineer in his sole discretion. New pavement markings shall not be applied over existing markings unless approved by the Engineer.

C. Application

1. The application of pavement markings shall be performed in the general direction of traffic. Striping against the direction of traffic flow shall not be permitted
2. The Contractor shall establish marking alignment points throughout the length of the marking area as approved by the Engineer.
3. The retro-reflective, preformed marking film shall adhere to bituminous concrete and portland cement concrete surface courses when applied according to the manufacturer's recommendations at surface temperatures down to 50 degrees F. A primer shall be applied to the roadway surface when recommended by the manufacturer. The roadway surface shall be dry at the time of marking application. Dirt, debris, loose particles and heavy oil residues shall be removed from the road surface application areas immediately prior to the installation of the preformed marking film.
4. Applied tape shall not be overlapped and only butt splices shall be used. Preformed marking film lines shall be placed with a mechanical applicator to provide lines which are neat, accurate and uniform without the use of heat, solvents or other additional adhesive means and shall be immediately ready for traffic after application.

5. **Preformed marking film for symbols and legend shall be carefully laid and aligned using butt splices only.**
6. **All new markings shall be immediately tampered in place with a rubber tire roller weighted at 100 pounds per inch of width minimum, or approved equal.**
7. **The Contractor shall prepare or remove and reapply any pavement markings that fail to satisfy the requirements specified in this Section at no cost to the Authority.**
8. **The Contractor shall continuously monitor, maintain and repair all installed pavement markings until completion of the Contract.**

END OF SECTION

SECTION 02582

**PREFORMED REMOVABLE RETRO-REFLECTIVE
PAVEMENT MARKING TAPE**

APPENDIX "A"

SUBMITTALS

- A. Submit detailed catalog cuts, manufacturer's specifications and test data of products proposed for use demonstrating conformance to requirements of this Section in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS.
- B. A schedule of pavement marking and striping to be performed.
- C. Submit proposed means of cleaning, removing, or obliterating existing or unsatisfactory markings to the Engineer for approval prior to commencing corrective work.

END OF APPENDIX "A"

DIVISION 2
SECTION 02588
TRAFFIC PAINT PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SUMMARY

A. This Section specifies requirements for traffic paint 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 M247 Glass Beads Used in Traffic Paints

American Society for Testing and Materials (ASTM)

ASTM D522	Mandrel Bend Test of Attached Organic Coatings.
ASTM D562	Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer.
ASTM D 711	No-Pick-Up Time of Traffic Paint.
ASTM D969	Laboratory Determination of Degree of Bleeding of Traffic Paint.
ASTM D2369	Volatile Content of Coatings.
ASTM D2805	Hiding Power of Paints by Reflectometry.
ASTM D3723	Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing.
ASTM D4060	Abrasion Resistance of Organic Coatings by the Taber Abraser.
ASTM E1347	Color and Color Difference Measurement by Tristimulus (Filter) Colorimetry.

Federal Highway Administration (FHWA)

MUTCD Manual on Uniform Traffic Control Devices

U.S. GSA - Federal Standards

Fed-Std 595B

Colors Used in Government Procurement

Color Reference

Munsell Book of Color

1.03 QUALITY ASSURANCE

- A. Environmental Requirements - Weather Limitations: Perform painting only when the surface is dry, when the atmospheric temperature is above 50 degrees Fahrenheit (or is 45 degrees Fahrenheit and rising) and when the weather is not foggy or windy.
- B. Warranty: The completed marking installation, except for temporary markings, shall be warranted to the Authority, from the date of issuance of the Certificate of Final Completion, against peeling, chipping, flaking and delamination for a period of one year. Warranty shall grant the Authority a direct right of action against the manufacturer.

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint to the construction site in sealed containers clearly marked with the date of manufacture, expiration date, name of manufacturer and VOC content.
- B. Store paint inside at normal room temperature.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Deliver no paint until the Engineer has pre-approved the paint manufacturer(s).

2.02 MATERIALS

- A. Paint

1. The paint shall be formulated and manufactured from first grade raw materials and shall be free from defect 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. Upon the Engineer's request, take a one-quart sample of paint. Seal the sample and mark it for future reference.

2. Directional Reflectance: The directional reflectance of the white paint

- (without glass spheres) shall be 84% minimum and of the yellow paint shall be 54% minimum when tested in accordance with ASTM E1347.
3. Flexibility: The paint shall show no cracking, chipping or flaking when tested in accordance with ASTM D522, Method B, when bent 180 degrees.
 4. Bleeding: The paint shall have a minimum bleed ratio of 0.95 when tested in accordance with ASTM D969.
 5. Viscosity: The consistency of the paint shall be not less than 75 or more than 95 Krebs Units at 77 degrees Fahrenheit, when tested in accordance with ASTM D562.
 6. Dry Opacity: Test the paint in accordance with ASTM D2805. The minimum contrast ratio of the paint shall be 0.95.
 7. Field Drying Time: The paint, when applied at 13 mils plus or minus 1 mil wet film thickness and 160 degrees Fahrenheit at the gun and with glass spheres at the specified application rate, shall dry to no pickup in under one minute when tested by 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.
 8. Lab No Pickup: The paint dry time when tested in accordance with ASTM D711 shall be not greater than 3 minutes.
 9. Abrasion Resistance: Maximum weight loss of the paint film shall be 49 mg when tested in accordance with ASTM D4060.
 10. Shelf Life: The paint shall have a usable shelf life of not less than 12 months. Store paint in inside structures at normal room temperature.
 11. The paint shall contain less than 0.06 percent lead when tested in accordance with FS TT-P-1952, Section 4.3.1.1 and shall be chromium free when tested in accordance with FS TT-P-1952 Section 4.3.1.2.
 12. Color
 - (a) For New Jersey traffic markings, the dried paint color shall match Fed. Std. 595B, Color Nos. White 37778 and Yellow 33538.
 - (b) For New York traffic markings, white shall be an approximate visual color match to Munsell Book Notation N9.5/0 and yellow shall be an approximate visual match to Munsell Book Notation 10YR 8/14.
 13. Non-Volatile Vehicle: The paint shall have a minimum non-volatile vehicle of 43.0% when tested in accordance with ASTM D3723.
 14. Pigment: The paint shall have a pigment content of 58.0 to 62.0 percent by

weight when tested in accordance with ASTM D3723.

15. Total Solids: The paint shall have a minimum solids content of 76 percent when tested in accordance with ASTM D3723.
 16. Volatile Organic Content (VOC): The VOC shall not exceed 150 g/L when tested in accordance with ASTM D2369.
- B. Glass Beads: Glass beads shall meet the requirements of AASHTO M247, Type I. Arrange for Manufacturer to treat glass beads with adhesion promoting and/ or flotation coatings.

PART 3 EXECUTION

3.01 GENERAL

- A. Apply painted pavement markings at the locations shown and in accordance with the patterns and dimensions indicated on the Contract Drawings and the MUTCD.
- B. Before any pavement marking Work is begun, submit a schedule of operations to the Engineer for approval.
- C. When painted 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.
- D. Perform painting of pavement markings in the general direction of traffic. Striping against the direction of traffic flow will not be permitted.
- E. Remove all tracking marks, spilled paint and paint applied in unauthorized areas, to the satisfaction of the Engineer.
- F. When necessary, establish marking alignment points at 25 foot intervals throughout the length of the marking area, or as otherwise approved by the Engineer.

3.02 EQUIPMENT

- A. All equipment for the Work shall be as approved by the Engineer and shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the Work.
- B. The mechanical marker shall be an atomizing spray-type marking machine suitable for application of traffic paint and glass beads. It shall produce an even and uniform film thickness at the required coverage and shall be designed so as to apply markings of uniform cross sections and clear-cut edges without running or

spattering and within the limits for straightness set forth herein. The machine shall have a gauge for measuring the quantity of paint used, graduated in gallons, or other approved measuring method. The equipment shall be truck mounted and capable of painting an 18-inch wide line in one pass.

- C. Suitable adjustments shall be provided on the sprayer(s) of a single machine or by furnishing additional equipment for painting the width required.

3.03 SURFACE CLEANING AND PAVEMENT PREPARATION

- A. The exact limits for the removal of existing pavement markings are to be as shown on the Contract Drawings and as verified at the work site and approved by the Engineer.
- B. Conduct removal and cleaning work in such a manner as to minimize airborne dust and similar debris.
- C. Contain, immediately collect and properly dispose of waste materials resulting from the removal of existing thermoplastic and painted pavement markings. Use a high efficiency particulate air (HEPA) filter equipped vacuum attachment operated concurrently with the removal operations to collect waste materials unless other collection means are approved by the Engineer.
- D. Do not wash wastes and residues resulting from the removal, surface cleaning and preparation operations into catch basins or the street storm drainage system.
- E. Remove existing pavement markings no longer needed to the extent that 95 percent removal is achieved without the removal of more than 1/8 inch of pavement.
- F. Prior to the start of removal operations, demonstrate the proposed method of removal to the satisfaction of the Engineer. Any method that leaves gouges, ridges or grooves in the pavement will not be permitted.
- G. Obliterating stripes by painting over them will not be permitted.
- H. Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance or other foreign material that would reduce the bond between the paint and the pavement. Clean the area to be painted by sweeping and blowing as required to remove all dirt and loose materials. Areas which cannot be satisfactorily cleaned by brooming and blowing, shall be scrubbed as directed with a water solution of trisodium phosphate (10 percent Na_3PO_4 by weight) or an approved equal solution. After scrubbing, rinse off the solution and dry the surface prior to painting.
- I. Do not apply paint to portland cement concrete pavement until the concrete in the areas to be painted is clean of curing material. Use abrasive blasting or high-pressure water to remove curing material from concrete surfaces.

3.04 LAYOUT OF MARKINGS

- A. Lay out pavement markings as shown on the Contract Drawings or, if not shown, as approved by the Engineer in advance of the paint application. Verify the location, alignment and radii of all existing pavement markings prior to using them as a guide. Space control points at such intervals as will ensure accurate location and reproduction of all markings at the tolerances specified herein.

3.05 APPLICATION

- A. Apply markings at the locations and to the dimensions and spacing shown on the Contract Drawings. Do not apply paint until the layout and condition of the surface have been approved by the Engineer.
- B. Mix paint in accordance with the Manufacturer's instructions and apply to the pavement with a mechanical marker at a rate of approximately 115 square feet per gallon for permanent markings and a rate of 230 square feet per gallon for temporary markings. The addition of thinner will not be permitted.
- C. Allow a period of 30 days, for permanent markings, to elapse between placement of a bituminous surface course or seal coat and application of the paint. For periods less than 30 days, install temporary markings. The paint shall not bleed excessively, curl or discolor when applied to bituminous surfaces. The paint, when applied at the application rate specified herein, and 160 degrees Fahrenheit at the gun, shall dry to no pick-up in under 1 minute.
- D. Paint to achieve neat straight edges. The edges of the markings shall not vary from a straight line by more than 1/2 inch in 50 feet, and marking dimensions and spacings shall be within the following tolerances:

DIMENSION AND SPACING	TOLERANCE
36" or less	±1/2"
>36" - 6'	±1"
>6' - 60'	±2"
>60'	±3"

- 1. If the markings do not conform to these requirements, immediately obliterate and correct them as approved by the Engineer. Perform corrective work within the Work hours specified by the Engineer.
- E. Distribute the glass beads to the surface of the marked areas immediately after application of the paint. Use a dispenser which is properly designed for attachment to the marking machine and suitable for dispensing glass spheres.
- F. Notify the Engineer upon arrival of each shipment of paint to the job site. Return all emptied containers to the paint storage area for checking by the Engineer. Remove the containers from the construction site, but only after authorization by the Engineer. Maintain an accurate accounting of the paint materials used in the accepted Work.
- G. Apply black paint as a 6-inch wide outline to increase visibility on concrete

surfaces.

H. Do not apply glass beads to temporary markings or black paint.

3.06 PROTECTION

A. After application of the paint, protect all markings from damage until the paint is dry. Erect or place suitable warning signs, flags or barricades, protective screens or coverings, as required. Protect all surfaces from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage and drippings of paint.

3.07 ADJUSTING

A. Defective Workmanship or Materials: When any material not conforming to the requirements of this Section or the Contract Drawings has been delivered to the construction site but not yet installed, or has been incorporated in the Work and has been found to be of inferior quality, as determined by the Engineer, such material or Work will be considered defective and shall be removed as directed by the Engineer and replaced, at no additional cost to the Authority.

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:

A. Product Data

1. Detailed catalog cuts and manufacturer's specifications of products proposed for use demonstrating conformance to the requirements of this Section. Arrange for Material Safety Data Sheets (MSDS) to be part of every shipment and test sample of paint.
2. Catalog cuts and/or manufacturer's specifications for all equipment to be used.

END OF APPENDIX "A"

DIVISION 2**SECTION 02610****EXTERIOR SANITARY SEWER SYSTEM****PART 1. GENERAL****1.01 SUMMARY**

This Section specifies requirements for exterior sanitary sewer 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 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 A 746 Ductile Iron Gravity Sewer Pipe

ASTM C 877 External Sealing Bands for Noncircular Concrete Sewer, Storm Drain, and Culvert Pipe

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 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
	<u>American Water Works Association (AWWA)</u>
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.
 - Griffen Pipe Products Co.
 - McWane, Inc.
 - U.S. Pipe and Foundry Co.

- B. **Gaskets**
 - Hamilton Rent Manufacturing Co.
 - Diplomatic Marine, Inc.
 - General Sealants, Inc.

- C. **Reinforced Concrete Pipe**
 - Kenvil Newcrete Products
 - N.J. Concrete Pipe Co.
 - Price Bros., Inc.
 - Vianini Pipe, Inc.

- D. **Plastic Pipe and Fittings**
 - Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
 - J. M. Manufacturing
 - Contech Construction Products, Inc.
 - Truss Pipe and Fittings
 - Contech Construction Products, Inc.

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 Type CR" for offset pipe
 - c. "Tylox Type O" 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, as shown on the Contract Drawings. Plastic gasket shall conform to AASHTO M 198, Type "B", 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 "O" ring gasket, SDR (Ratio of the outside pipe diameter to minimum wall thickness) not greater than 35

or
2. Truss Pipe and Fittings

Solvent welded coupling type, with the following requirements:
 - a. 3 to 6 inches nominal size - ASTM D 2751 ABS solid wall sewer pipe with SDR not greater than the following:

<u>Nominal Size</u>	<u>SDR</u>
3 inch	35
4 inch	23.5
6 inch	23.5
 - b. 8 to 15 inches nominal size - ASTM D 2680 ABS composite sewer pipe, Type SC.
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, trap rock or recycled Portland cement concrete aggregate conforming to the following gradation determined in accordance with ASTM C 136 and C 117. Recycled concrete aggregate shall contain not less than 95 percent crushed Portland cement concrete and shall be in accordance with the requirements of the Section entitled "AGGREGATE BASE COURSE."

<u>Sieve Size</u>	<u>Total Passing Percent by Weight</u>
2 1/2 inch	100
1 inch	60 - 100
3/4 inch	45 - 85
3/8 inch	30 - 60
No. 10	14 - 30
No. 40	3 - 15
No. 200	0 - 3

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 sub trench 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 sub trench 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 "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 layer, place and compact additional bedding material in small lifts to the dimensions shown.
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 shall be subject to the approval of the Engineer and in accordance with ASTM C 924 for pipes up to 24 inches diameter and ASTM C 1103 for pipes greater than 24 inches diameter.
2. The Contractor is directed to the safety precautions necessary when performing air tests as specified in ASTM C 924 and ASTM C 1103.
3. Unless otherwise approved by the Engineer, the lines shall be tested from structure to structure.
4. Coat all capped and plugged fittings and all joints with soap solution to detect leakage.
5. 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.
6. 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.
7. The minimum test time shall be as specified in ASTM C 924 or ASTM C 1103. 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.
8. If the pipe section or joint exceeds the allowable pressure loss specified by ASTM C 924 and ASTM C 1103 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.
9. 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 Manager, Materials Engineering Division, 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 02664

**EXTERIOR WATER SUPPLY SYSTEM FOR
CITY OF NEWARK, NJ FACILITIES**

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for ductile iron pipe and appurtenances to be used for exterior water supply systems for Port Authority facilities in the City of Newark, New Jersey.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American National Standards Institute (ANSI)

- | | |
|--------------|--|
| ANSI B 16.18 | Cast Copper Alloy Solder Joint Pressure Fittings |
| ANSI/NSF-61 | Drinking Water Systems Components-Health Effects |

American Society for Testing and Materials (ASTM)

- | | |
|------------|--|
| ASTM A 48 | Gray Iron Castings |
| ASTM A 536 | Ductile Iron Castings |
| ASTM B 88 | Seamless Copper Water Tube |
| ASTM C 117 | Test Method for Material Finer Than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing |
| ASTM C 136 | Test Method for Sieve Analysis of Fine and Coarse Aggregates |

American Water Works Association (AWWA)

- | | |
|------------|--|
| AWWA C 104 | Cement - Mortar Lining for Ductile-Iron Pipe and Fittings for Water |
| AWWA C 105 | Polyethylene Encasement for Ductile-Iron Pipe Systems |
| AWWA C 110 | Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids |
| AWWA C 111 | Rubber-Gasket Joints for Ductile - Iron Pressure Pipe and Fittings |
| AWWA C 116 | Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service |
| AWWA C 151 | Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids |

AWWA C 153	Ductile-Iron Compact Fittings, 3 in. Through 16 in., for Water and Other Liquids
AWWA C 502	Dry-Barrel Fire Hydrants
AWWA C 600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C 651	Disinfecting Water Mains
	<u>The Society of Protective Coatings (SSPC)</u>
SSPC SP-3	Power Tool Cleaning

1.03 QUALITY ASSURANCE

Ensure that the entity performing the Work of this Section has at least three years of installation experience on projects with piping systems of types and sizes similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Ductile iron pipe delivered to the construction site shall be stacked or laid out along the route of the system to be installed, as directed by the Engineer. If stacked, conform to AWWA C 600.
- B. Care shall be taken when handling pipe and appurtenances to ensure that the pipe, fittings and appurtenances are not damaged. Pipe, fittings or appurtenances that are damaged will be rejected and shall be replaced in kind at no additional cost to the Authority.
- C. Hydrants, gate valves, valve boxes, glands, gaskets, copper tubing and fittings, and other similar items shall be stored at the construction site under lock and key.

1.05 SUBMITTALS

For Submittals, see Appendix A.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Manufacturer of the ductile iron pipe and appurtenances shall be one of the following, no substitutions will be permitted:

American Cast Iron Pipe Company (Co.), Birmingham, Alabama

EBAA Iron Sales, Incorporated (Inc.) , Eastland, Texas

Griffin Pipe Products Co. , Florence, New Jersey

McWane, Inc. , Birmingham, Alabama

United States (U.S.) Pipe & Foundry Co., Birmingham, Alabama

Atlantic States Pipe Cast Iron Pipe Co. Inc., Phillipsburg, New Jersey

2.02 MATERIALS

A. Ductile Iron Pipe - 4 Inches and Larger

Use one of the following at the Contractor's option:

1. Push-On Joint
 - a. "Tyton" Joint, as manufactured by U.S. Pipe & Foundry Co. and Griffin Pipe Products Co., "Fastite" Joint, as manufactured by American Cast Iron Co., or "Push-On" Joint, as manufactured by McWane, Inc. conforming to AWWA C 151, Special Thickness Class 53. Pipe shall be cement-mortar lined and coated with a petroleum asphaltic coating approximately 1 mil thick on the outside of the pipe. Cement-mortar lining shall be twice the standard thickness specified in AWWA C 104. Rubber gaskets shall conform to AWWA C 111. Cement-mortar lining, asphaltic coating and rubber gaskets shall comply with the requirements of ANSI/NSF-61.
 - b. Where joint restraint is shown on the Contract Drawings, use one of the following systems, as approved by the pipe manufacturer, to restrain push-on joints:
 - (1) "Field-Lok" gaskets for 4 inches through 24 inches, as manufactured by U.S. Pipe & Foundry Co. and Griffin Pipe Products Co.
 - (2) "TR Flex", including "TR Flex Gripper Rings", for pipe 4 inches through 64 inches, as manufactured by U.S. Pipe & Foundry Co. "TR Flex Gripper Rings" are available for pipe 4 inches through 36 inches.
 - (3) "Flex-Ring", including field-adaptable rings, for pipe 4 inches through 12 inches, as manufactured by American Cast Iron Pipe Co.
 - (4) "Lok-Ring" for pipe 14 inches through 54 inches, as manufactured by American Cast Iron Pipe Co.
 - (5) "Fast-Grip" gaskets for 4 inches through 16 inches, as manufactured by American Cast Iron Pipe Co.
 - (6) "Lok-Fast" for pipe 4 inches through 54 inches, as manufactured by American Cast Iron Pipe Co.
 - (7) "Snap-Lok", including "Snap-Lok FC", for pipe 6 inches through 24 inches, as manufactured by Griffin Pipe Products Co.
 - (8) "Type A Restrain", including lock ring with set screw, for pipe 6 inches through 24 inches, and "Type B Restrain" for pipe 30 inches and 36 inches, as manufactured by McWane, Inc.
2. Mechanical Joint
 - a. "Mechanical" Joint as manufactured by American Cast Iron Pipe Co., Griffin Pipe Products Co., McWane, Inc., or U.S. Pipe & Foundry Co. conforming to AWWA C 151, Special Thickness Class 53. Pipe shall be cement-mortar lined and coated with a petroleum asphaltic coating approximately 1 mil thick on the outside of the pipe. Cement-mortar lining shall be twice the standard thickness specified in AWWA C 104. Rubber gaskets shall conform to AWWA C 111. Cement-mortar lining, asphaltic coating and rubber gaskets shall comply with the requirements of ANSI/NSF-61.

- b. Where joint restraint is shown on the Contract Drawings, one of the following systems, as approved by the pipe manufacturer, shall be used to restrain mechanical joints:
- (1) "MJ Gripper" glands for pipe 4 inches through 12 inches, as manufactured by U.S. Pipe & Foundry Co.
 - (2) "Bolt-Lok", including "Bolt-Lok FC", for pipe 4 inches through 24 inches, as manufactured by Griffin Pipe Products Co.
 - (3) "Megalug" series for pipe 4 inches through 48 inches, as manufactured by EBAA Iron Sales, Inc.
 - (4) "F-1058 Ductile Iron Retainer Gland", for pipe 4 inches through 24 inches, as manufactured by McWane, Inc., or approved equal.
- B. Fittings for Ductile Iron Pipe shall be ductile iron conforming to AWWA C 110 and/or AWWA C 153. Ductile iron fittings shall be cement-mortar lined to twice the standard thickness specified in AWWA C 104 and coated with a petroleum asphaltic coating approximately 1 mil thick on the outside or coated with a minimum 6 mil thick fusion-bonded epoxy coating on the interior and exterior conforming to AWWA C 116. Joint type shall be push-on or mechanical. Cement-mortar lining, asphaltic coating, rubber gaskets, and fusion-bonded epoxy coating shall comply with the requirements of ANSI/NSF-61.
- C. Copper Tubing - 2 inches and Smaller
ASTM B 88, Type K, O50
- D. Fittings for Copper Tubing
ANSI B 16.18 solder joint pressure fittings, or flared joint fittings.
- E. Fire Hydrants
1. Fire hydrants shall conform to the requirements of AWWA C 502 and shall be standard breakaway hydrants with a mechanical joint inlet connection. Hydrants shall have a 4 1/4-inch valve opening and shall be fitted with one 4 1/2-inch steamer nozzle (National Standard Thread) and two 2 1/2-inch hose nozzles (City of New York Thread). Hydrants shall be the models specified below. No substitutions will be permitted.
 - a. For Newark Liberty International Airport: U. S. Pipe and Foundry Co. 'S' Series.
 - b. For Port Newark: U.S. Pipe and Foundry Co. Metropolitan 250 Model M-94.
 2. Hydrant colors shall be: Yellow barrel and outlet caps, and green bonnet.
- F. Gate Valves
1. Valves shall conform in all respects to the specifications of the City of Newark, and as specified below.

2. Valves 4 inches through 12 inches shall be A.P. Smith Metropolitan Gate Valves Figure No. 3460 or Metroseal 250 Resilient Seated Gate Valve, as manufactured by U.S. Pipe and Foundry Co. Valves shall have mechanical joint connection and "O" ring seals. Valves shall be nut operated, non-rising stem valves, and open in a clockwise direction. Valves shall be rated for 200 psi working pressure, 400 psi test pressure. No substitutions will be permitted.
 3. Valves 16 inches and larger shall be horizontal type Series 3000, A.P. Smith Metropolitan Gate Valves, as manufactured by U.S. Pipe and Foundry Co. Valves shall have flanged joint connection, "O" ring seals and bevel gears in a grease case. Valves shall be nut operated, non-rising stem valves, and shall open in a clockwise direction. Valves shall be furnished with a 3-inch by-pass and shall be 150 psi working pressure, 300 psi test pressure. No substitutions will be permitted.
 4. **Indicator Valves and Posts**
 - a. Valves and posts shall be UL listed and shall have the direction of operation plainly marked by an arrow cast on the head of the post. Provide lock with breakable hasp.
 - b. Color of indicator posts shall be red.
- G. **Valve Boxes**
- Valve boxes shall be of the type shown on the Contract Drawings and shall be fabricated of ASTM A 48, Class 30B cast iron. Valve chambers shall be furnished and installed as shown on the Contract Drawings for valves larger than 16 inches. Where cast iron manhole cover is shown, manhole cover shall be fabricated of ASTM A 48, Class 30B cast iron. Where ductile iron manhole cover is shown, manhole cover shall be fabricated of ASTM A 536, Grade 60-40-18, or Grade 65-45-12, ductile iron. Ductile iron manhole covers shall bear the letters "D.I." in a clearly visible manner on the upper surface.
- H. **Wet Tap Connections**
- Use A.P. Smith T-9 mechanical joint tapping sleeve and Metropolitan No. 3860 mechanical joint by flange tapping valve, as manufactured by U.S. Pipe & Foundry Co., or approved equal.
- I. **Crushed Stone for Pipe Bedding**
- Crushed limestone, gneiss, trap rock or recycled Portland cement concrete aggregate conforming to the gradation specified below, determined in accordance with ASTM C 117 and C 136. Recycled concrete aggregate shall contain not less than 95 percent crushed Portland cement concrete and shall be in accordance with the requirements of the Section entitled "Aggregate Base Course".

<u>Sieve Size</u>	<u>Total Percent By Weight Passing Sieve</u>
2 1/2 inch	100
1 inch	60 - 100
3/4 inch	45 - 85
3/8 inch	30 - 60
No. 10	14 - 30
No. 40	3 - 15
No. 200	0 - 3

- J. Pipe Guards and Hydrant Fenders
1. Size and weight of pipe guards and hydrant fenders shall be as shown on the Contract Drawings.
 2. Concrete for footing and pipe fill shall be Portland cement concrete conforming to the requirements specified in the Section entitled "Portland Cement Concrete".
 3. Color of pipe guards shall be yellow.
- K. Paint for Rods, Bands, Nuts, Bolts, Washers, and Other Appurtenances
- Bitumastic No. 50, as manufactured by Carboline Company, No. CA-50, as manufactured by the Barrett Division of Allied Chemical and Dye Corporation, or approved equal.
- L. Paint for Fire Hydrants, Indicator Posts, Hydrant Fenders, and Pipe Guards
- 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, or approved equal. Prime and finish coats shall be products of same manufacturer.
- M. Paint for Pipe, Valves, Fittings, and Appurtenances Within Valve Chamber (Only)
- Carbomastic 15 LO, as manufactured by the Carboline Company, or approved equal. Color of paint shall be black.
- N. Polyethylene Film for Ductile Iron Pipe
- AWWA C 105, Low Density or High Density (Cross-Laminated) polyethylene film, Class C

PART 3. EXECUTION

3.01 EXAMINATION

Where the pipeline is to cross existing utilities, as shown on the Contract Drawings, the Contractor shall verify their elevation and horizontal location through excavation of test pits or other approved exploratory means.

3.02 PREPARATION

Prior to the start of the pipeline installation, the Contractor shall have in place those items shown on the Contract Drawings and required by the Specifications for the maintenance of traffic.

3.03 INSTALLATION

A. Operation of Valves

Unless directed by the Engineer, the Contractor shall not operate existing valves.

B. Excavation and Backfill

1. Perform trench excavation and backfilling in accordance with the requirements of the Section entitled "EXCAVATION, BACKFILLING AND FILLING" to the alignment and grades shown on the Contract Drawings. Unless otherwise shown on the Contract Drawings, pipe shall have a minimum cover of four feet.
2. If groundwater is encountered, methods of dewatering shall be approved by the Engineer. No pipe shall be installed if there is water in the trench at or above the level of the bottom of the bell.
3. Over-excavation and the use of timber blocking beneath the pipe may be permitted, as approved by the Engineer, to meet the requirements of 3.03 B.2, where the groundwater volume is such that, in the opinion of the Engineer, the requirements of 3.03 D.4 cannot be attained or the Contractor is unable to maintain groundwater accumulation below the level of the bottom of the bell.

C. Polyethylene Encasement

1. Install polyethylene encasement 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, do not allow soil or embedment material to become trapped between the pipe and the polyethylene encasement.
3. Fit the polyethylene film to the contour of the pipe to effect a snug, but not tight, encasement with the minimum space between the polyethylene and the pipe. Provide sufficient slack in contouring to prevent stretching the polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings, and to prevent damage to the polyethylene due to backfilling operations.
4. Secure overlaps and ends with adhesive tape, string or plastic tie straps to hold the polyethylene encasement in place until backfilling operations are complete.

D. Pipe Installation

1. Install ductile iron pipe in accordance with AWWA C 600 and Section 4 of AWWA C 651.
2. If an obstruction that is not shown on the Contract Drawings is encountered and interferes with the installation of Work under this Contract, the Contractor shall notify the Engineer. No work shall be performed until directed by the Engineer. Alterations or deviation in the alignment and grade shown on the Contract Drawings or the removal, relocation or reconstruction of the obstruction shall be approved by the Engineer.
3. Place calcium hypochlorite granules or tablets in the water main, as specified in Section 5.1.1 of AWWA C 651, prior to placing pipe in the trench.
4. 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 proper grade and alignment. Make suitable excavations for pipe bells 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 crushed stone bedding material in small lifts to the dimensions shown.

5. Immediately prior to their placement in their trench, inspect all pipe, valves, hydrants, fittings, and/or appurtenances in the presence of the Engineer to verify that they are internally clean and free of damage to the materials, linings and coatings. Damaged units shall be removed from the construction site and replaced at no additional cost to the Authority.
 6. When lowering the pipe into the trench and joining the units, ensure that the interior of the pipeline remains clean.
 7. Close all openings in the pipeline with water tight plugs when pipe-laying is stopped, at the conclusion of any Work period or if Work is interrupted for any reason, to preclude contamination of the pipeline. Plugs shall be fitted with a means for venting.
- E. Pipe Restraint
1. Pipe shall be restrained where and as shown on the Contract Drawings. Use only the pipe manufacturer's approved joint restraint system.
 2. Where push-on joint pipe is to be restrained, install one of the systems specified in 2.02 A.1.b in accordance with the manufacturer's recommendation and printed instructions.
 3. Where restraint under 1 and 2 above is not possible, install bands and rods, as directed by the Engineer.
- F. Hydrant Installation
1. Install hydrants as shown on the Contract Drawings and orient hydrant nozzles so that they do not point directly at hydrant fenders or pipe guards, walls, poles or other obstructions.
 2. Relocate existing hydrants as shown on the Contract Drawings. Exercise care in removal and relocation operations so as not to damage the hydrants. Any portions of the hydrants damaged by the Contractor shall be repaired or replaced by the Contractor, as directed by the Engineer and to his satisfaction, at no additional cost to the Authority.
- G. Wet Tap Connections
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 connections are 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 connection is completed, inspect the polyethylene for damage and repair if needed.
- H. Painting
1. Rods, Bands, Nuts, Bolts, Washers, and Other Appurtenances
 - a. Before backfilling, and prior to installing any required polyethylene encasement, apply two heavy brush coats of paint specified in 2.02 K to all rods, bands, nuts, bolts, washers and other appurtenances.

2. Pipe, Valves, Fittings and Appurtenances Within Valve Chamber (Only)
 - a. After installation, apply two 5-mil thick, brush coats of paint as specified in 2.02 M. to all pipe, valves and fittings located within valve chambers as shown on the Contract Drawings.
 - b. Prepare surfaces and apply the coating in accordance with the manufacturer's printed instructions.
3. Fire Hydrants, Indicator Posts, Hydrant Fenders, and Pipe Guards
 - a. Prior to painting, clean all surfaces to be painted to the requirements of SSPC SP-3.
 - b. Paint fire hydrants, indicator posts, hydrant fenders and pipe guards with prime and finish coats of paints specified in 2.02 L.

I. Concrete Encasement and Foundations

Before backfilling, the Engineer shall verify that the concrete encasement and concrete hydrant foundations are installed where and as shown on the Contract Drawings. The Contractor shall not backfill until the Engineer has inspected and approved said work.

3.04 FIELD TESTS

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.

A. Hydrostatic Pressure and Leakage Tests

1. After completion of the pipeline installation, including backfill, but prior to final connection to the existing system, conduct in the presence of the Engineer concurrent hydrostatic pressure and leakage tests in accordance with AWWA C 600.
2. Provide all equipment required to perform the leakage and hydrostatic pressure tests.
3. The test pressure shall be not less than 200 psi or 50 psi in excess of maximum static pressure, whichever is greater.
4. The hydrostatic test shall be of at least a 2-hour duration.
5. No pipeline installation will be approved if the pressure varies by more than 5 psi during the duration of the hydrostatic pressure test.
6. Before applying the test pressure, completely expel air shall from the section of piping under test. Install corporation cocks so that the air can be expelled as the pipeline 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 tests, remove and plug the corporation cocks.
7. Slowly bring the piping to the test pressure and allow the system to stabilize prior to conducting the leakage test. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure.

8. Carefully examine all exposed pipe, fittings, valves, hydrants, and joints during the hydrostatic pressure test. Any damage or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with sound material at no cost to the Authority, and test shall be repeated to the satisfaction of the Engineer.
9. No pipeline installation will be approved if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{p}}{133,200}$$

Where:

L = the allowable leakage, 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 leakage test, in pounds per square inch (gauge)

10. If leakage exceeds the rate as determined in 3.04 A. 9, locate the source and make repairs as necessary, to the satisfaction of the Engineer.

B. Disinfection, Flushing and Sampling

1. Disinfect the pipeline installation in accordance with AWWA C 651, except that liquid chlorine shall not be used.
2. Upon completion of the retention period required for disinfection, flush the pipeline until the chlorine concentration of water leaving the pipeline is no higher than that generally prevailing in the existing system or is acceptable for domestic use.
3. 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 discharge will cause damage to the environment, apply a neutralizing chemical to the chlorinated water to neutralize thoroughly the chlorine residual remaining in the water.
4. After final flushing and before the pipeline is connected to the existing system or placed in service, employ an approved independent testing laboratory to sample, test and certify the water for conformance with the purity standards of the City of Newark, the United States Environmental Protection Agency and the Federal Clean Water Act Health Standards. Forward certification from the testing laboratory to the Engineer. No installation will be approved without such certification.

3.05 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. Perform all such remedial measures at no additional cost to the Authority.

END OF SECTION

SECTION 02664

EXTERIOR WATER SUPPLY SYSTEM FOR

CITY OF NEWARK, NJ 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. 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.
- B. Submit "Piping Layout" drawings, including details specified in "D".
- C. Submit catalog cuts for: pipe, fittings, pipe restraint system, fire hydrants, gate valves, wet tap sleeve and valve, valve boxes, including manhole cover, and paints including manufacturer's installation instructions.
- D. Submit shop drawings of valve chambers, hydrant fenders and pipe guards.
- E. Submit certificate from the ductile iron pipe manufacturer certifying that the ductile iron pipe, including joint restraint system to be used with the pipe, exterior coating, cement mortar lining, and rubber gaskets comply with the requirements specified in this Section.
- F. Submit certificate from the ductile iron fitting manufacturer certifying that ductile iron fittings comply with the requirements specified in this Section.
- G. Submit certificate from the copper tubing and fitting manufacturer certifying that the copper tubing and fittings comply with the requirements specified in this Section.
- H. Submit certificate from the indicator valve and post manufacturer certifying that the indicator valve and post comply with the requirements specified in this Section.
- I. Submit certificate from the valve box and manhole cover manufacturer certifying that the valve box and manhole cover comply with the requirements specified in this Section.
- J. Submit to the Manager, Materials Engineering Division, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07302-1397, 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 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.
 5. Notify the Engineer when material is delivered to the construction site. Field sampling and testing will be performed by Materials Engineering Personnel for quality assurance purpose. These field samples must be approved before any of the material is used.
- K. Submit certificate from the polyethylene film manufacturer that such polyethylene film complies with the requirements specified in this Section.
- L. 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 3.03 B.2.
 3. Hydrostatic pressure and leakage tests specified in 3.04 A.
 4. Disinfection, flushing and sampling as specified in 3.04 B.
- M. Submit for approval 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.
- N. Submit results of field tests specified in 3.04 A. and B.
- O. Submit drawing(s) showing the final constructed alignment and grade of the water main to such an extent that the exact location of the water main can be determined in the field utilizing such drawing(s). In addition, valves, fittings, including distance between fittings, connections and thrust restraint method employed shall be shown.

END OF APPENDIX "A"

DIVISION 2
SECTION 02720
MANHOLES AND DRAINAGE STRUCTURES

PART 1. GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for manhole 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 Association of State Highway and Transportation Officials
(AASHTO)

AASHTO M 198 Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

American Concrete Institute (ACI)

ACI 318 Building Code Requirements for Reinforced Concrete

American Society for Testing and Materials (ASTM)

ASTM A 48	Gray Iron Castings
ASTM A 536	Ductile Iron Castings
ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C 55	Concrete Building Brick
ASTM C 117	Test Method for Material Finer Than 0.075mm (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 497	Method of Testing Concrete Pipe, Manhole Sections, or Tile.
ASTM C 822	Definition of Terms Relating to Reinforced Concrete Pipe and Related Products

ASTM C 891	Installation of Underground Precast Concrete Utility Structures
ASTM C 913	Precast Concrete Water and Wastewater Structures

1.03 ENVIRONMENTAL REQUIREMENTS

- A. Cold weather requirements shall conform to the applicable requirements of the Section entitled "PORTLAND CEMENT CONCRETE" 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.
- B. Hot weather requirements shall conform to the applicable requirements of the Section entitled "CONCRETE".

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

- A. When approved by the Engineer, the Contractor may substitute cast-in-place manholes and drainage structures which conform in size and strength to the precast structures shown on the Contract Drawings and as specified in this Section. When approved by the Engineer, the Contractor may also substitute precast drainage structures which conform in size and strength to the cast-in-place 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. The Contractor may substitute castings of the same material and strength to those shown on the Contract Drawings and designed to support the applicable live load with a factor of safety of 4.0 for castings subject to aircraft loads and 3.0 for other castings.
- C. Design of lifting devices for precast structures shall conform to ASTM C 913.
- D. Design of joints for precast structures shall conform to ASTM C 913. Unless otherwise shown on the Contract Drawings, joints shall be designed for leakage not to exceed .025 gallons per hour per foot of joint at 3 feet of head.

1.05 QUALITY ASSURANCE

- A. Workers 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 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 and as specified in this Section.
- E. Conform to the applicable requirements for quality assurance of the Section entitled " PORTLAND CEMENT CONCRETE" 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.

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 the Contractor's expense.
- C. Each precast 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

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.

- 1. Manhole and Drainage Structure Frames, Covers and Grates
- 2. Campbell Foundry Co.

2.02 MATERIALS

- A. Concrete
 - 1. Concrete including concrete mixes shall conform to the applicable requirements of the Section entitled " PORTLAND CEMENT CONCRETE" except as otherwise specified herein.

B. Precast Concrete Manholes and Drainage Structures

1. Precast manholes and drainage structures shall be fabricated of air entrained concrete as shown on the Contract Drawings using ASTM C 150, Type II or Type III, Portland cement, having a minimum 28-day compressive strength of 4000 psi and a maximum water cement ratio of 0.45. Substitution of slag or fly ash for a portion of the cement shall not be required.
2. There shall be a continuity of reinforcement at all corners of the structure.
3. In uncontaminated soil, 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.4 below.
4. Where manhole and drainage structure installation in contaminated soil is shown on the Contract Drawings, joints between precast sections shall be sealed with a preformed flexible plastic gasket conforming to AASHTO M198, Type B, 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 the following, or approved equal:

"Ram-Nek", as manufactured by Diplomatic Marine, Inc.

"GS-79", as manufactured by the General Sealants Corp.

C. Steel Reinforcement

Steel reinforcement shall conform to the Section entitled "CONCRETE REINFORCEMENT".

D. Silt Buckets

All sanitary sewer manholes shall be provided with cast aluminum silt buckets as shown on the Contract Drawings.

E. Frames, Grates and Covers

1. Castings for manhole and drainage structure frames shall be of the type shown on the Contract Drawings and shall be fabricated of ASTM A 48, Class 30B cast iron.
2. Manhole covers and drainage 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 ASTM A 48, Class 30B cast iron. Where ductile iron is shown, manhole covers and drainage grates shall be fabricated of ASTM A 536, Grade 60—40—18 or Grade 65-45-12, ductile iron and castings 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.

- F. **Masonry for Manhole and Drainage Frame Collars**
 - 1. Concrete Brick - ASTM C 55, Grade N-i.
 - 2. Mortar — one part ASTM C 150, Type II Portland cement, three parts sand and sufficient potable water to produce a plastic homogeneous mortar.
- G. **Crushed Stone for Pipe Bedding**
 Crushed limestone, trap rock or recycled Portland cement concrete aggregate conforming to the following gradation determined in accordance with ASTM C 136 and C 117. Recycled concrete aggregate shall contain not less than 95 percent crushed Portland cement concrete and shall be in accordance with the requirements of the Section entitled "AGGREGATE BASE COURSE".

Total Passing	
<u>Sieve Size</u>	<u>Percent by Weight</u>
2 1/2 inch	100
1 inch	60 - 100
3/4 inch	45 - 85
3/8 inch	30 - 60
No. 10	14 - 0
No.	403 - 15
No.200	0 - 3

2.03 FABRICATION

Manufacture of precast concrete structures shall conform to ASTM C 913.

PART 3. EXECUTION

3.01 PREPARATION

- A. For cast-in-place structures, preparation shall conform to the Section entitled "PORTLAND CEMENT CONCRETE".
- B. Consult Contract Drawings for the proper orientation of the structure to ensure proper alignment with entering pipes, conduits or cables.
- C. Do not install structures under site conditions known to result in loads heavier than that for which the structure was designed.

- D. 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 manholes and drainage structures in accordance with the Section 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. Manholes or drainage structures 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. Manhole and Drainage Structure Support and Backfilling

1. Manholes and drainage structures shall be supported at proper grade and alignment on crushed stone bedding or other support system, as shown on the Contract Drawings.
2. Backfill excavations for manholes and drainage structures in accordance with the Section entitled "EXCAVATION, BACKFILLING AND FILLING".

C. Precast Concrete Manhole and Drainage Structure Installation

1. To ensure safety, precast structures shall only be lifted at the lifting points so designated by the manufacturer.
2. When lowering manholes and drainage structures into the excavations and joining pipe to the units, take precautions to ensure that the interior of the pipeline and structure remains clean.
3. Set precast structures so that they firmly and fully bear on crushed stone bedding, compacted in accordance with the provisions of the Section entitled "EXCAVATION, BACKFILLING AND FILLING" or on other support system shown on the Contract Drawings.
4. Assemble multi-section structures by lowering each section into the excavation. Lower, set level and firmly position the base section before placing additional sections.

5. Ensure joint integrity by removing all foreign materials from joint surfaces and verifying that sealing materials are placed properly. Avoid misalignment by using guide devices affixed to the lower section or as otherwise approved by the Engineer.
6. Joint sealing materials may be installed at the Site or at the manufacturer's plant.
7. Verify that manholes and drainage structures installed satisfy required alignment and grade.
8. Remove knockouts or cut structure to receive piping so as not to create openings in excess of that required to receive pipe. Fill annular space with mortar.
9. Cut pipe to finish flush with interior of structure.
10. Shape inverts through manhole as shown on the Contract Drawings.

D. Cast-In-Place Concrete Manhole and Drainage Structure Installation

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 the provisions of the Section entitled "CONCRETE FORMWORK" and ensure that they are braced against all movement.
3. Install reinforcing steel in accordance with the details shown on the Contract Drawings and the provisions of the Section entitled "CONCRETE REINFORCEMENT".
4. After formwork and concrete reinforcement installations have been inspected and approved by the Engineer, place and cure concrete in accordance with the provisions of the Section entitled "PORTLAND CEMENT CONCRETE".
5. Complete installation in accordance with the applicable requirements of 3.02 C above.

E. Installation of Castings

1. Set frames 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.
2. For manholes and other structures with covers located within unpaved areas, set frame and cover 2 inches above finished grade to allow the area to be graded away from the cover beginning 1 inch below the top surface of the frame.

3.03 ADJUSTMENTS

A. Vertical Adjustment of Existing Manhole and Drainage Structures

1. Where required, adjust the top elevation of existing manholes and drainage structures to suit finished grades shown on the Contract Drawings.
2. Existing frames, grates and covers shall be carefully removed, cleaned of all mortar fragments to the satisfaction of the Engineer and reset to the required elevation in accordance with the requirements specified in 3.02 E for installation of castings.
3. When removal of an existing concrete wall is required, the concrete shall be removed so as not to damage the existing vertical reinforcing bars. The vertical bars shall be cleaned of all concrete to the satisfaction of the Engineer and bent into the new concrete top slab or spliced to required vertical reinforcement, as shown on the Contract Drawings.
4. Clean and apply sand-cement bonding compound on all existing concrete surfaces to receive cast-in-place concrete. Sand-cement bonding compound and its application shall be in accordance with the requirements specified in the Section entitled " PORTLAND CEMENT CONCRETE".

3.04 FIELD TESTS

Field tests will be used by the Engineer to evaluate and approve cast-in-place concrete in accordance with the Section entitled " PORTLAND CEMENT CONCRETE".

3.05 PROTECTION

Protection and curing of concrete shall be in accordance with the Section entitled "CONCRETE"

END OF SECTION

SECTION 02720

MANHOLES AND DRAINAGE STRUCTURES

SUBMITTALS

APPENDIX "A"

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of DIVISION 1 -GENERAL PROVISIONS:
1. Shop drawings of precast concrete manholes and drainage structures and of concrete reinforcement for cast-in-place concrete manholes and drainage structures, if used;
 2. Catalog cuts of frames, grates and covers;
 3. Catalog cuts of gaskets for joints in precast concrete manholes and drainage structures, including manufacturer's installation instructions.
- B. 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.
 2. For substitute castings, submit calculations which verify that the substituted design will support the live loading including factor of safety or submit certified proof-of-design test results.
- C. 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 joint used.
- D. Submit certified test results for precast concrete compressive strength testing.
- E. 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 structures as specified in 3.02.
 3. Methods to prevent flotation of watertight structures as specified in 3.01.
- F. 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 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.

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/ exfiltration testing.
- B. Definition of terms relating to Reinforced Concrete Pipe shall be in accordance with ASTM C 822.

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 655	Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe

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 systems specified below unless otherwise shown on the Contract Drawings.

- A. 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. 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 Type CR" 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. Crushed Stone for Pipe Bedding
- Crushed limestone, trap rock or recycled Portland cement concrete aggregate conforming to the following gradation determined in accordance with ASTM C 136 and ASTM C 117. Recycled concrete aggregate shall contain not less than 95 percent crushed Portland cement concrete and shall be in accordance with the requirements of the Section entitled "AGGREGATE BASE COURSE".

<u>Sieve Size</u>	<u>Total Passing Percent by Weight</u>
2 1/2 inch	100
1 inch	60 - 100
3/4 inch	45 - 85
3/8 inch	30 - 60
No. 10	14 - 30
No. 40	3 - 15
No. 200	0 - 3

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. Continue backfilling of the trench from the pipe support limits reached in 3.02 B.1 and 2 above in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING".

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 02732

STABILIZED CRUSHED SCREENINGS

PART 1 – GENERAL

1.01 SUMMARY

The Work of this Section consists of furnishing and installing crushed screenings in areas designated on the Contract Drawings.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

The American Association of State Highway and Transportation Officials

- | | |
|---------------|---|
| AASHTO T11-91 | Materials Finer Than 75- μ m (No. 200) Sieve In Mineral Aggregates By Washing |
| AASHTO T27-93 | Sieve Analysis Of Fine And Coarse Aggregates |
| AASHTO T89-93 | Determining The Liquid Limits Of Soils |
| AASHTO T90-92 | Determining The Plastic Limit And Plasticity Index Of Soils |
| AASHTO T96-92 | Resistance To Abrasion Of Small-Size Coarse Aggregate By Abrasion And Impact In The Los Angeles Machine |

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Prior to delivery to the construction site the Contractor shall have a representative sample of crushed screenings conforming to the requirements of this Section delivered to the Engineer for approval. Do not deliver the material to the construction site until the color and a certificate supplied by the Supplier have been approved by the Engineer.
- B. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered crushed screenings from the construction site and replace it with material that does conform.

1.04 SUBMITTALS

See Appendix 'A' for submittals requirements.

1.05 QUALITY ASSURANCE

A. Specific Requirements for Operations and Products

1. Products listed in PART 2 – Products shall be subject to the Engineer's written approval prior to delivery to the construction site.
2. 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.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Crushed Screenings

1. Clean, hard, durable particles or fragments of 1/4" minus select brown/gray crushed granite, river rock or basalt. Fines shall be evenly mixed throughout the aggregate. When produced from gravel, 50 percent, by weight, of the material (??) retained on a No. 4 sieve shall have one fractured face.
2. The portion retained on the No. 4 sieve shall have a maximum percentage of wear of 50 at 500 revolutions as determined by AASHTO T96-92.
3. The portion passing a No. 40 sieve shall have a maximum liquid limit of 25 and a maximum plasticity index of 7, as determined by AASHTO T89-93 and AASHTO T90-92, respectively.
4. The crushed screenings shall be free from clay lumps, vegetable matter and deleterious material.

B. Grading Requirements

1. Percentage of Weight Passing a Square Mesh Sieve – AASHTO T-11-91 and T27-93.

<u>Sieve Designation</u>	<u>Percent Passing</u>	<u>Sieve Designation</u>	<u>Percent Passing</u>
--------------------------	------------------------	--------------------------	------------------------

3/8 - inch	100	No. 30	40 - 50
No. 4	95 - 100	No. 50	25 - 35
No. 8	75 - 80	No. 100	20 - 25
No. 16	55 - 65	No. 200	5 - 15

C. Soil Stabilizer

1. Stabilizer: a non-toxic, colorless, odorless, non-staining, concentrated organic powder that binds soil and crushed screenings together. Stabilizer shall be as manufactured and distributed by Stabilizer, Inc., 4832 East Indian School Road, Phoenix, AZ 85018 NO SUBSTITUTIONS D. Stabilized

crushed screenings shall be as follows:

Have stabilized crushed screenings delivered to the construction site premixed and ready for use as supplied and delivered by George Schofield Company, Inc., Bound Brook, New Jersey 08805, NO SUBSTITUTIONS. Color to be 'Trap Rock Grey'.

PART 3 - EXECUTION

3.01 Preparation

A. Soil Stabilizer

1. Thoroughly pre-blend Stabilizer with the 1/4" minus crushed screenings, at the rate of 16 pounds of Stabilizer per ton of crushed screenings prior to placing of Stabilized mix. Stabilizer shall be mixed thoroughly and uniformly through the crushed screenings. Blend with a truck-mounted mixer or a portable mechanical mixer. Blend for a minimum of 15 minutes prior to placement.

B. Crushed Aggregate Screenings

1. After pre-blending, install stabilized crushed screenings as shown on the Contract Drawings.

SECTION 02732

STABILIZED CRUSHED SCREENINGS

SUBMITTALS

APPENDIX 'A'

Submit the following in accordance with the requirements of "Inspections and Rejections" of Division 1 – GENERAL PROVISIONS.

A. Products

1. Submit the following in accordance with the requirements of "Inspections and Rejections" of Division 1 – GENERAL PROVISIONS:
 - a. A complete "Product List", listing all products to be used under this Section.
 - b. A copy of the US Department of Labor Material Safety Data Sheets (MSDS) for all hazardous chemicals utilized During the Work of this Section.

B. Test Reports

1. Submit test results of 1.03 A. and 1.03 B. to the Chief of Materials Engineering, Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07318-1397 together with a two pound sample of screenings and location of the source of the crushed aggregate screenings.

END OF APPENDIX "A"

DIVISION 2

SECTION 02812

AUTOMATIC LANDSCAPE IRRIGATION SYSTEM

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for an underground landscape irrigation system.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. The irrigation system shall have provision for air pressure blowout for winterizing of the entire system.

B. Controller Power: Electrically powered 117VAC,60 Hz with battery back-up.

C. Controller output to valves: 26.5 VAC, 2.5A.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's instructions for unloading, storing and moving irrigation system components.

B. Store irrigation system components on pallets or raised platforms with suitable coverings satisfactory to the Engineer to protect them against damage and weather.

C. Keep specialty items at the construction site under lock and key.

1.04 SPARE PARTS

Deliver to the Engineer at the completion of the installation the following spare parts for the operation and maintenance of the irrigation system installed under this Contract (number of spare parts shall be as per contract drawings):

12" Pop-up sprinkler heads
Line flushing valve

1.05 SUBMITTALS

See Appendix "A" for submittals requirements.

PART 2. PRODUCTS

2.01 PIPE AND FITTINGS

- A. The outlet side piping (down stream) of the solenoid valves shall be 100 lbs. polyethylene piping. Polyethylene pipe shall be manufactured by OIL CREEK PLASTICS, East Titusville Rd., P.O. Box 385, Titusville, PA 16354, ENDOT, POLY-STAR, or approved equal.
- B. Materials for the system from water meter pits to the control valves shall be pvc schedule 40 solvent weld pressure fittings as manufactured by Freedom Plastics or approved equal.

2.2 SPRINKLER HEADS AND ACCESSORIES

- A. Pop-up sprinkler heads shall be manufactured by Rain Bird, Hunter, Thompson fixed spray pattern, adjustable arc, or approved equal. The arc of sprinklers shall be adjusted at the set-up of the system. Sprinklers shall be pressure-regulating type.
- B. Warranty

Sprinkler heads shall be guaranteed for five (5) years to be free of defects in workmanship and materials. Warranty shall be for the Authority's benefit and shall grant the Authority a direct right of action against the manufacturer.
- C. All 1/2 inch sprinkler heads shall incorporate a standard Schedule 80 nipple, a "funny pipe" swing joint, or a Marlex triple swing joint. All 1-inch sprinkler heads shall incorporate a Schedule 80 pre-assembled swing joint assembly or approved equal.

2.03 VALVES, METERS AND PROTECTIVE ENCLOSURES

A. Control Valves:

The remote control valve shall be a normally closed 24-volt AC, 60-cycle solenoid actuated Model PESB Series as manufactured by RAINBIRD INC., 4261 SOUTH COUNTRY CLUB, TUCSON, AZ. 85714, or approved equal.

B. Master Valve:

Master solenoid valve shall be a normally closed 24 volt a-c, 60 cycle valve Model PESB Series with "B to A" solenoid adapter kit as manufactured by RAINBIRD INC., 4261 SOUTH COUNTRY CLUB, TUCSON, AZ. 85714, no substitutions.

C. Flow Meter (Sensor):

Flow Meter (Sensor) shall be Model "FS" Series plastic body as manufactured by RAINBIRD INC., 4261 SOUTH COUNTRY CLUB, TUCSON, AZ. 85714, no substitutions. Sensor shall be placed after the master valve and shall be a minimum of 10 pipe diameters from the outlet of the master valve. Sensor outlet shall be a minimum of 5 pipe diameters from any

fitting. Size of sensor shall be as required by main line and flow.

D. Pressure Reducing Valve:

Pressure reducing valves shall be the same size as the feed line and shall be Model #500-HLR as manufactured by Wilkins, 1747 Commerce Way, Paso Robles, CA 93446, Watts, Hersey, or approved equal.

E. Isolation Valve:

Furnish and install 1-inch and 2-inch brass isolation gate valve sized to solenoid valve (one per zone). Valve shall have Kitz #46 Class 150 IPS isolation valve as manufactured by KITZ CORP. F AMERICA, 6100 Vest by Northwest Blvd., Suite 100, Houston, TX, 77040, Wetts, Red & White, or approved equal.

F. Gate Valves:

Valves shall be flared, class 150, bronze, with rising stem as manufactured by Walworth, Jenkins, Nibco or approved equal.

G. Protective Enclosure:

Fiberglass construction with lockable cover sized to enclose valves, and splices.

2.04 CONTROLLER

A. Manufacturer:

Rainbird Model ESP-SITE-SAT series, no substitutions. The controller shall be able to tie into a central control/monitoring system. A maximum of 3 zones shall be wired to a single terminal within the controller.

B. Controller Housing:

The controller shall be vandal-resistant, and corrosion-proof. It shall be capable of continuous operation in ambient air temperatures ranging from 14 degrees Fahrenheit to 140 degrees Fahrenheit.

C. Pedestal:

Install controllers on Rain Bird Model PEDDD16 columns, no substitutions, according to controller manufacturer's specifications so as to allow VHF radio-control upgradability. Pedestal shall be brushed stainless steel.

D. Control Wires:

24 volt control wiring shall be as shown in the Contract Drawings. All wiring shall be installed in PVC Schedule 40 (heavy wall) conduit.

F. Cluster Control Unit:

Connect the satellite to the cluster control unit with the link radio kits specified.

PART 3. EXECUTION

3.01 PREPARATION

- A. Verify exact location of existing utilities and sleeves.
- B. Route piping to avoid plants, ground cover, utilities and structures.
- C. Layout and stake locations of system components.
- D. Review and coordinate layout requirements with other affected Work. Coordinate locations of sleeves under paving to accommodate system.

3.02 TRENCHING

- A. Trench in accordance with specification section entitled "Excavation, Backfilling and Filling".
- B. Trench size:
 - 1. Minimum Width: 12 inches
 - 2. 48" minimum cover over main lines from source to control valves.
 - 3. 18" minimum cover over control conduits from controller to valves.
- C. Trench to accommodate grade changes.

- D. Maintain trenches free of debris, material, or obstructions that may damage pipe.

3.03 INSTALLATION

- A. Furnish and install pipe, valve, controls, in accordance with approved shop drawings and manufacturer's instructions.
- B. Furnish and install control valves where shown and group together where practical. Place no closer than six inches to walk edges buildings and walls.
- C. Pipe may be assembled on the surface. Snake pipe from side to side of trench bottom to allow for expansion and contraction.
- D. Make all connections between polyethylene tubing and pvc pipe with threaded fittings using plastic male adapters.
- E. Cap or plug all openings as lines are installed to prevent the entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
- F. Thoroughly flush out all water lines before installing valves and other hydrants.

3.04 FIELD TEST

- A. Request the presence of the Engineer in writing at least 48 hours in advance of testing.
- B. Perform all testing in the presence of the Engineer.
- C. Center load piping with a small amount of backfill to prevent arching or slipping under pressure.
- D. Apply a continuous and static water pressure of 100 p.s.i. with no loss for a 2-hour period when testing the polyethylene piping.
- E. Repair leaks resulting from test.

3.05 AUTOMATIC CONTROLLERS

- A. Connect remote control valves to controller in a logical sequence.

- B. Install control wire in conduit, mains and laterals in common trenches wherever possible.
 - C. Control wire splice will be allowed only in run of more than 500 feet. Install all splices in watertight junction boxes installed flush with finished grade.
- 3.06 BACKFILL AND COMPACTING
- A. After system is operating and required tests and inspections have been made, backfill excavations and trenches with soil free of rubbish.
 - B. Backfill for all trenches, regardless of the type of pipe covered, shall be compacted to a minimum of 90% density.
 - C. Compact trenches in areas to be planted by thoroughly flooding the backfill.
 - D. Dress off the area to finished grades.
- 3.07 CLEAN UP
- Remove all debris resulting from Work of this Section. Leave construction site clean to the satisfaction of the Engineer. Coordinate efforts with planting Work.
- 3.08 START-UP AND ADJUSTMENTS
- A. Prepare and start systems.
 - B. Adjust control system to achieve time cycles required.
- 3.09 DEMONSTRATION
- A. Perform a system demonstration.
 - B. Prior to issuance of Certificate of Final Completion, instruct Authority personnel in the operation and maintenance of the irrigation system. This shall include inspection of the irrigation system, controller operation, system start up, shut down and clean out. Provide this instruction on no less than two occasions between April and November. Submit to the Engineer as-built drawings of the system and maintenance manuals.

END OF SECTION

SECTION 02812

AUTOMATIC LANDSCAPE IRRIGATION SYSTEM

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: Indicate piping layout to water source, locations of sleeves under pavement, location of emitters, control valves and zones, controller locations, water meters, backflow preventers, wiring and installation diagrams and details of the installations of the work.
 - 2. Product Data: Provide component and control system data and wiring diagrams for each item to be furnished.
- B. Submit instructions for operation and maintenance of the system and controls, seasonal activation and shutdown, and manufacturer's parts catalog.
- C. Submit schedule-indicating length of time each valve is required to be open to provide a determined amount of water.
- D. Submit a record of actual locations of all concealed components of piping system and control valves.
- E. Submit the name of the entity installing the automatic irrigation system and proof from Rain Bird that the entity held a valid 'Maxicom Certified Level 1' certification. Submit schedule indicating length of time each valve is required to be open to provide a determined amount of water.

END OF APPENDIX "A"

DIVISION 2

SECTION 02832

METALLIC-COATED STEEL CHAIN LINK FENCE AND GATES

PART 1. GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for aluminum-coated and zinc-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:

	<u>American Concrete Institute (ACI)</u>
ACI 318	Building Code Requirements for Structural Concrete.
	<u>American Society for Testing and Materials (ASTM)</u>
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 392	Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
ASTM A 491	Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
ASTM A 817	Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire.
ASTM A 824	Specification for Metallic-Coated Steel Marcellled 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 900	Specification for Industrial and Commercial Swing Gates.
ASTM F 1043	Specification for Strength and Protective Coatings on Metal 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.
- ASTM F 1345 Specification for Zinc - 5% Aluminum Mischmetal Alloy-Coated Steel Chain-Link Fence Fabric.

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:

"Easy Track" by
Boundary Fence and Railing Systems, Inc.
Richmond Hill, NY 11418

"Internal Roller" by
Anchor Fence/Master Halco Inc.
Baltimore, MD 21224

"Fortress Gate" by
Tymetal Corporation
Clifton Park, NY 12065

2.02 MATERIALS

- A. General
 - 1. Chain link fence components shall be zinc-coated steel except as otherwise permitted herein for fabric, barbed wire and gate framing.
 - 2. Take field measurements prior to preparation of Shop Drawings and fabrication.

3. Unless otherwise specified herein or shown on the Contract Drawings, materials, coatings and shapes shall be of uniform type and manufacture.
- B. Fence Fabric
1. Unless otherwise shown on the Contract Drawings, comply with ASTM A 817 for 0.192-inch diameter, 2-inch mesh, wire fabric.
 2. Type II, Class 2 Zinc-Coated (Galvanized) fabric shall comply with ASTM A 392.
 3. Type I Aluminum-Coated (Aluminized) fabric shall comply with ASTM A 491.
 4. Type III Zinc - 5% Aluminum - Mischmetal coated fabric shall comply with ASTM F 1345.
 5. Fence fabric height shall be as shown on the Contract Drawings. For fabric height of 6 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 6 feet, both top and bottom selvages shall be knuckled.
 6. Apply clear acrylic sealer to selvage area after weaving.
- C. Barbed Wire
1. Each line of barbed wire shall consist of two strands of No. 12 1/2 gage (0.099-inch diameter) wires twisted with 4-point No. 14 gage barbs spaced approximately 5 inches apart. The barbed wire shall conform to ASTM A 121, Class 3 (0.8 oz/sf) zinc-coated or ASTM A 121, Type II aluminum-coated steel barbed wire with aluminum alloy barbs.
 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. Steel posts and rails shall conform to ASTM F 1043 for Heavy Industrial Fence.
 2. External and internal protective coatings shall conform to ASTM F 1043 for the fence framework material group furnished. 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 percent red rust.
 - b. Interior: 650 hours with maximum 5 percent red rust.
 3. Zinc-coated (galvanized) round steel pipe shall conform to the applicable portions of ASTM F 1083, Standard Weight Pipe (Schedule 40) with a minimum yield strength of 25,000 psi.

4. Unless otherwise shown on the Contract Drawings, 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 as determined by ASTM F 1043.
 5. 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 3 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 metallic-coated steel chain link fence except that aluminum alloy framing conforming to ASTM B 429 may be used.
 - c. Gates shall be designed 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. Swing 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. The gate leaf frames and tracks shall be fabricated of aluminum conforming to ASTM B 429 alloy 6063-T6 or as required to meet the performance requirements of ASTM F 1184 and specified herein.

- b. Frame members shall be minimum 2-inch square, 0.91 lb/ft aluminum tubing assembled by welding at all corners to form a rigid, one-piece unit. Fabric shall be securely stretched and held in the center of the tubing. All cantilever overhang frames shall have 3/8-inch brace rods. For gate leaf sizes 23 feet to 30 feet, an additional lateral support rail shall be welded adjacent to the top and bottom horizontal rails.
- c. The single leaf opening size shall determine the minimum overhang as follows:

<u>Opening</u>	<u>Overhang</u>
Up to 10'-0"	6'-6"
10'-1" to 14'-0"	7'-6"
14'-1" to 22'-0"	10'-0"
22'-1" to 30'-0"	12'-0"

- d. The track shall be a combined integral track and rail. The rail shall be an aluminum extrusion having a minimum total weight of 3.72 pounds per foot and designed to withstand a reaction load of 2000 pounds. The roller track assembly shall be designed for the same reaction load as the rail and shall consist of two swivel type zinc die cast trucks having four sealed-lubricant ball bearing wheels of a minimum 2-inch diameter by 9/16-inch width. Provide two side-rolling wheels to ensure alignment of truck in track for each gate leaf. Fasten trucks to post brackets by minimum 7/8-inch diameter, 1/2-inch shank ball bolts.
- e. Provide galvanized steel guide wheel assemblies for each supporting post. Each assembly shall consist of two rubber wheels of minimum 4-inch diameter with oil-impregnated bearings. The assembly shall be attached to the post so that the bottom horizontal member will roll between the wheels and can be adjusted to maintain plumb gate frames and proper alignment.

F. Tension Wire: 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 conform to ASTM F 626.
3. Ferrous accessories and fittings shall be zinc-coated at a minimum of 1.2 oz./sf. in accordance with ASTM A 153, unless otherwise specified herein.
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 2-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. Cut post footings flush with the ground surface and grout resulting voids, unless otherwise shown on the Contract Drawings.
- B. Fencing materials and debris resulting from removal operations shall be disposed of away from Authority property, unless otherwise shown on the Contract Drawings.

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 2 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 1 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 the posts be disturbed within 7 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 attach each span independently 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 2 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 turnbuckles 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 B.
- 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 NESC-093E, Specification Section 16450 and NFPA 780.
- 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. Bond each barbed wire strand to a grounded fence post or grounding conductor.
- H. Ground the fence wire mesh fabric, unless it is held in place by a conductive tie-wraps or similar device.
- I. Construct electrical grounds at other locations along the fence as shown on the Contract Drawings.

END OF SECTION

SECTION 02832

METALLIC-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, 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

ORNAMENTAL STEEL FENCE AND GATES

PART 1. GENERAL

1.01 SUMMARY

- A. This Section specifies materials and construction requirements for the furnishing and installing of Ornamental Steel Fence and gates.
- B. Definitions
 - 1. Herein, the term fence, shall mean ornamental steel fence.
- C. See Division 3 Section on concrete for post footings.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

<u>American Concrete Institute (ACI)</u>	
ACI 318	Building Code Requirements for Reinforced Concrete
<u>American Society for Testing and Materials (ASTM)</u>	
ASTM A 513	Electric - Resistance - Welded Carbon and Alloy Steel Mechanical Tubing
ASTM A 653 / 653M	Steel Sheet Zinc Coated or Zinc-Iron Alloy coated (Galvanized by the Hot Dip Process)
ASTM B 429	Aluminum - Alloy Extended Structural Pipe and Tube
ASTM F 567	Installation of Chain Link Fence
ASTM F 626	Fence Fittings
ASTM D 1730	Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting
<u>Surface Preparation</u>	
SSPC-SP 7	Brush-Off Blast Cleaning

1.03 QUALITY ASSURANCE

- A. Manufacturer: Fence and gates shall be manufactured and marketed by a firm with a minimum of 5 years experience in the production and sales of ornamental steel fence and gates. For manufacturers proposed for use but not named in these specifications, 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. Fence shall be produced by the same manufacturer or, if not the same manufacturer, one that is acceptable to the gate manufacturer.

- B. Verify that the entity performing installation Work of this Section is a firm that is approved by the fence and gate manufacturer and has worked on at least 3 projects involving complexities equal to those required for the Work of this Section.
- C. Field Constructed Mock-up: Prior to the installation of fence, install a field mock-up comprised of three (3) continuous 8'-0" fence panels at full 4'-0" height. Posts and frames shall be submitted to the Engineer for approval prior to complete fabrication and installation of the field mock-up. Construct the fence mock-up within the construction site at a location approved by the Engineer.
- D. Upon request arrange for the Engineer to inspect fencing materials at the place of manufacture.
- E. Have fence panels delivered to the construction site in preassembled sections.
- F. Single-Source Responsibility: Obtain fence and gates, including accessories, fittings and fastenings, from a single source.
- G. Field Measurements: Verify layout information for fence and gates shown on the Contract Drawings by field measurements.

1.04 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.

1.05 SUBMITTALS

For submittal requirements see Appendix "A" to this Section.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Ornamental steel fence and gates shall be as manufactured by one of the following manufacturers, or approved equal:

Ameristar Fence Products, Inc. Tulsa, OK

The Anchor Group Monumental Iron Works Baltimore, MD

Boundary Fence, Jamaica, NY

Master Halco, Inc., Edgewood, MD

2.02 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 shall be the products of a single manufacturer.

B. Fence

1. The tubing for fence pickets, rails and posts shall be manufactured from coil steel per ASTM A 513. The steel shall be furnished pregalvanized with a minimum zinc coating weight of .90 oz. per sq. ft as per ASTM A 653.
2. Fasteners: Stainless steel tamperproof screws. Touch-up paint in field only as required.
3. Fence height and other details shall be as shown on the Contract Drawings.

C. Coating

1. All steel and ferrous fence members shall have a galvanized undercoat inside and outside to assure maximum corrosion resistance.
2. All fence and gate components (including tamperproof screws) shall be cleaned per SSPC-SP1 solvent cleaning followed by an SSPC-SP 7 brush-off blast cleaning surface preparation to uniformly roughen exposed surfaces to receive paint without removing the galvanizing, followed by a Tiger Drylac 09/73841 Out Gas Forgiving (OGF) primer and a Series 38 top coat.
3. Color of coating shall be People Mover Gray, to match existing ornamental steel picket fences at the airport.
4. Coatings shall be factory applied by electrostatic spray and baked at approximately 500 degrees Fahrenheit for 20 minutes. Dry film thickness of final coat shall be 2.50 mil. minimum. Furnish and install above referenced products of Tiger Drylac, Reading, PA or approved equal.

D. Gates

1. Gates shall be the type shown on the Contract Drawings. The gate opening widths and directions of operation shall be as shown on the Contract Drawings.
2. Gates shall be factory assembled and shall conform to the requirements specified for Steel Ornamental Fence.
3. Gates shall be designed for operation by one person.
4. For cantilever sliding gates, the materials, manufacture, dimensions and weights of frame members and posts shall, at a minimum, meet the requirements of ASTM F 900 for swing gates of similar sizes.
5. Cantilever Sliding Gates
 - a. Cantilever sliding gates, truck assemblies, enclosed gate tracks, roller assemblies, brackets and associated hardware shall be as designed and manufactured by Master Halco, Inc., Edgewood, MD, 21040, (800) 299-5615 or approved equal. The design shall be in accordance with the New Jersey Uniform Construction Code.
 - b. Use same pickets as those used for fence for gate in-fill.

- c. The gate leaf frames and tracks shall be fabricated of aluminum conforming to ASTM B 429 alloy 6063-T6.
- d. Frame members shall be minimum 2-inch square, 0.94 lb/ft aluminum tubing assembled by welding at all corners to form a rigid, one piece unit. All cantilever overhang frames shall have 3/8-inch brace rods. For gate leaf sizes 23'-0" to 30'-0", an additional lateral support rail shall be welded adjacent to the top and bottom horizontal rails.
- e. All steel gate components (including gate posts and brackets for roller/truck assemblies) shall be galvanized (inside and out) prior to surface preparations and receiving powdercoating as per 2.02 C. Coating.
- f. All aluminum gate components shall be pretreated according to ASTM D 1730 Type B, Method 5 or 7/DIN 50 939 using a multi-stage chromate pretreatment process approved by Tiger Drylac, Reading, PA., followed by a series 69-70000 protective primer and series 38 top coat. Color: 'People Mover Gray,' to match sample in Engineer's office. Coatings shall be factory applied by electrostatic spray and baked at 500 degrees fahrenheit for 20 minutes. Dry film thickness of final coat shall be 2.50 mil. minimum. Furnish and install above referenced products of Tiger Drylac, Reading, PA., (610) 926-8148, or approved equal.
- g. The single leaf opening size shall determine the minimum overhang as follows:

<u>Opening</u>	<u>Overhang</u>
Up to 10'-0"	6'-6"
10'-1" to 14'-0"	7'-6"
14'-1" to 22'-0"	10'-0"
22'-1" to 30'-0"	12'-0"

- h. The enclosed track shall be a combined one-piece track and rail system that shall be an aluminum extrusion having a minimum total weight of 3.72 pounds per foot and designed to withstand a reaction load of 2,000 pounds. The roller truck assembly shall be designed for the same reaction load as the rail and shall consist of two swivel type zinc die cast trucks having four sealed lubricant, ball-bearing wheels of a minimum 2-inch diameter by 9/16-inch width with two side-rolling wheels to ensure alignment of truck in track for each gate leaf. Trucks shall be fastened to post brackets by minimum 7/8-inch diameter, 1/2-inch shank ball bolts.
- i. Furnish and install galvanized steel guide wheel assemblies for each supporting post. Each assembly shall consist of two rubber wheels of minimum 4-inch diameter with oil-impregnated bearings. The assembly shall be attached to the post so that the bottom horizontal member will roll between the wheels and can be adjusted to maintain plumb gate frames and proper alignment.
- j. Submit the following for approval by the Engineer:
 - 1). Shop drawings, including layout of cantilevered gates with dimensions, details and finishes of component accessories, gate keepers, gate post foundations and design calculations for gate members, signed and sealed by a professional Engineer licensed in the state of New Jersey.
 - 2). Product data: Manufacturer's catalog cuts indicating material compliance.

- 3). Sample of powder coated finish as specified above. Furnished samples shall be 12 inches long and shall include a gate picket and gate rail. Submit samples of all accessories.

E. Accessories and Fittings

1. Furnish and install all necessary fittings for installation of fence as a complete unit including, but not limited to, post and line caps and truss rods.
2. Fence fittings shall conform to ASTM F 626.
3. Furnish and install manufacturer's recommended gate latch stops and keeper with padlock eye suitable for operation from either side of gate (unless otherwise shown on the Contract Drawings).
4. Furnish two-inch, cylinder type padlock for each gate and provide 3 keys for each padlock.
5. Test complete gate framing components for alignment and fit at the factory prior shipping.
6. Furnish and install 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 (unless otherwise shown on the Contract Drawings).
7. Furnish and install keepers to hold the gate leaf in the fully open position until manually released.

F. Concrete

Concrete for post footings shall be Class B concrete attaining a minimum compressive strength of 4000 psi in 28 days and conforming to (1) the requirements of ACI 318 for mixing and placing and to (2) additional requirements specified in Division 3 Section on concrete.

PART 3. EXECUTION

3.01 PREPARATION

- A. Verify locations of existing ornamental steel fence to be removed and salvaged for reuse within this Contract and as follows:**
1. Verify and flag limits of existing ornamental 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 secure location.
 3. Clean salvaged existing ornamental steel fence of any debris, and individually wrap components with a protective covering of air cellular cushioning material.
 4. Store salvaged existing ornamental steel fence until required for use in this Contract at no additional cost to the Authority.

3.02 SITE INSPECTION

- A. Verify that areas to receive fencing are completed to final grades and elevations.**

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. The clear opening from end posts to buildings, fences and other structures shall not exceed four inches unless otherwise approved in advance by the Engineer.
- D. Post Installation
 - 1. Where posts are shown on the Contract Drawings to be installed in soil, excavate holes for posts to the diameter and spacing shown on the Contract Drawings without disturbing the underlying materials. Center and align posts. Place concrete around posts and vibrate or tamp for consolidation. Recheck 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. Seal the joints between the concrete footings and surrounding pavements and sidewalks in accordance with the Section entitled "Pavement Joint Sealing".
 - 2. Where posts are shown on the Contract Drawings to be core-drilled into concrete substrate, core-drill holes in concrete and, after placing posts and shoring, fill annular spaces with a fine aggregate.
 - 3. Where posts are shown on the Contract Drawings to be installed within pre-cast concrete block salt splash pavement, locate the top elevation of the post footing just below the unit paver block as shown on the Contract Drawings.
- E. Welds
 - 1. All fence construction shall be welded as per the Details shown on the Contract Drawings.
 - 2. Use E70 Low Hydrogen Electrodes for welds unless otherwise approved by the Engineer in writing.
 - 3. All welds shall be full penetration and shall be ground smooth.
- F. Weld fence panel to posts as shown on the Contract Drawings.
- G. Weld pickets to rails as shown on the Contract Drawings.
- H. Install gates plumb, level and secure for full opening without interference.

3.04 PROTECTION

- 1. Protect Work of this Section from damage during shipping, handling and erection.
- 2. Replace damaged fence or gates.
- 3. Subject to the sole discretion of the Engineer, minor damage to the polyester resin based coatings may be repaired using the manufacturer's recommended materials and methods. Where the galvanized undercoating has been visibly damaged, replace the member.

3.05 WARRANTY

- A. Provide manufacturer's standard limited warranty covering cantilever slide gates and truck assembly against failure resulting from normal use for a period of five (5) years from date of installation. Failure is defined as any defect in manufacturing that prevents the gate from operating in a normal manner. Warranty shall run to Authority's benefit and shall grant the Authority direct right of action against manufacturer.

END OF SECTION

SECTION 02837

ORNAMENTAL 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 of New Jersey.
 3. Submit design calculations for fence components, fence footings, cantilevered gates, all gate components and gate post foundations, signed and sealed by a professional Engineer, licensed in the state of New Jersey.
 4. Submit samples of powder coated paint finish submitted as three, 12-inch long samples of all fence components, gate picket and gate post with specified powder coated finish.
- B. Submit to the Engineer
1. Qualification data for manufacturer, if other than one of those specified, 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.

END OF APPENDIX "A"

DIVISION 2
SECTION 02840
BOX BEAM GUIDE RAIL

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for box beam guide rail.

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-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

1.03 QUALITY ASSURANCE

- A. Box beam guide rails and appurtenances may, at the option of the Engineer, be inspected at the place of manufacture.
- B. Furnish certificate for each type of material specified in 2.01 of this Section, certifying that such material complies with the applicable specified requirements.
- C. Box Beam guide rails and appurtenances will be visually inspected by the Engineer when delivered to the construction site. Any such material that does not meet the requirements of this Section, or is damaged, shall be removed from the construction site and replaced.
- 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

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

- A. **Box Beam Guide Rails and Terminal Sections**
 - 1. Form from electric furnace steel no thinner than No. 10, U.S. Standard gauge.
 - 2. Sections shall be as shown on the Contract Drawings.
- B. **Posts and Spacers**

ASTM A 36 of type and size shown on the Contract Drawings.
- C. **Bolts and Nuts**

Conform to the Contract Drawings.
- D. **Galvanizing**

Galvanize all rail and terminal sections and all posts and spacers in accordance with ASTM A 153.

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 shall be determined. If the underground utilities conflict with the posts, post spacing may be adjusted by six inches and/or 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 the manufacturer.
- H. Paint portions of posts to be imbedded in concrete with two heavy coats of an approved bitumastic paint.

- I. Touch up all damaged areas in the zinc coating with an approved type zinc rich paint.

3.02 STAGING FOR INSTALLATION ADJACENT TO EXISTING ROADWAYS

Install box 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 the traffic.
- C. At the end of a work period, all posts that have been installed shall have the rail elements attached.
- D. New box beam 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 02840
BOX BEAM GUIDE RAIL
APPENDIX "A"
SUBMITTALS

Submit detailed shop drawings of all components of the box beam 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 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 BARRIER

SUBMITTALS

APPENDIX "A"

Submit the following for approval by the Engineer in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

- A. Certification from the concrete barrier supplier stating that the concrete barrier(s) meet the requirements of the Contract Drawings.
- B. Shop Drawings detailing departures from the Standard Drawings included in the Contract Documents.
- C. Proposed equipment Catalog Cuts and procedures to be used for installing, maintaining, relocating and removing the barrier(s).
- D. Proposed end treatment details and Catalog Cuts including but not limited to impact attenuator type.

END OF APPENDIX A

DIVISION 2

SECTION 02846

TEMPORARY WATER-FILLED BARRIER

PART 1. GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for temporary water-filled 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

1.03 SUBMITTALS

Refer to Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 CONSTRUCTION FEATURES AND MATERIALS

- A. General
- B. 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.

After delivery, a construction site inspection of the barrier and equipment will be made by the Engineer. If any barrier or equipment has been damaged or if, for any reason, the barrier or equipment does not comply with the requirements herein, the Contractor shall repair or replace the barrier and equipment at its own cost and expense, even though the equipment had been inspected for shipment. After such satisfactory replacement and/or repair and subsequent Engineer written approval, the barrier shall be installed.

C. **Water-Filled Barriers**

Shall be manufactured by Energy Absorption System Inc., or approved equal, and be installed in alternating white and orange sections.

D. **Barrier Reflectors**

Barrier reflectors shall be installed as specified by the manufacturer, or as shown on the Contract Drawings. Reflectors shall be high intensity reflectorized, with the color, white or yellow, matching the pavement edgeline, or as shown on the Contract Drawings.

E. **Barrier Lights**

Install low intensity steady burn type C barrier lights as specified by the manufacturer or 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, in alternating white and orange sections.
- B. Approach ends of barriers shall be flared away from traffic at a rate of 10 to 1 or flatter or as shown on the Contract Drawings. End treatment shall be provided by leaving the water out of the first section, and the pin out of the exposed end, or as specified by the manufacturer.
- C. Secure barriers against lateral displacement by use of drift pins or anchor bolts drilled into roadway surface or as shown on the Contract Drawings.
- D. Install reflectors and lights as specified herein, or 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 02846

TEMPORARY WATER-FILLED BARRIER

APPENDIX "A"

SUBMITTALS

Submit the following for approval by the Engineer in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 – GENERAL PROVISIONS:

- A. Certification from the water-filled barrier supplier stating that the water-filled barriers meet the requirements of the Contract Drawings.
- B. Shop Drawings detailing departures from the Standard Drawings included in the Contract Documents.
- C. Proposed equipment Catalog Cuts and procedures to be used for installing, maintaining, relocating and removing the barrier(s).

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 Tempered-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

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 – GENERAL PROVISIONS:
1. 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.
 2. 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.
 3. Catalog cuts of all the materials to be used for sign faces.
- B. 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

This Section specifies requirements for the following:

- A. Aluminum sign panels for use in the construction of directional, guide, warning and regulatory roadway signs.

1.02 REFERENCES

The following is a listing of the 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

American Society for Testing and Materials (ASTM)

- ASTM A 153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- ASTM A 193 Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
- ASTM A 194 Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
- ASTM A 325 High-Strength Bolts for Structural Steel Joints
- ASTM A 325 High-Strength Bolts for Structural Steel Joints
- 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

American Welding Society (AWS)

- AWS D 1.2 Structural Welding Code - Aluminum

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
- 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.

1.04 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.

1.05 SUBMITTALS

Refer to Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Aluminum Sign Panels

1. Aluminum sheets and plates shall conform to ASTM B 209, alloy 6061-T6.
2. Fabricate panels from standard sheet widths. The thickness for panel sizes of 30 inches by 30 inches or smaller shall be 0.080 inch and the thickness of larger panels shall be 0.125 inch unless otherwise shown on the Contract Drawings.
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

Scotchlite Brand High Intensity Grade Series 2800 (heat activated adhesive) or Series 3800 (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, and shall meet or exceed the reflecting requirements associated with High Intensity Grade, sheetings.

2. Non-Reflectorized Sheeting

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, or approved equal
- b. Scotchcal Brand Process Colors Series 3900 and 4100 for use on Non-Reflectorized 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 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 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.
 4. Stainless steel nuts shall conform to ASTM A 194, Grade 8F, except that the nuts shall be lock nuts with semifinished hex nuts equivalent to American Standard Heavy Series. Stainless steel bolts, washers, and screws shall conform to ASTM A 193, 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 AASHTO Manual for Signing and Pavement Marking of the National System for Interstate and Defense Highways.
 2. The FHWA Manual on Uniform Traffic Control Devices for Streets and Highways (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.
- 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 or 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 and burrs.

- B. The blanks shall be cleaned, degreased, and chromated or otherwise properly prepared in accordance with the sheeting manufacturer's recommendations. After treatment, 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 consumable 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, cover, and remove signs as shown on the Contract Drawings.
- B. Side-of-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 2.01 D, and 1.03 of this Section.
- D. Horizontal and vertical sign clearances shall be as shown on the Contract Drawings.

3.02 FIELD INSPECTION

- A. Immediately prior to erection, all material will be inspected by the Engineer for damage that is attributable 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. The completely erected signs may also be inspected at night by the Engineer.
- C. As the Work progresses, 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. Any deviation from the above-indicated procedure shall be approved by the Engineer.

END OF SECTION

SECTION 02851

ALUMINUM SIGN PANELS

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. Detailed sign face layout for all 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.
 2. Shop drawings of sign panels showing the sizes of the members and their connection details including joining and anchorage, stiffening, and bracing.
 3. Catalog cuts of all the materials to be used for sign faces.
- B. 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 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 operations.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Base standards for weather conditions on reports on the weather radio band of the National Oceanic and Atmospheric Administration, Washington Science Center, Rockville, MD 20852, and on its publication entitled "Local Climatological Data With Comparative Data", published 12 times a year as a monthly and once a year as an annual.

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 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 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 it performs all tests as specified in 2.01 and as outlined in Appendix B of this Section.
- B. Test Requirements
 - 1. Prior to seeding, submit a representative sample of on-site fill material for analysis to a certified independent laboratory to ensure conformance to requirements specified in 2.01. Submit 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. Submit a minimum of two test samples representative of the range of existing soil found at the site scheduled to receive plantings in this Contract.
4. Allow a minimum of two weeks for processing at the testing laboratory.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not commence seeding 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 has approved a report from the Contractor verifying that the Contractor has reviewed the soil analysis and will comply with its recommendations.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

- A. Soil Testing conforming to the following:
 1. 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 all other undesirable materials.
 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. Submit 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 which 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. Submit 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 that finish grade elevations (excepting the addition of soil amendments) have been established.

1. Obtain grab samples from a minimum of five locations (and no more than ten locations) representative of the range of existing soil found within the entire nine-and-a-half acres of existing soil area to receive compost and seed.
2. Each grab sample shall weigh two pounds.
3. Remove stones over two inches in any dimension, roots, rubbish and other extraneous materials from the sample.
4. Contractor is responsible for following the recommendations provided by the soil testing laboratory.
5. Do not start 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 and undisturbed by excavation, grading and 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 Engineer in accordance with 1.04 and 2.01.

C. Test Reports

Submit laboratory analyses of soil and the results of the "Landscape Level 3 Topsoil Evaluation" to the Chief of Materials Engineer, 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 Engineer 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 - Soil Testing

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) Retain Pan	Min. %		

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 subgrade preparation and for the supplying and spreading of screened loam soil.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Base standards for weather conditions on reports on the weather radio band of the National Oceanic and Atmospheric Administration, Washington Science Center, Rockville, MD 20852, and on its publication entitled "Local Climatological Data With Comparative Data", published 12 times a year as a monthly and once a year as an annual.

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 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 it performs all tests 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 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, 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 demonstrating that it meets this specification, 3) A "Landscape Level 3 Topsoil Evaluation", 4) A two pound sample and 5) One sample for up to each one (1) Acre of construction area to receive screened loam soil. In the event that the sample does not conform to the specified requirements, submit additional samples until the results do conform to the specifications, all at no 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 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 and all other undesirable materials.
 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 Bouyoucos Hydrometer method, shall consist of the following, based on dry (air-dried only) weight of sample:

- a. Sand 40% - 60%, inclusive;
- b. Silt 30% - 50%, inclusive;
- c. Clay 10% - 30%, inclusive.

2.02 ENVIRONMENTAL PARAMETERS

- A. 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. Environmental parameter tests must be performed by a laboratory certified in New Jersey by NJDEP.

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. Loosen 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. Till 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".

C. 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 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

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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 "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 B and Appendix B.

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.#:

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:			

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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, that 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. Fertilizers shall conform to current standards as established by the Association of American Plant Food Control Officials, Inc., Division of Regulatory Services, University of Kentucky, Lexington, KY 40546.
- C. Base standards for weather conditions on reports on the weather radio band of the National Oceanic and Atmospheric Administration, Washington Science Center, Rockville, MD 20852, and on its publication entitled "Local Climatological Data With Comparative Data", published 12 times a year as a monthly and once a year as an annual.
- D. Seed and installation practices shall comply with Federal Aviation Administration (FAA) Advisory Circular 150/5200-33A, Hazardous Wildlife Attractants On Or Near Airports, July 27, 2004.
- E. Pest control for turfgrass shall be in accordance with the "2006 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.

- F. 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 the originating seed company from Oregon.
 5. Submit certification from 4 above that the seed delivered to the Work site has 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 will not be accepted.
 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. 4 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 with seed that complies with this Specification.

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 the Work has a Brillion Turfmaker II Seeder.
 4. 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 and 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 F. 1 – 12 to the Engineer for review and approval prior to delivery to the construction site.
 - b. Do not supply or plant any of 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

3. Pesticide
 - a. Select to act on identified pest and use the manufacturer's recommended formula, application rate and safety instructions at all times.
 - b. Keep all records that are or may be required by Federal, State or Local laws. Submit copies of these records to the Engineer within five 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.
4. 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 "C" and submit the results to the Engineer prior to delivery. Submit a minimum of one (1) pint of seed per fifty (50) bags 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 "C" and submit the results to the Engineer prior to delivery. Submit a minimum of one hundred (100) seeds per fifty (50) bags delivered to the Work site.
 - c. Submit the test results for "Tiller testing". No later than two months after on-site germination, submit tiller sample for testing in accordance with Appendix "C" and submit the results to the Engineer. Submit a minimum of fifty tillers per ten (10) cres of seeded area.
5. Soil Testing
 - a. Submit to the Engineer the "Landscape Level 3 Topsoil Evaluation" from the Rutgers Soil Testing Laboratory as specified in Section 02920 – Soil Testing.

- b. Submit a minimum of up to one sample per Acre of area to be seeded.
 - c. Perform nutrient controls as recommended in the "Landscape Level 3 Topsoil Evaluation". Make nutrient control adjustments at no additional cost to the Authority.
- 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 that are dead or have weed and/or pest infestations, at no additional cost to the Authority.
 - 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.

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.
- 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.

1.07 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

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% P₂O₅

4% K₂O

2.0 % Magnesium (Mg)

1.0 % Iron (Fe)

2. 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 as provided in Appendix "B" and accordance to 1.03 F and 1.05 B. 4.

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. 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

F. 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 an approved equal.

PART 3. EXECUTION

3.01 PREPARATION

A. Areas of Changed Grades

Verify that areas of changed grades, to be seeded as shown on the Contract Drawings, are in conformance with the grading plans and have smooth, uniform surfaces. Loosen 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. Apply erosion and sedimentary control measures at all times as required by this Contract and regulatory agencies.

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 and turf. Where applicable as shown on the Contract Drawings, apply "Roundup Pro" as per manufacturer's instructions, at least ten days prior to seeding. Dispose of such materials away from Authority property.
2. Till 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. Stockpile of Existing Surface Soil

The stockpile soil shall be the existing surface soils, excavated from the top six inch (6") depth of existing lawn areas and stockpiled, and reused for top twelve inches (12") of finished grade over infiltration trenches. Test existing surface soils as per Section 02920 and have them approved by the Engineer prior to reuse in areas shown on the Contract Drawings.

Sustainable Measures

Promptly remove all debris resulting from the soil preparation operations. 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. Erosion Control and Sedimentation Measures

Apply erosion and sedimentary control measures at all times as required by this Contract and regulatory agencies.

3.02 INSTALLATION

- A. Seeding Operations for areas to receive 2" compost. (Areas designated on the Contract Drawings.)
1. Apply two (2) inches of compost as per Section 02960 to all areas to be seeded.
 2. Apply 10 pounds of finely ground Elemental Sulfur per 1000 square feet to all areas to be seeded. Rototill sulfur to six (6) inch depth prior to seeding.
 3. Apply 10-6-4 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.
 4. Application of Hydrogels
Mix hydrogels into the top six inches of soil at the rate of one (1) pound per 1,000 square feet. Apply seed mix, then water.
 5. Sow grass seed at the rate provided in Appendix B of this Section and cover in such manner that a uniform stand will result.
 6. 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 per 1000 square feet for both passes.
- B. Seeding Operations for Infiltration Trenches. (Areas designated on the Contract Drawings.)
1. Install twelve (12) inches of stockpiled existing surface sandy soil over the prepared infiltration trench.
 2. Apply 10-6-4 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. Application of Hydrogels
Mix hydrogels into the top six inches of soil at the rate of one (1) pound per 1,000 square feet. Apply seed mix, then water.
 4. Sow grass seed at the rate provided in Appendix B of this Section and cover in such manner that a uniform stand will 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 per 1000 square feet for both passes.
- C. Mulching Seeded Areas (3.02 A and B)
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 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. Add FGM at such a rate that all has been 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 fully cover 100% of the soil surface. Minimum application shall be 3,000 lbs/acre for slopes <3:1.
 3. Do not over-spray the hydromulch onto runways, taxiways, roadway, sidewalks, signs, 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 cost to the Authority.
- D. Application of Dust Retardant
1. Apply dust retardant on all completed areas that have not been seeded and/or where seed germination is less than 50% (1) after 3 weeks from date seed was sown, (2) when the calendar seeding date limits (See Appendix "B") have expired and seeding can no longer be performed or (3) 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.
- E. Care of Seeded Areas
- As provided in 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 valid license of the pesticide applicator.
3. Submit list of equipment owned by the entity.
4. Submit list of contracts or similar scope including contracts using similar construction methods, products and equipment. Provide Contract Name, date of completion, number of acres seeded, 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 F, 1 - 11.
3. Submit for approval by the Engineer, proof that the entity performing the seeding has a Brillion Turfmaker II Seeder, hydroseeder and a hydromulcher in accordance with 1.05 A. 3 - 4.
4. Submit certification from the manufacturer for Flexible Growth Medium that the installation meets or exceeds the required product preparation and application rate.

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 test results for testing Endophyte levels as specified in 1.05 B. 4.

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2. Submit to the Engineer the test results for "Landscape Level 3 Topsoil Evaluation" as specified in Section 02920 and 1.05 B 5 of this section.
 2. Submit to the Engineer the test results for the nutrient controls as recommended in the "Landscape Level 3 Topsoil Evaluation" as specified in Section 02920.

END OF APPENDIX "A"

APPENDIX "B"

SECTION 02930

SEEDING

A. SEED MIX

Permanent Seeding

1. Seed Mixture shall be as distributed by F M Brown Seed, Sinking Spring, PA 19608 (800) 345-3344, Lesco, Inc., Mountainside, NJ 07092 (908) 317-0509, National Seed, New Brunswick, NJ 08901 (800) 828-5856, Jonathan Green, Farmingdale, NJ, (732) 938-7007 or approved equal and as follows:

Kind of Seed	% Mix:	% Min. Purity:	% Min. Germ:	% Min. Endophyte Infection:
Avenger or Firenza	100	99	95	>90

2. Seed at a rate of 6 pounds per 1000 square feet.
3. Perform seeding 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)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.
4. 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 level 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, National Seed, New Brunswick, NJ 08901 (800) 828-5856, Jonathan Green, Farmingdale, NJ, (732) 938-7007 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. Seed at a rate of 6 pounds per 1000 square feet.
3. Perform seeding 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 level as specified on the "blue tag certified" label and matching Oregon State University Seed Laboratory Report Seed Analysis when submitted to the Engineer.

END OF APPENDIX "B"

APPENDIX "C"
SECTION 02930
SEEDING
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-pound seed sample
 - Seed Grow-out/Plant Tissue Endophyte Analysis*
 - Plant Tissue: Grass Tillers Endophyte Analysis*
- 2.) Agrinostics Ltd. Co
2850 Elder Mill Road
Watkinsville, GA 30677
Contact: Nick Hill (cell: 706-614-2485)
Tele: 706-769-2397
Web: www.agrinostics.com
Endophyte Tests offered:
- Seed Testing: Immunoblot assay*
Lab requires minimum sample of 100 seeds
 - Seed Grow-out Endophyte Analysis*
Lab requires minimum sample of 100 seeds
 - Plant Tissue: Grass Tillers Endophyte Analysis*
Lab requires minimum of 50 tillers for tissue testing.

- 3.) 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 pint of seed for testing.
- Plant Tissue: Grass Tiller Endophyte Analysis Test *
Lab requires minimum of 50 tillers for tissue testing.

- 4.) Fescue Diagnostic Laboratory
209 Life Science Building
Auburn University
Auburn, AL 36849
Contact: Larry Dalrymple
E-mail: dalrylw@auburn.edu
Website: www.ag.auburn.edu/enpl//services/fescue.htm
Tele: (334)-844-5006

Endophyte Tests offered:

- Seed Testing: "Staining Test"*
Lab requires one-pound seed sample.
- Seed Testing: Request "Seed Grow-out Testing"*
Lab requires one-pound seed sample
- Plant Tissue / Grass Tillers Endophyte Analysis*
Lab requires minimum of 50 tillers for tissue testing.

* Verify Fees/Sampling Procedures with Lab

End of APPENDIX "C"

DIVISION 2

SECTION 02954

**TREES, SHRUBS AND GROUND COVER
IN GROUND
(NEW JERSEY)**

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for trees, shrubs and ground cover (hereinafter sometimes referred to as "plants") using simple topsoil mix.

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 Nursery Stock" ANSI Z 60.1-2004, published by the American Association of Nurserymen, 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, 3 Perimeter Rd. - Unit 1, Manchester, NH 03031.
- D. Base standards for weather conditions on reports on the weather radio band of the National Oceanic and Atmospheric Administration, Washington Science Center, Rockville, MD 20852, and on its publication entitled "Local Climatological Data With Comparative Data", published 12 times a year as a monthly and once a year as an annual.
- E. Mulch shall conform to current standards established by Mulch and Soil Council, 10210 Leatherleaf Ct., Manassas, VA 20111-4245.

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 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

Perform planting 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 - June 1 and August 15 - September 30

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 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 they are residing.
4. Verify that the entity performing the work of this Section employs a New Jersey Certified 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. Qualification as a Tree Expert by 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 utilizes the services of a New Jersey Certified Tree Expert who shall act 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: plant material deliveries, maintenance of plants at the site after delivery and prior to installation, verifying the trunk 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 in 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 in either the State of New Jersey or New York, has experience in top soil testing and performs 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. Submit products listed in PART 2 - PRODUCTS to the Engineer for approval prior to delivery to the construction site.

2. After delivery to the construction site, allow the Engineer, at his discretion, to 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. 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. Submit one copy of said sheets to the Engineer for review and approval prior to introduction of material to the construction site.
4. Verify that all plant materials are 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 in 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

Be prepared to identify the Asian longhorned beetle. If beetles are observed or 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. Trees, Shrubs and Ground Cover

- 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. Obtain certification by Federal and State authorities that each shipment is 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, 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 such rejected plants from Authority property and replace them at no additional cost to the Authority.
- g. Upon the Engineer's request, remove typical representative numbers of plants 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), arrange for the Contractor's Tree Expert (NJ) and the Contractor to perform weekly drive and walk through site inspections of the Area of Work, accompanied by the Engineer, to address the following:
 - (1) 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. Arrange for the Contractor's Tree Expert (NJ), within 48 hours of each site inspection, to 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.

3. 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 will be permitted. Submit test results to the Engineer of Materials, 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. The Engineer will reject any loam soil analysis by a certified independent laboratory the date of which is more than one month prior to the date of delivery to the construction site.
 - c. Prior to delivery to the construction site, advise the Engineer of Materials of the location of the source of the screened topsoil and submit a two pound sample to the Engineer of Materials.
 - 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 Engineer of Materials for approval. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered screened topsoil from the construction site and replace it with material that does conform at not cost to the Authority.
4. Loam Soil Mix
- a. Do not combine Loam Soil mix components until components have been approved in writing by the Engineer of Materials.
 - b. After Loam Soil mixing operations have been completed and prior to delivery to the construction site, submit a representative sample of the Loam Soil 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 Engineer of Materials, 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. The Engineer will reject any loam soil mix analysis by a certified independent laboratory the date of which is more than one month prior to the date of delivery to the construction site.
 - d. Prior to delivery to the construction site, advise the Engineer of Materials of the location of the source of Loam Soil mix and submit a two pound sample to the Engineer of Materials.
 - e. Do not deliver Loam Soil mix to the construction site until the Engineer of Materials has approved the submittal in writing.

- f. After delivery of Loam Soil 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 Engineer of Materials for approval. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered Loam Soil mix from the construction site and replace it with material that does conform at no cost to the Authority.

D. Certification

Prior to delivery of screened Loam Soil and/or Top Soil mix to the construction site, submit to the Engineer of Materials a written statement from the topsoil supplier giving the depth of stripped Loam Soil and certification that topsoil has never been treated with herbicides.

E. Replacement

1. Replace unsatisfactory furnished and installed trees, shrubs and ground cover 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 away from Authority property.

D. Specific Requirements

1. Loam Soil and Loam Soil Mix

Conform to requirements of 1.04 C.3 and 1.04 C.4.

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. 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 (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. 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:

<u>Passing</u>	<u>Retained On</u>	<u>Percentage</u>
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 topsoil passing the 2mm sieve, based on the mechanical analysis of the soil as determined by the Buoyocous 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. Loam Soil Mixes: Composed of screened Loam Soil, various soil amendments and nutrient control materials and conforming to the following:

1. Loam Soil 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 shall have a 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 Loam Soil mix shall contain:
 - a. 3 3/4 cubic yards of screened Top Soil;
 - b. 1 1/4 cubic yards of compost
 - c. 17 lbs. of Hydrogel
4. Loam Soil 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 shall contain materials of a generally humus nature. The product shall not contain any materials toxic to plant growth or that produce objectionable odors. Compost shall meet EPA Exceptional Quality Standards and all State Environmental Agency requirements. In addition, 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	<5.0mmhos/cm (ds/m)
Nitrogen	>1.5%
Phosphorus	>20%
Potassium	>0.5%

2. Compost shall be "AgresoilCompost - Fairfield, CT" as supplied by Agresource - The Source for Compost, Amesbury, MA 01913 or an approved equal.

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.
"Round-up Pro" as manufactured by Monsanto, St. Louis, MO 63167 or approved equal.

E. Hydrogel

"Viterra Gelscape" shall be as manufactured by Amereq. Inc., New City, N.Y. 10956 or an approved equal and shall conform to the following:

99.5% Potassium Propenoate - Propenamide Copolymer
0.5% Inert Ingredients

F. Nursery Stock

1. Furnish and plant trees, shrubs and ground cover in the quantity and 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. 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 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.
 - 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 shall 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:
 - (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 overcrowding, 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 more than two inches of native soil or container soil found to be above the tree's or shrub's natural root flare at the trunk.
- m. With respect to their roots, trees shall:
- (1) Be free from girdling roots.
 - (2) If girdling roots are present, then the Contractor's NJ Certified tree expert shall remove them at no cost to the Authority.
 - (3) 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) Arrange for trees to 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) 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. [Query: What is Contractor supposed to do with "Bulb-Tone?" Does this spec tell him what to do?]

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	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. Iron Sulphate

Commercial iron sulphate as manufactured by Bonide Products, Inc. Oriskany, NY 13424, or an approved equal. Total Iron (Fe) shall be 15% derived from Ferrous Sulfate.

2. Granulated Dolomitic Limestone

As manufactured by Southdown, Inc., Lee, MA 01238, 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. 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:

<u>Essential Element Ingredient:</u>	<u>% Analysis by Weight:*</u>
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:

Humic Acid (Minimum 12% by weight)
Natural Sugars, Dried Yeast & Other
Carbohydrates
Amino Acids
Yucca Plant Extract (Wetting Agent)
Sea Kelp (Biostimulant)

Derived From:

Natural Humates
Processed Grain By Products
Animal and Plant Proteins
Yucca schidigera
Ascophylum nodosum

Beneficial Bacteria:

Nitrogen-Fixing Bacteria Spores
Phosphorous-Solubilizing Bacteria Spores
Growth-Promoting Bacteria Spores

Per 21 Gram Tablet:

2 million
2 million
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:

Live Spores of VA
Endomycorrhizal Fungi

Live Spores of an
Ectomycorrhizal Fungus

Terra-Sorb HB Water
Absorbent Gel

Dry Soluble Yucca Plant
Extract

Soluble Sea Kelp Extract

Humic Acids

Analysis (per 3 ounce packet):

Minimum of 1000 Spores of Vesicular-Arbuscular
(VA) Fungi.

Includes: Entrophospora columbiana, Glomus
etunicatum, Glomus clarum and Glomus sp.

Minimum of 60 million spores of Pisolithus
tinctorius.

Acrylamide copolymer gel

Yucca schidigera

Ascophylum nodosum

Leonardites Humates

J. Fertilizer/Bio-Stimulants (Shrubs, Ground Cover and Seasonal Displays)

- 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:

<u>Beneficial Mycorrhizal Fungi Bacteria:</u>	<u>Analysis (per 4 ounces)</u>
Live Spores of VA Endomycorrhizal Fungi	Minimum of 300 Spores of Vesicular-Arbuscular (VA) Fungi. Includes: Entrophospora 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

<u>Soil Conditioner Ingredients:</u>	<u>Derived From:</u>
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)	Ascophyllum nodosum

Guaranteed Nutrient Analysis 4-7-4:

<u>Nutrient:</u>	<u>% Analysis By Weight:</u>
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%

K. Rodent Control

1. Rodent Control shall be a water soluble, non-toxic, colorless solution with the following active ingredients:

<u>Ingredient:</u>	<u>Percentage:</u>
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.

L. Pruning Alcohol

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) 87303749, as per U.S. Patent No.'s 141, 903 & 6,065,243.

2. Staple sizes shall be 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. Obtain Tree Staples from the following suppliers:

- NYP Corp., 805 East Grand St., Elizabeth, NJ 07201
- Northern Nurseries, 487 Elizabeth Ave., Somerset, NJ 08873
- Northeastern Supply, 50 Notch Rd., West Paterson, NJ 07836
- Or approved equal.

N. Shredded Hardwood Bark Mulch

Shredded hardwood bark mulch shall be double hammermilled hardwoods, cedar, hemlock hardwood blend as supplied by American Landscape Supply, Inc., Branchburg, NJ 08876 or approved equal.

O. Anti-desiccant

"Wilt-Pruf NCF" as manufactured by Wilt-Pruf Products, Inc., Greenwich, CT 06830-0280; "Cloud Cover" as manufactured by Easy Gardner, Waco, TX 76702-1025; "Transfilm" as manufactured by PCI-Gordon Corp., Kansas City, MO 64101 or approved equal.

P. 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 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 and TreeGator Junior portable drip irrigation systems shall be as manufactured by Spectrum Products, Raleigh, NC 27619-8187.

Q. Erosion Control Mat

1. Erosion control mat shall be 100% organic, machine spun bristle coconut fiber, woven into a high strength matrix. All components of erosion control mat shall be 100% biodegradable.
2. Erosion control mat shall be "Coir Mat 700" as distributed by Pinelands Nursery, Columbus, NJ 08022 or approved equal conforming to the following:

<u>Property:</u>	<u>Typical Value / Units:</u>
Composition	100% machine woven coconut fibers
Weight	20.6 ounces / square yard
Thickness	0.30 inch
Tensile Strength	1348 x 626 pounds / foot
Elongation	34% x 38%
Flexibility (Mg – Cm)	65030 x 29590
Flow Velocity	11 feet / second
Open Area	50%
Standard Roll Size	6 ½' x 164' (120 square yards)

3. Staples shall be 6" long, #11 gauge wire staple with a .091" wire thickness.

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, insect infestation and improper pruning. Do not plant until deficiencies are corrected or plants are replaced.

3.02 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 landscape 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. All planting areas as shown on Contract Drawings.
- C. Prior to planting operations, stake out tree, shrub and ground cover locations and outline planting beds on ground for approval by the Engineer.
- D. Do not begin excavation until locations are approved by the Engineer.

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:

<u>Size of Ball or Container</u>	<u>Diameter of Hole</u>	<u>Depth Below Bottom of Ball or Container</u>
Less than 4 feet diameter	2 x diameter of ball or container	6 inches
4 to 5 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. Do not plant until excavated plant pits have been approved by the Engineer.

- B. Trees: Trunk Flare 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 and expose the trunk flare as shown on the Contract Drawings and as directed by the Engineer, 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 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 Tree Expert (NJ) and the Engineer.

C. Planting Operations

Plant only in the presence of the Engineer, and as follows:

1. Planting Balled & Burlaped (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. Lift, transport and place trees into individual tree pits using the tree lifting method shown on the Contract Drawings.
 - c. Set plants plumb.
 - d. Set tree so that top of root ball is level with the finished grade after settlement.
 - e. 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 topsoil mix backfill.
 - f. For B & B plants, after the topsoil 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.
 - g. Avoid bruising or breaking roots when tamping soil.
 - h. Firm Loam Soil mix at 6- to 8-inch intervals and thoroughly settle it with water.

2. Tree Staple Installation Instructions

- a. Leaving burlap intact, heel the plant's root ball into place.
- b. Remove plastic safety caps from Tree Staples and set aside.
- c. Set each Tree Staple opposite the other and against the outside edge of root ball. The shorter prong should be positioned over root ball, halfway between the trunk and the ball's outer edge.
- d. Using a sledgehammer, drive each Tree Staple into the ground until the cross bar is recessed one to two inches below the surface of the root ball. Alternate between hitting either of the prongs to insure that the Tree Staples are completely below grade.
- e. Place safety caps on exposed ends.
- f. Cut back burlap, leaving material under the cross bars.
- g. Backfill in accordance to the Contract Drawings.
- h. If the root ball size is less than 24" or if provided on the Contract Drawings, follow steps a, b, and c above, changing the position of the short prong to the outside edge of the root ball. Tie common burlap tree wrap (3" – 5" width) to the crossbars on each side of the trunk. Leave about 2" – 3" of play in the straps. Keep straps away from the trunk. Proceed with installation instructions d, e, and g.

3. Fertilizer/Bio-Stimulants

a. Fertilizer/Bio-Stimulants (Trees)

- (1) Make 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 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:

<u>Tree Root Ball Size:</u>	<u>Quantity of 21 Gram Fertilizer Tablets Req:</u>
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 topsoil mix around the root ball after the tree has been planted as per the manufacturer's directions and as follows:

<u>Tree Root Ball Size:</u>	<u>Quantity of 3 Ounce Packets Required:</u>
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 topsoil 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 topsoil mix.
 - (d.) Thoroughly mix the top 3"-4" topsoil 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 Seasonal Display Plantings)
- (1) Make one (1) application of Fertilizer/Bio-Stimulants to all shrubs, ground cover and perennials installed under this Contract, during the initial planting installation, as supervised by the Contractor's Tree Expert (NJ) and the Engineer.
 - (2) Incorporate Fertilizer/Bio-Stimulants into the top 6"-8" of topsoil mix of plant pits of each shrub, ground cover and perennials, during the initial planting installation, as per the manufacturer's directions and as follows:

<u>Plant Container/Root Ball Size:</u>	<u>Application Rates (Per 4 Ounce Scoop):</u>
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. 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.

E. 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 around each plant as shown on the Contract Drawings.
3. Place a maximum of 2 inches of mulch in the plant basin.
4. Maintain a minimum radius of 4 inches between the tree or shrub trunk flare and the start of the mulch.
5. Mulch Volcanoes are prohibited. Wherever mulch is inappropriately applied, remove the inappropriately installed mulch from the construction site and replace it in conformance with the Contract Drawings at no cost to the Authority.

F. Irrigation

Commence irrigation immediately after planting and maintain as required until issuance of Certificate of Final Completion.

G. Rodent Control

1. Make a minimum of two (2) rodent control applications to all plants installed under this Contract, between November 1st and December 15th, as per the manufacturer's directions and as supervised by the Contractor's Tree Expert (NJ) and the Engineer.

H. Arborist's Site Inspections/Reports

1. Drive/Walk Through Site Inspections

a. During Contract performance (prior to rendition of a Certificate of Final Completion), the Contractor's Certified 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..

Within 48 hours of each site inspection, transmit from the Contractor's Certified Tree Expert (NJ) to the Engineer 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.

I. Seasonal Displays, Herbaceous Plants and Bulbs

1. Furnish, install, maintain and remove seasonal displays in accordance with the Contract Drawings.
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
 - (4) Dig bulb holes twice the diameter of the bulb. Set daffodil bulbs three times (3) 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.
 - (5) After individual bulb holes are excavated or a mass planting area is excavated to the specified depth, evenly apply Superphosphate 0-20-0 at a rate of five lbs. Per 100 square feet. Apply Bulbtone as per manufacturers requirements. Backfill with Planting Mix and water thoroughly.

END OF SECTION

SECTION 02954

TREES, SHRUBS AND GROUND COVER IN GROUND

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 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 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 pesticide applicators license, valid 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 materias 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.

2. Submit the location of the source of the screened Loam Soil, Loam Soil 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 1.04C.4.

C. Test Reports

Submit laboratory analyses of screened Loam Soil and Loam Soil mix to the Engineer of Materials, 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, Appendix B and Appendix C.

D. 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.

E. Arborist's Site Inspection Reports

1. Within 48 hours of each site inspection, transmit from the Contractor's Tree Expert (NJ) to the Engineer 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
IN GROUND**

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% 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%		
Buoyocous Hydrometer Test of Material:			
Passing 2mm (#10) Percent - Sand	40% - 60%		
Percent - Silt	30% - 40%		
Percent - Clay	10% - 20%		

END OF APPENDIX "B"

SECTION 02954

**TREES, SHRUBS AND GROUND COVER
IN GROUND**

APPENDIX "C"

Material: Planting Mix
Specification: Sections 02921 and 02960
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%		
Buoyoucus Hydrometer Test of Material:			
Passing 2mm (#10) Percent - Sand	40% - 60%		
Percent - Silt	30% - 40%		
Percent - Clay :	10% - 20%		
Potassium: lbs./Acre			
Phosphorus: lbs./Acre			
Nitrogen From NO3: lbs./Acre			
Nitrogen From NH4: lbs./Acre			

END OF APPENDIX "C"

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. Base standards for weather conditions on reports on the weather radio band of the National Oceanic and Atmospheric Administration, Washington Science Center, Rockville, MD 20852, and on its publication entitled "Local Climatological Data with Comparative Data", published 12 times a year as a monthly and once a year as an annual.
- C. Compost shall conform to the standards established by the US Composting Council, Rokonkoma, NY 11779.
- D. Use product testing methods described in Test Methods for the Examination of Composting and Compost (TMECC).

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 Test Method 04.10 Electrical Conductivity For Compost, 1:5 Slurry Method, Mass Basis, as provide by the TMECC.
 4. 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 will be subject to approval in writing by the Engineer prior to delivery to the construction site.
 2. 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.
 3. At the commencement of each 100 cubic yards of compost delivered to the construction site, allow the Engineer at his discretion to take a sample of compost for analysis to determine if the product is in conformance to these specifications.
 4. 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 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 Specification.
- 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.
- D. Formulation, Application, and Equipment
 1. Follow 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.

1.06 SUBMITTALS

- A. See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

- A. 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.
- B. Compost
 - I. Compost shall be derived from biosolids, free of viable weed seeds and shall 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: .

<u>Parameters:</u>	<u>Range:</u>
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)
Soluble Salts - 1:5 Slurry Method	< 2.5 mmhos/cm (ds/m)
Nitrogen	> 1.5%
Phosphorus	< 20%
Potassium	< 0.5%
Maturity Index	7-8

PART 3. EXECUTION

3.01 PREPARATION

- A. Areas of Changed Grades
 - I. Areas of changed grades shown on the Contract Drawings are predominately a cut and fill operation utilizing on-site existing soils.
 - 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. 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 promptly after preparation.

2. Areas of changed grades shown on the Contract Drawings 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. 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 promptly 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. Dispose of such materials away from Authority property in a legal manner.
3. Rake and drag to remove high areas and fill depressions.
4. Limit preparation to areas that will receive compost 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 Material".

D. Erosion Control and Sedimentation Measures

Apply erosion and sedimentary control measures at all times as required by this Contract and the governing regulatory agencies.

3.02 INSTALLATION

A. Preparation

1. Apply a minimum depth of compost as described on Contract drawings, evenly over landscape area and uniformly rototill into the soil.
2. 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 and a two-pound representative sample of compost (as many as required) 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 C.

END OF APPENDIX "A"

DIVISION 2

SECTION 02971

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE (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 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," "Landscaping Maintenance," and 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, 3 Perimeter Rd. - Unit 1, Manchester, NH 03031.
- E. Base standards for weather conditions on reports on the weather radio band of the National Oceanic and Atmospheric Administration, Washington Science Center, Rockville, MD 20852, and on its publication entitled "Local Climatological Data With Comparative Data," published 12 times a year as a monthly and once a year as an annual.
- 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 exhibiting signs of 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 "Cornell Recommendations for Pest Control for Commercial Production and Maintenance of Trees and Shrubs" and "Cornell Recommendations for Florist Crops, Part II: Pest Control - Diseases, Insects and Weeds," published by Cornell University, Ithaca, NY. These publications are available from the Distribution Center, Research Park, Cornell University, Ithaca, NY 14850. Telephone (607) 255-2080.

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:

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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 New Jersey Certified Tree Expert and a member of the International Society of Arboriculture and State Chapter where it is located.
 4. Make arrangements to have a New Jersey Certified 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 Certified 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 by 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 Certified 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: plant material 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 in either the State of New Jersey or New York, has experience in topsoil testing and performs 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 subject to approval in writing by the Engineer prior to delivery to the construction site.

2. After delivery to a the construction site, allow the Engineer, at his discretion, to 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. Submit one copy of said sheets to the Engineer for review and approval prior to introduction of material to the construction site.
4. Verify that all plant materials is 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 in 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 follow the manufacturer's recommended formula, application rate and safety instructions at all times.
 - b. 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.
 - 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, 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

Prepare to encounter the Asian longhorned beetle. If beetles are observed or 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. Trees, Shrubs and Ground Cover:

- 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. Ensure that each shipment is 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, 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 such rejected plants from Authority property and replace at no 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. 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 Engineer of Materials, 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 by the certified independent laboratory the date of which is more than one month prior to the date of delivery to the construction site will be rejected.
- c. Prior to delivery to the construction site, advise the Engineer of Materials of the location of the source of the screened Loam Soil and submit a two pound sample to the Engineer of Materials.
- d. Do not deliver screened topsoil to the construction site until the Engineer of Materials has approved the submittal in writing.

- e. After delivery of screened topsoil 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 Engineer of Materials for approval. In the event that the delivered sample is not consistent with the sample approved prior to delivery, remove the delivered screened topsoil from the construction site and replace it with material that does conform at no cost to the Authority.

3. Loam Soil Mix

- a. Do not combine Loam Soil mix components until components have been approved in writing by the Engineer of Materials.
- b. After loamsoil mixing operations have been completed and prior to delivery to the construction site, submit a representative sample of the topsoil 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 Engineer of Materials, 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 by the certified independent laboratory the date of which is more than one month prior to the date of delivery to the construction site will be rejected.
- d. Prior to delivery to the construction site, advise the Engineer of Materials of the location of the source of loamsoil mix and submit a two pound sample to the Engineer of Materials.
- e. Do not deliver topsoil mix to the construction site until the Engineer of Materials has approved the submittal in writing.
- f. After delivery of loamsoil 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 Engineer of Materials 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 at no cost to the Authority.

D. Certification

Prior to delivery of screened loamsoil and/or Planting mix to the construction site, submit to the Engineer of Materials a written statement from the loamsoil supplier giving the depth of stripped topsoil and certification that topsoil has never been treated with herbicides.

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 to all requirements of the Specifications and Contract Drawings at no additional cost to the Authority.

2. Replace unsatisfactory plants with products and by operations that comply with all requirements of the Specifications and Contract Drawings and on such date(s) as ordered by the Engineer at no additional cost to the Authority.

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. Follow 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. Loam Soil and Planting Mix

Conform to requirements of 1.04 C.3 and 1.04 C.4.
 2. Trees, Shrubs, Ground Cover and Perennials

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 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. 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 Buoyoucouous 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 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 shall have a 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 topsoil 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. Loam Soil 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 that reduce objectionable odors. Compost shall meet EPA Exceptional Quality Standards and all State Environmental Agency requirements. In addition, compost shall conform to the following:

<u>Parameters</u>	<u>Range</u>
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)
Nitrogen	>1.5%
Phosphorus	>0.5%
Potassium	>0.1%

2. Compost shall be "Agresoil Compost – Fairfield, CT" as supplied by Agresource – The Source for Compost, Amesbury MA 01913 or an approved equal.

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.
41% - Glyphosate N - (phosphonomethyl) glycine
59% - Inert Ingredients

E. Hydrogel

"Viterra Gelscape" shall be as manufactured by Amereq. Inc., New City, N.Y. 10956 or an approved equal and shall conform to the following:

99.5% Potassium Propenoate - Propenamide Copolymer
0.5% Inert Ingredients

F. Nursery Stock

1. Furnish and plant trees, shrubs and ground cover 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, 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. 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 and 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.

1. 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 canopy.
 - (e.) Root flare exposed and no more than two inches of native soil or container soil found to be above the tree's or shrub's natural root flare at the trunk.
- m. With respect to their roots, trees shall:
 - (1) Be free from girdling roots.
 - (2) If girdling roots are present, then the Contractor shall have his NJ Certified tree expert remove them at no cost to the Authority.
 - (3) Bareroot plants will be rejected.
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.

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%

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0.3%... Water Soluble Magnesium	Sodium (Na)	0.1%
Sulfur (S)	5.0% Zinc (Zn)	0.05%

H. Soil pH Adjustment

1. Iron Sulphate

Commercial iron sulphate as manufactured by Bonide Products, Inc. Oriskany, NY 13424, or approved equal.

2. Granulated Dolomitic 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:

<u>Ingredients:</u>	<u>% by Weight</u>
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 (K ₂ O) 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.

J. Rodent Control

1. Rodent Control shall be a water soluble, non-toxic, colorless solution with the following active ingredients:

<u>Ingredient:</u>	<u>Percentage:</u>
Benzyldiethyl (2.6 xylylcarbonyl) 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 as supplied by American Landscape Supply, Inc., Branchburg, NJ 08876 or approved equal.

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. Anti-desiccant

"Wilt-Pruf NCF" as manufactured by Wilt-Pruf Products, Inc., Greenwich, CT 06830-0280; "Cloud Cover" as manufactured by Easy Gardener, Waco, TX 76702-1025, "Transfilm" as manufactured by PC1-Gordon Corp., Kansas City, MO 64101.

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 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.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, Shrubs and Ground cover

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. Perennials

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.

C. 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.

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 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 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. Properly re-cut crushed, jagged cuts or cuts leaving too much stub and existing improper cuts .
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.
2. Apply one-inch deep mulch on planting beds and planters.
3. Apply burlap and/or snow fencing as shown on the Contract Drawings and as directed by the Engineer.

H. Tree, Shrub, Perennial and Ground Cover Removals

1. Within 24 hours of notification by the Engineer, remove, at no cost to the Authority, 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 at 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 are prohibited. Wherever mulch is inappropriately applied, 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. Perennials and Bulbs
1. Furnish, install and maintain all perennials and bulbs in accordance with the Contract Drawings.
 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) 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 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 will 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 Perennials and Bulbs

- a. Within 24 hours of notification by the Engineer, replace, at no cost to the Authority, 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. Furnish and install 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. Drive/Walk Through Site Inspections

- a. During the Contract (prior to rendition of a Certificate of Final Completion), the Contractor's Certified 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) 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, transmit from the Contractor's Certified Tree Expert (NJ) to the Engineer a report stating the following:
 - (4) Site Inspection Attendees.
 - (5) Agenda and items discussed.
 - (6) Description of issues/problems.
 - (7) Solutions to be implemented by the Contractor with 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. Apply rodent control in the presence of the Engineer.

N. Precast Concrete Block Pavement, Asphalt Block Pavement and Screenings

Maintain the Precast Concrete Block Pavement, Asphalt Block Pavement and Screenings as shown on the Contract Drawings free of weeds, litter, debris and any other deleterious materials and in accordance with Appendix 'D'.

END OF SECTION

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SECTION 02971

MAINTENANCE OF PERMANENT PLANTING (NEW JERSEY) AND HARDSCAPE

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, 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.

C. Test Reports

Submit laboratory analyses of screened topsoil and topsoil mix to the Engineer of Materials, 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, Appendix B and Appendix C.

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- 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 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, transmit from the Contractor's New Jersey Certified Tree Expert to the Engineer an inspection report, to include but not limited to the following: List of inspection attendees, the item(s) discussed, a brief description of maintenance 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.
- 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 3.02 E of this Section.

END OF APPENDIX "A"

SECTION 02971

MAINTENANCE OF PERMANENT PLANTING (NEW JERSEY) AND HARDSCAPE

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%		
Buoyocous Hydrometer Test of Material:			
Passing 2mm (#10) Percent - Sand	40% - 60%		
Percent - Silt	30% - 40%		
Percent - Clay	10% - 20%		

END OF APPENDIX "B"

SECTION 02971

MAINTENANCE OF PERMANENT PLANTING (NEW JERSEY) AND HARDSCAPE

APPENDIX "C"

Material: Planting Mix

Specification: Section 02954 – Trees, Shrubs and Ground Cover in Ground

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%		
Buoyoucouc Hydrometer Test of Material:			
Passing 2mm (#10) Percent - Sand	40% - 60%		
Percent - Silt	30% - 40%		
Percent - Clay	10% - 20%		

END OF APPENDIX "C"

SECTION 02971

MAINTENANCE OF PERMANENT PLANTING (NEW JERSEY) AND HARDSCAPE

APPENDIX "D"

A. To Be Maintained

- Trees
- Shrubs
- Ground Cover
- Grass Lawn
- Perennials and Bulbs
- Precast Concrete Block Paver, Asphalt Block 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. Apr., Oct. & Nov.	Once a week Once every 2 weeks
Weed Removal	April - November	Identify/remove once/week
Litter Removal	January - December	Once a week

Function	Schedule	Description
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.
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

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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 New Jersey Certified 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 New Jersey Certified 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 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.
Hardscape - Asphalt Block Pre-cast Concrete Screenings	January - December	Check once/month. Reset or replace pavers or screenings out-of-place or missing.
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 15 th and October 15th	Inspect for frost heave or girdled roots and adjust or remove, as per recommendations of Certified 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 (Certified Tree Expert's Inspection Reports due within 48 hours of each inspection).

END OF APPENDIX "D"

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
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. Formwork 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;
 - 3. Provide a layout of all embedded items, including electrical and telephone conduit and plumbing and drainage pipes, at least 15 days prior to concrete placement.
- B. Catalog Cuts, Material Certification and Test Results
 - 1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples";
 - 2. Material certifications, brand names and test results (where required) for all formwork materials. Submit at least 35 days prior to concrete placement.
- C. Samples
 - 1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples";
 - 2. Form ties and spreaders with manufacturer's specifications, submit at least 21 days prior to ordering any material;
 - 3. Tapes for form joints with manufacturer's literature;
 - 4. Waterstops and premolded expansion joint filler;
 - 5. Form liners with manufacturer's specifications, submit at least 21 days prior to ordering any material;
 - 6. Form coating agent with manufacturer's literature.
- D. Design Computations

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 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
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Concrete Reinforcing Steel Institute (CRSI)

	Manual of Standard Practice Placing Reinforcing Bars
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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.

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 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.

- 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.

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

Provide minimum 16-gage, annealed type. Provide nylon, plastic or epoxy-coated wire for use with epoxy-coated and galvanized reinforcing bars, if any.

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.

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 D1.4.

PART 3. EXECUTION

3.01 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. 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.
- D. When a vapor barrier is shown on the Contract Drawings, do not cut or puncture during concrete reinforcement placement.
- E. 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.
- 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 2.01A.

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.

END OF APPENDIX "A"

DIVISION 3
SECTION 03300
PLACEMENT OF PORTLAND CEMENT CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

This Section specifies requirements for casting Portland Cement concrete.

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 Society for Testing and Materials (ASTM)

ASTM D 1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types)

ASTM D 1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

New Jersey Department of Transportation (NJDOT) Standard Specifications for Road and Bridge Construction

Port Authority Standard Specification sections:

#03301	Portland Cement Concrete, Long Form
#03200	Concrete Reinforcement
#03100	Concrete Formwork
#02574	Abrasive Blasting of Pavements

1.03 ENVIRONMENTAL REQUIREMENTS

A. For Cold Weather Requirements see Section 03301, entitled PORTLAND CEMENT CONCRETE, LONG FORM.

B. Reinforcement, forms and soils with which concrete will be in contact shall be completely frost-free.

C. Comply with all provisions of this Section for placing and curing.

D. For Hot Weather Requirements see Section 03301, entitled PORTLAND CEMENT CONCRETE, LONG FORM.

1.04 QUALITY ASSURANCE

A. A pre-concrete construction meeting will be conducted as specified in Part 1.06 of Section 03301 entitled PORTLAND CEMENT CONCRETE, LONG FORM.

- B. For concrete where riding surface tolerances are required, as indicated on the Contract Drawings, the following requirements shall be met:
1. The Engineer will test the entire surface of the hardened concrete with a rolling straight edge for conformance to the smoothness requirements. Surface smoothness deviations shall not exceed 1/8 inch in 10 feet. Tests will be made in both the longitudinal and transverse direction of the slab and will span joints. Correct any deficiencies as specified in 3.04A and 3.04B.
 2. The Engineer will survey the slab surface for vertical deviation from grade. Vertical deviation from the grade shown on the Contract Drawings shall not exceed plus or minus 0.04 foot at any point.
 3. Finished grade will be determined by running levels at intervals of 25 feet longitudinally and transversely. Correct deficiencies as specified in 3.04A and 3.04B.
- C. Specified concrete finishes, as shown on the Contract Drawings, shall conform to the requirements set forth in 3.02D.2. Correct deficiencies as specified in 3.04D.

1.05 SUBMITTALS

- A. For submittals - see Appendix "A".
- B. Do not deliver any concrete to the construction site until all approvals required in this Section and Section 03301 have been obtained.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Expansion Joints (Except For Bridge Decks) and Contraction Joints
1. Vinyl plastic water stops shall be of types and sizes shown on the Contract Drawings and conforming to Corps of Engineers Specification for Polyvinylchloride Waterstops (Designation: CRD-C572-60, latest revision).
 2. Premoulded expansion joint filler, when shown on the Contract Drawings:
 - a. Cork type shall be ASTM D 1752, Type II;
 - b. Bituminous type shall be ASTM D 1751.
 3. Joint Sealant when shown on Contract Drawings: Federal Specification SS-S-1401, latest revision.
- B. For Curing Materials see 2.02R, Section 03301, entitled PORTLAND CEMENT CONCRETE, LONG FORM.
- C. For Evaporation Retardant see 2.02S, Section 03301, entitled PORTLAND CEMENT CONCRETE, LONG FORM.

PART 3 - EXECUTION

3.01 PREPARATION

A. Construction Joints

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. Place joints at points of minimum shear unless otherwise shown on approved shop drawings or as directed by the Engineer.
4. Avoid lips and other irregularities between adjoining sections of concrete. Secure forms tightly against previously placed concrete.

B. Expansion and Contraction Joints

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 filtered compressed air.
2. Install joint sealant to finish flush with concrete surface, except where otherwise shown on the Contract Drawings.

C. Preparation for Placing Concrete

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. Have the repair crew available at the time of examination.
4. Check all locking devices for formwork 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 3.02 A and the Contract Drawings for all procedures, equipment limitations and requirements to be performed prior to placing concrete. Submit a surface preparation plan to the Engineer for review and approval.
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 any base course or fill has been properly compacted in accordance with the Contract requirements.
8. Install vent holes (1/4 inch diameter, minimum) in edge angles or embedded plates at joints where vibrating alone will not ensure elimination of voids. Locate vent holes at high points and with uniform spacing along joints for

escape of air during concreting operations. Evidence of voids adjacent to embedments shall be cause for rejection of work. Submit shop drawings showing all vent holes and procedures for placement of concrete at joints for review and approval.

3.02 APPLICATION

A. Bonding New Concrete to Existing Concrete:

Where new concrete is placed against existing concrete surfaces:

1. Existing concrete surfaces shall be abrasive blasted or shot blasted within 8 hours preceding the start of concrete placement or, if the area was open to vehicular traffic, after final closure of the area to traffic, prior to concrete placement. Abrasive blasting shall conform to Section 02574, entitled ABRASIVE BLASTING OF PAVEMENTS.
2. After abrasive blasting, just prior to placing concrete, thoroughly clean existing 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.
3. Immediately prior to placing concrete, moisten existing concrete with water. Remove puddles of standing water.
4. Broom into the wetted surface a thin layer of material from the leading edge of the concrete being placed. Exercise care to ensure that all vertical and horizontal surfaces receive a thorough, even coating and that the rate of progress is limited so that the broomed material does not dry before being covered with additional material as required for final grade.

B. 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 fresh 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. Deposit concrete for fill in steel reinforced pipe piles, steel shells and caissons using a metal hopper and an elephant trunk. The hopper and elephant trunk shall be set above the top of piles, steel shells and caissons to permit the escape of air as the concrete is placed. Elephant trunks shall extend a minimum distance of 10 feet below top of piles, steel shells and caissons. 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.
 11. Avoid 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 to require as little rehandling as possible. Place and spread concrete using an approved mechanical spreading device that prevents segregation of the materials. Placing shall be continuous between contraction joints. Necessary hand spreading shall be done with shovels, not rakes.
 13. Deposit concrete as near to joints as possible without disturbing them. Do not discharge concrete onto a joint assembly unless placement is centered above the joint assembly.
 14. 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 allow vibrators to come in contact with a joint assembly, base course or side form. In no case shall the vibrators be used to move the concrete.
 15. Screed and float concrete for riding surfaces as it is placed and use an approved evaporation retardant or fog spray.
- C. 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. Prior to the start of Work and periodically during construction progress check all vibrators 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.

D. Consolidation and Finishing

1. Bridge Decks and other Riding Surfaces

- a. Machine finishing shall conform to NJDOT Standard Specifications Subsection 405.13, Item B.
- b. Finishing at and adjacent to joints shall conform to NJDOT Standard Specifications Subsection 405.13, Item C.
- c. 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 the 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. An approved portable screed shall be used. Use a second screed 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 or of other suitable material covered with metal. Achieve consolidation by the use of suitable vibrators.

- d. After the concrete has been struck off and consolidated, finish it further by means of a longitudinal float using one of the following methods:
 1. Long-handled floats shall not be 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 pavement 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 disposed of outside of Port Authority property.
 2. If necessary 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, use long-handled floats having blades not less than 5 feet in length and 6 inches in width to smooth and fill in open-textured areas in the pavement. When the crown of the pavement will not permit the use of the mechanical float, float the surface transversely by means of a

long-handled float. Do not work the crown out of the pavement during the operation. After floating, remove and dispose of any excess water and laitance in excess of 1/8 inch thick outside of Port Authority property. 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 with a 10-foot straightedge swung from handles 3 feet (1 m) 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. Removed from the surface of the pavement any excess water and laitance in excess of 1/8 inch thick and dispose of outside of Port Authority property. 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 assure that the surface across joints meets the smoothness requirements set forth in 1.04B. Continue straightedge testing and surface corrections until the entire surface is found to be free from observable departures from the straightedge and until the slab conforms to the required grade and cross section. Minimize the use of long-handled wood floats; they may be used only in emergencies and in areas not accessible to finishing equipment.
 - f. Test the surface across the joints with a 10-foot straightedge as the joints are finished and correct any irregularities in excess of 1/8 inch before the concrete has hardened.
2. Specified concrete finishes, as shown on the Contract Drawings, shall be in accordance with the following requirements:
- a. "Smooth Finish" shall be a surface of concrete obtained by the use of special forms as specified in the 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. Rub any mortar patches with a carborundum brick as above specified.
 - b. "Scored Finish" shall be 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" shall be 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" shall be 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. Do not trowel 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" shall consist of a monolithic layer of abrasive concrete having a minimum thickness of 3/4 inch and which shall be Emericrete, as manufactured by the Walter Maguire Company, Inc., or approved equal. Prepare the base and install the monolithic finish in accordance with the recommendations of the manufacturer of the abrasive concrete. Give the surface a wood float finish. Round the sides and edges of pavement slabs with an approved edging tool to the minimum radius obtainable in the sole opinion of the Engineer.
- f. "Burlap Finish" shall be 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 from a bridge that shall not come in contact with the fresh concrete at any point. The use of any burlap that causes irregularities or grooves greater than one-sixteenth 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 is in such a condition that the surface will be 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. "Tine finish" and acceptance criteria for "Tine finish" shall conform to the requirements of the NJ DOT Standard Specifications, Subsection 405.13, Item G.
 - j. "Saw Cut Grooved Surface" shall conform to the requirements of the NJ DOT Standard Specifications, Division 500. For deck slabs, conform to Subsection 501.15, Item 3. For overlays, conform to Subsection 518.06, Item C13.
 - k. Concrete Curbs and Sidewalks:
 1. Give sidewalks a "Float Finish" and tool edges and joints for a width of two 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.
3. Removal of Forms

Removal of forms shall be subject to the following:

- a. Remove forms in accordance with the requirements of Specification Section 03100 entitled CONCRETE FORMWORK.
- b. Machine finishing shall conform to NJDOT Standard Specifications Subsection 405.13, Item B. 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.
- c. After forms are removed, cure sides of slabs greater than 12 inches in thickness in accordance with 3.03.
- d. 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. Remove all fins and other surface irregularities 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.

3.03 For CURING requirements, see 3.05, Section 03301, entitled PORTLAND CEMENT CONCRETE, LONG FORM. For exterior slab and overlay work, perform wet-curing procedures immediately after the concrete has been worked with a screed.

3.04 CORRECTION OF DEFICIENCIES

A. Diamond Grinding and Partial Depth Removal

1. Cured riding surfaces that do not meet the smoothness or finished grade requirements set forth in 1.04B shall be corrected, to obtain the specified smoothness deviation, as follows:
 - a. High spots between 1/8" and 1/2" and surfaces that exceed the finished grade requirements shall be identified and ground with diamond grinding equipment.
 - b. Low spots between 1/8" and 1/2" and surfaces that are below the finished grade requirements shall be corrected by partial depth removal of the entire slab to 1" below rebars by hydrodemolition, or by hydromilling and constructing an overlay in conformance with these specifications.
 - c. Remove slab areas that exceed finished grade or smoothness criteria by more than 1/2" as set forth in 3.04B.
2. Diamond grinding equipment will be subject to Engineer's approval and shall have a minimum grinding head of 36 inches.
3. Where grinding is required, grind the entire width of the riding surface by the length of defective area. In the sole opinion of the Engineer, if the deficiencies are closely spaced and grinding individual areas will adversely affect ride, grind the entire surface.
4. Slurry produced from grinding operations shall be disposed of outside of Port Authority property.
5. Perform diamond grinding, partial depth removal and construction of an overlay, if required to correct deficiencies, at no additional cost to the Authority.

B. Remove and Replace Slabs

Remove and replace full concrete slabs in a manner approved by the Engineer and at no additional cost to the Authority if any of the following deficiencies exist in the finished riding surface, unless the Engineer elects to accept the concrete:

1. Slabs showing high or low spots exceeding 1/2 inch when tested in accordance with 1.04B.
- C. If the slab concrete is found to have developed plastic shrinkage cracks, repair it at no cost to the Authority with an approved epoxy or methacrylate repair system or remove as directed by the Engineer.
- D. If concrete finishes do not meet the requirements set forth for the specified finishes,

re-finish the hardened concrete as directed by the Engineer, at no cost to the Port Authority.

END OF SECTION

SECTION 03300
PLACEMENT OF CONCRETE
SUBMITTALS
APPENDIX "A"

Submit the following to the Engineer for approval except as otherwise noted:

A. Shop Drawings

1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples".
2. Proposed number, location and details of contraction, control, expansion and construction joints at least 15 days prior to concrete placement.
3. Test placement details at least 15 days before test placement.

B. Catalog Cuts, Material Certification and Test Results

1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples".
2. At least 35 days prior to concrete placement, the following:
 - a. Brand name and chemical composition of form oil.
 - b. Source of expansion and/or contraction joints.

C. Samples

1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples".

D. Construction Procedures, and Quality Control and Assurance Documents

1. At least 35 days prior to concrete placement, the following:
 - a. Surface Preparation Plan for surfaces on which concrete will be placed.
 - b. Type, number and method of application of concrete vibrators.
 - c. Method of concrete placement in pipe piles (including elephant trunk size, length and material type).
 - d. Method of concrete placement and consolidation adjacent to joint assemblies and embedded hardware.

E. Design Computations

1. If required by the Engineer or noted on the Contract Drawings, design computations shall be signed and sealed by the Professional Engineer licensed in the state where Work is being done.

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, 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

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):Standard Specifications for Highway Bridges

M 182	Burlap Cloth Made From Jute or Kenaf
TP 26	Quality of Water to be Used in Concrete
T 277	Electrical Indication of Concrete's Ability to Resist Chloride
T 318	Water Content of Freshly Mixed Concrete Using Microwave Oven Drying

American Concrete Institute (ACI)

211	Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
213	Guide for Structural Lightweight Aggregate Concrete
222R	Corrosion of Metals in Concrete
301	Specifications for Structural Concrete for Buildings
302.1	RGuide for Concrete Floor and Slab Construction
303.1	Cast in Place Architectural Concrete
304R	Guide for Measuring, Mixing, Transporting and Placing Concrete

- 304R Chapter 8: Concrete Placed Under Water
- 305R Hot Weather Concreting
- 306R Cold Weather Concreting
- 308 Standard Practice for Curing Concrete
- 318 Building Code Requirements for Reinforced Concrete
- 548.4 Standard Specification for Latex Modified Concrete Overlays

American Society for Testing and Materials (ASTM):

- C 31 Practice for Making and Curing Concrete Test Specimens in the Field
- C 33 Specification for Concrete Aggregates
- C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C 42 Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- C 78 Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
- C 88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- C 94 Specification for Ready-Mixed Concrete
- C 109 Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
- C 114 Test Methods for Chemical Analysis of Hydraulic Cement
- C 131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C 138 Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
- C 143 Test Method for Slump of Hydraulic Cement Concrete
- C 150 Specification for Portland Cement
- C 156 Test Method for Water Retention by Concrete Curing Materials
- C 157 Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
- C 171 Specification for Sheet Materials for Curing Concrete
- C 172 Practice for Sampling Freshly Mixed Concrete
- C 173 Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- C 174 Measuring Length of Drilled Concrete Cores

- C 191 Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
- C 227 Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
- C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- C 260 Specification for Air Entraining Admixtures for Concrete
- C 289 Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
- C 309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- C 311 Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
- C 330 Specification for Lightweight Aggregates for Structural Concrete
- C 494 Specification for Chemical Admixtures for Concrete
- C 535 Test for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- C 566 Test Method for Total Moisture Content of Aggregate by Drying
- C 567 Test Method for Unit Weight of Structural Lightweight Concrete
- C 618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
- C 979 Specification for Pigments for Integrally Colored Concrete
- C 989 Specification for Ground Granulated Blast Furnace Slag for Use in Concrete and Mortars
- C 1064 Test Method for Temperature of Freshly Mixed Portland Cement Concrete
- C 1116 Specification for Fiber-Reinforced Concrete and Shotcrete
- C 1152 Test Method for Acid-Soluble Chloride in Mortar and Concrete
- C 1218 Test Method for Water-Soluble Chloride in Mortar and Concrete
- C 1240 Specification for Silica Fume for Use in Hydraulic Cement Concrete and Mortar
- C 1583 Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials By Direct Tension (Pull-Off Method)
- C 1611 Slump Flow of Self Consolidating Concrete
- D 3665 Practice for Random Sampling of Construction Materials
- D 4580 Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding
- D 4791 Test Method for Flat and Elongated Particles in Coarse Aggregate

D 4833	Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
D 5199	Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
E 965	Standard Test Method for Measuring Pavement Macrotexture Depth Using a Volumetric Technique
E 1347	Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry

US Army Corps of Engineers

Handbook of Concrete and Cement

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°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°F and monitored, or at temperatures specified in ACI 306R, Table 3.1, whichever is more stringent. In addition, demonstrate that the specified concrete properties can be achieved within the time requirements specified while maintaining a minimum curing temperature of 50°F.
3. Do not mix or place concrete when the ambient temperature is below 35°F, or when conditions indicate that the temperature will fall below 35°F within 72 hours, unless the areas to receive fresh concrete are insulated or enclosed, and maintain the concrete temperature at 50°F or in accordance with Table 3.1 in ACI 306.
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°F. The use of chemicals to eliminate frost will not be permitted.

B. 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°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°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°F by scheduling 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/ft²/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/ft²/hr.
4. If the concrete temperature reaches 92°F as measured at the construction site in accordance with ASTM C 1064, it will be rejected.

1.04 QUALITY CONTROL

A. General

1. Maintain a level of Quality Control sufficient to consistently provide the end result performance properties specified herein. In addition:
 - a. Provide 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.

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 Program Administrator 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 Construction airport and/or highway concrete construction experience.
 - (2) NICET Level III certified engineering or materials technician in Civil Engineering Technology with 5 years of airport and/or highway concrete construction experience.

- (3) New Jersey ACI Chapter's "Concrete Construction Technology" course with 5 years of airport and/or highway concrete construction experience.
 - (4) ACI Concrete Transportation Construction Inspector 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 each test is to be performed.
 - a. Include the performance of gradation and moisture content of testing for fine and coarse aggregates in accordance with ASTM C 136 and ASTM C 566, 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. 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.
5. Requirements 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 FOUR 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 Division Laboratory. 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 Section 2.03C 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 according to scale 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 actual size, but shall be 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.
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 in close proximity 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, test pour, and to discuss the methods and procedures to achieve the specified concrete quality. The Contractor shall notify the Engineer and shall 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. The Contractor shall, 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. Minutes of the meeting shall be recorded, typed, and printed by the Contractor and distributed to all attendees of the meeting within 5 days of the date of the meeting.
- C. The pre-concrete construction meeting shall not be scheduled until all of the following have been submitted for approval, as applicable to the Work of the Contract:
1. Mix Proportions
 2. Admixture dosage charts showing the effects of concrete temperatures from 50°F to 90°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. For submittals - see Appendix "A".
- 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 has not been approved by either the New Jersey or New York State Department of Transportation.

2.02 MATERIALS

- A. Cement: Conforming to ASTM C 150, Type I and II, as well as Type III where early strength gain is required and may be used, 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 C 39. During cold weather concrete construction, demonstrate that the specified compressive strength can be obtained at a curing temperature of 50°F.
 - 2. Absolute drying shrinkage less than, or equal to, 0.04% at 28 days for the mix proportions containing the Very High Early Strength Cement in accordance with ASTM C 157 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 C 191, 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 a Lot of cement not to exceed every 50,000 pounds of cement to be used for production. Provide 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 m²/kg
 - 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 as manufactured by or an approved equal:
 - 1. MetaMax manufactured by Engelhard, Iselin, New Jersey.
 - 2. PowerPozz manufactured by Advanced Cement Technologies, LLC, Blaine, Washington.
- E. Fly Ash: Conforming to ASTM C 311 and ASTM C 618, Class F except the maximum loss on ignition shall be less than 4%.
- F. Slag: Conforming to ASTM C 989, Grade 120.
- G. Fine Aggregate: Conforming to ASTM C 33, ASTM C 227, ASTM C 289, and ASTM C 131 with a maximum percentage of wear of 30%.

H. **Coarse Aggregate (Normal Weight Concrete):** Conforming to ASTM C 33, ASTM C 227, ASTM C 289, ASTM C 535 with a maximum percentage of wear of 40%, and ASTM C 88 with a magnesium sulfate loss of not more than 12% for a five-cycle test period. Trap rock or gneiss shall be used for all roadway 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 not be 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 or on the Contract Drawings.

1. For full depth pavement concretes unless otherwise shown on the Contract Drawings 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 C 136:

Sieve Size % Passing	For Pavement 10 Inches or Greater in Thickness		For Pavement Less Than 10 Inches in Thickness	
	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 C 33 Size Number 8, coarse aggregate. The ratio of coarse aggregate to fine aggregate by volume shall not be 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 C 33 Size Number 8.
4. **Minimum Volume of Coarse Aggregate:** All mixes shall contain a minimum of 39% coarse aggregate by volume, with the exception of 1) applications specified in Part 2.02.H.1-4, 2) Performance Category VI applications, 3) bridge decks, and 4) mixes containing ASTM C33 Size #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 #8 stone not covered in Part 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.

- I. Coarse Aggregate (Lightweight Concrete):
1. Expanded clay or shale produced by the rotary kiln process conforming to ASTM C 330 shall be graded in accordance with the requirements for ¾" to No. 4 sieve sizes shown in Table I of that specification.
 2. The oven dry unit weight of plant-tested, lightweight aggregate shall not vary 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 TP 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 C 260.
- M. Admixtures: All admixtures shall conform to ASTM C 494. They shall not contain more than 0.05% chloride ions, and shall be used in accordance with the manufacturer's recommendations. Dosage charts, including the effects of concrete temperatures from 50°F to 90°F, shall be submitted to the Engineer. All admixtures shall be manufactured by one of the following:
1. Euclid Chemical Company
 2. W.R. Grace & Company
 3. Master Builders Technologies
 4. Sika Corporation
- N. Polycarboxylate High Range Water Reducer: For use when self-compacting concrete is desired and approved by the Engineer. Conforming to ASTM C 494, 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 performed 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 Master Builders Technologies
- O. Corrosion Inhibitors:
1. Corrosion Inhibitor shall be one of the following:
For cast in place or precast:
 - a. "DCI-S" as manufactured by W.R. Grace & Company.
 - b. "Eucon CIA" as manufactured by Euclid Chemical Company.
 - c. An approved equal.

For precast applications only:

- a. "Sika CNT" as manufactured by Sika Corporation.
 - b. "Rheocrete CNT" as manufactured by Master Builders Technologies
 - c. 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. A retarder and/or other admixtures shall be used to assure 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°F to 90°F.
- P. Viscosity Modifying and/or Self-Consolidating Admixtures: may be required for tremie concrete applications at the rate recommended by the manufacturer. Concrete shall be tested 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 3 standard test drops in water.
- Q. Pigments: Conforming to ASTM C 979.
- R. Curing Materials:
1. Apply Liquid Membrane Forming Curing Compound immediately after surface moisture has evaporated. Apply two full applications perpendicular to each other. Allow the first coat to become tacky prior to application of the second coat. 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" by Vexcon Chemicals Inc.
 - f. Day-Chem White Pigmented Cure (J-10-W) 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 C 309 Type 2, Class B materials. ASTM C 309 Type 1 D, Class B membranes are acceptable for other exterior applications. ASTM C 309 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 (V.O.C.) compliant for both the states of New York and New Jersey. Certification of compliance shall be submitted 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 1 curing compounds, and 200 square feet per gallon per coat for Type 2 curing compounds when tested in accordance with ASTM C-156.
3. Burlap: conforming to AASHTO M 182, Class 3, weighing approximately 9 oz./sq. yd. dry.
4. Sheet Material: Conforming to ASTM C 171.
- a. Polyethylene Film:
 - (1) White opaque, where curing surface is exposed to sun
 - (2) Clear, for other applications
 - b. White Burlap Polyethylene Sheet
5. Cotton Mats: conforming to ASTM D 5199 with a minimum thickness of 40 mils, ASTM C 156 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 Master Builders Technologies
 - 4. "SikaFilm" as manufactured by Sika Corporation
 - 5. "Aquafilm" as manufactured by Conspec Marketing & Manufacturing Company, Inc.
- T. Fiber Reinforcement:
- 1. Polypropylene Fibers
 - a. Provide 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 C 1116, 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 not be less than the minimum requirements of 2.02.T.1.b.1. and 2.02.T.1.b.2.
 - (7) Fiber manufacturer or approved distributor: Provide the services of a qualified representative at the pre-concrete construction meeting and for the first two days of fibrous concrete placement production.

2.03 MIX PROPORTIONS

- A. Develop mixes in accordance with the latest editions of ACI 211, ACI 301, and ACI 318 to produce 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, 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 perform testing shall have AASHTO 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, pozzolons, aggregates, admixtures that will be used at the proposed batch plant. In addition to fineness modulus of fine aggregate, the applicable properties listed in 1.05.A.1.a. shall also be shown. 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 40% for slag, unless otherwise approved by the Engineer. When using fly ash or slag for Category IV applications, use a minimum of 30% fly ash or 40% slag substitution by total weight of cementitious material. Fly ash and slag substitution in the same mix may be permitted upon approval by the Engineer.
2. For concrete placed underwater, the minimum cementitious material content shall be 700 pounds per cubic yard of concrete.
3. Water to cement ratio shall be computed 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.
4. For Categories II, III and IV concrete applications, the mix water to cement ratio shall not exceed 0.37 and the absolute drying shrinkage at 28 days shall not exceed 0.04% in accordance with ASTM C 157 (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 without calcium nitrite and 1,500 when the mix contains calcium nitrite. 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 performed at 90 days instead of 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 0.04% in accordance with ASTM C 157 (Air Drying Method). 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° to 90° 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 C 231 for normal and heavyweight concrete mixes, and ASTM C 173 for porous, lightweight aggregate.

7. Make adjustments to the weight of coarse, lightweight aggregate in accordance with the following:
 - a. Design lightweight concrete mix proportions not to exceed 123 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. For lightweight aggregate mixes, advise the batch plant 72 hours prior to pouring in order to saturate the aggregate. Lightweight coarse aggregate shall be presoaked a minimum of 72 hours prior to mixing of concrete. The lightweight aggregate shall have an absorbed moisture content not less than the manufacturer's written recommendations or the concrete will be rejected.
- 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 not be less than 7.6 cubic feet (absolute volume).
- C. Architectural Concrete
 1. A minimum of 35 days prior to construction of a mock-up, submit mix proportions and 2 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 Division Laboratory 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 C 979, 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 mockup in accordance with ACI 303.1 Section 1.6 Quality Assurance shall be required for approval by the Engineer. For walls, a mockup shall include all details that will be encountered in a typical day's pour. The mockup 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. The approved mock-up shall be kept at the precast concrete production facility for the Engineer's representative to compare with the production units for acceptance or rejection. Acceptance or rejection shall be determined solely by the Engineer.
 4. Mockups shall be constructed only with all of the actual constituents of the approved mix proportions. The Contractor shall 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, the Contractor will not be permitted to 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, the following shall be submitted 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 C 39): The Lower Quality Limit, LQL, shall be the specified mix compressive strength at 28 days, unless otherwise noted on the Contract Drawings.
 2. Flexural Strength (ASTM C 78): The Lower Quality Limit, LQL, shall be 700 psi at 28 days, unless otherwise noted on the Contract Drawings.
 3. Permeability (AASHTO T 277): The Upper Quality Limit, UQL, shall be 1500 Coulombs for mixes not containing a corrosion inhibitor and 2000 Coulombs for mixes that do contain a corrosion inhibitor. 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 90 days.
 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 A4 plus 0.05.
 6. Air Content (ASTM C 138, ASTM C 173 or ASTM C 231): 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	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 C 1152, ASTM C 1218, ASTM C 114, 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 specified on the Contract Drawings.
 9. Delaminations: 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 4580-86.
- B. Unless otherwise specified on the Contract Drawings, the above specified Quality Acceptance Limits shall be used for calculating 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 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.

3.02 BATCHING AND MIXING CONCRETE

- A. Measurement of Proportions
1. All concrete batching shall be in conformance with ASTM C 94 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 shall 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.
 - a. On an annual basis transit mix trucks must be inspected and approved by either the New Jersey or New York State Departments of Transportation.
 - b. 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.
 - c. Mixers which are found to be mechanically unsatisfactory shall be immediately repaired or withdrawn from use.
2. If truck mixers are used, 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 shall be available. 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, 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.
 - b. Water and cement shall be measured accurately to within 1% of the required amounts before being loaded into the mixer. Fine and coarse aggregate shall be measured accurately to within 2% of the required amounts before being loaded into the mixer.
3. The Engineer may permit one re-tempering of the concrete subject to the following:
 - a. The addition of water to the concrete mix at the construction site shall not be permitted for mix proportions with a water to cement ratio of 0.40 or less. For all other mixes, water may be added, but the total amount of water shall not exceed the approved mix proportion water to cement ratio.
 - b. The redosage of high range water reducer shall conform to the Engineer-approved redosage chart and shall not exceed the recommended manufacturer's limitation, nor shall it retard the initial set of the concrete by more than 30 minutes.
 - c. Concrete that has partially hardened or has attained its initial set shall not be re-mixed or re-tempered, and will be rejected.
 - d. The Engineer reserves the right to reject concrete that has not been placed within 90 minutes from the time the cement had first contact with water or, if the concrete temperature reaches 92°F, as measured in accordance with ASTM C 1064.
 - e. When air content is below the lower quality limit specified in 2.04A.6.

4. **Construction Site Mixing:** Measure mix components in accordance with tolerances given in ASTM C 94. 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 be readily adjustable to provide for 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. The Engineer may also perform testing of 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. Mixing shall be 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 C 566. If these limits are exceeded, concreting operations shall not continue until drier aggregates are obtained. The Engineer may view and copy all records for moisture content testing at any time.

3.03 PRE-PLACEMENT FIELD REQUIREMENTS

- A. During all concrete placements at the construction site, the Contractor shall be required to have an individual in a supervisory capacity present with a valid certification from one of the following programs:
1. ACI Concrete Transportation Construction Inspector
 2. New Jersey ACI Chapter's "Concrete Construction Technology" course.
- 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°F to 80°F or 68° F to 78° F when the design compressive strength is 6000 psi or greater, and to provide the moisture to maintain the curing conditions specified in ASTM C 31. During hot weather when the temperature is greater than 80°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 such boxes from vibration or 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 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. 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. Placement shall not begin 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.
- F. 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.
- G. 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. 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°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°F for

applications with a minimum dimension less than 12 inches; 40°F for applications with a minimum dimension between 12 and 36 inches; 30°F for applications with a minimum dimension between 36 and 72 inches; and 20°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.

B. Wet Curing

1. All pavement concrete and structural slabs: Immediately after screeding of the concrete, apply an evaporation retardant, or commence the operation of a fog spraying system to keep moisture in the atmosphere surrounding the concrete until all concrete finishing has been completed. Do not direct fogging at the fresh concrete and do not permit ponding of water on the fresh concrete surface.
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, such 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 have a length at least one foot greater 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.
4. Wet curing procedures may be stopped only when: the ambient temperature is expected to fall below 35°F within 24 hours, when placing concrete for slabs directly adjacent to the fog spraying system or soaker hoses or when concrete is to receive traffic.
 - a. When the ambient temperature at the surface of placement is 35°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.d.
 - 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 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.d.
 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, 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. Choice of curing material and method shall be as approved by the Engineer.
 - b. Polyethylene film or burlap polyethylene sheet, if used, shall be lapped at edges and ends at least one foot and shall have all ends and edges taped to adjacent sheets or surfaces to completely seal areas to be cured. Secure in a manner that will not allow the film, the sheets, or the securing mechanism to be removed by wind forces, resulting in exposure of the fresh concrete and rapid drying.
 - c. Inspect sheet material before reuse. Repair all holes and tears with cemented patches, subject to approval by the Engineer.
 - d. Apply liquid membrane forming curing compound 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 of such occurrence.
 - (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.

3.05 QUALITY ASSURANCE TESTING, SAMPLING, AND INSPECTIONS

- A. Quality Assurance testing during mixing and placing of concrete will be performed on samples taken from the end of the pump line or at the point of discharge in accordance with ASTM C 172. 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, cylinders will be made in accordance with ASTM C 31 when testing for compressive strength, as well as 4x8 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 C 39 and ASTM C 78 respectively for each Sublot to determine the compressive strength and flexural strength at the time requirements specified.

TABLE I
LOTS AND SUBLOTS

<u>Daily Placement Quantity (Cubic Yards)</u>	<u>Number of Lots</u>	<u>Number of Sublots</u>
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 I Notes:

1. If a given Class of concrete has one Work period's placement 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 C 31 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, 4" x 8" cylinders will be used when the nominal maximum size of the coarse aggregate allows. 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 C 39. The Engineer will calculate the average of 2 test specimens at the compressive strength time requirement. The average of the two test specimen result values for each Sublot shall be considered the Sublot compressive strength value.
2. **Flexural Strength:** From each Sublot sample, cast beams in accordance with ASTM C 31. Engineer will test the beams in accordance with ASTM C 78 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.
3. **Slump Test:** Performed by the Engineer at the point of delivery during the time of placement in accordance with ASTM C 143 or ASTM C1611 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.

4. **Air Content Test:** Performed during the placement in accordance with ASTM C 138, ASTM C 173 or ASTM C 231. The Engineer will perform one test for each Sublot, which will be considered the Sublot air content test value.
 - a. When results for either two consecutive tests or three tests in one lot or days production indicate that the air content is outside the Quality Limits specified in 2.04A.6 by +1.0 or -0.50% the placement of the next load will be delayed until test results are obtained. If the air content for this load is outside the Quality Limits specified in 2.04A.6, it will be rejected. The Engineer will test subsequent loads until the air content is found to be within the specified limits of 2.04A.6.
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 C 138. For lightweight concrete, the plastic unit weight, as determined in accordance with ASTM C 567, shall not exceed 125 pounds per cubic foot 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 T318. He may adjust drying times depending on the mix constituents to provide 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 1½ inches, the Engineer will obtain a sample of approximately 5000 grams. 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 subplot water cement ratio as given above.
 - a. When results for either two consecutive tests or three tests in one lot or days production indicate that the water content exceeds the limits given in 2.03A.4 by 0.10, do not place the next load until test results are 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 2.04A.5.
7. **Coulomb Test:** To evaluate the permeability of the concrete the Upper Quality Limit, UQL, shall be 1500 Coulombs for mixes without a corrosion inhibitor and 2000 Coulombs for mixes containing a corrosion inhibitor, as tested by the Engineer in accordance with AASHTO T 277 after a 28 day wet cure. For mixes containing only fly ash or slag, no silica fume or metakaolin, permeability shall be evaluated at 90 days, using the same performance requirements stated above (1500 Coulombs for mixes without a corrosion inhibitor and 2000 Coulombs for mixes with a corrosion inhibitor). 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 two-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 C 1583. 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 shall be evaluated as follows. Powder samples from 28 day concrete cylinders, prepared in accordance with ASTM C 31, shall be tested to assess both the acid soluble and water soluble chloride ion concentrations by weight of cementitious material from the concrete mix produced at the construction site. 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 shall be obtained from the inner three inches of the cylinder specimen, and shall 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 Division Laboratory in accordance with preparatory standards ASTM C 1152 and ASTM C 1218, respectively, followed by ASTM C 114 (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 shall be cored for verification. The cores will be measured in accordance with ASTM C 174. The average of three test result values for the Sublot will be considered the Sublot test value.
11. 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 shall be obtained in accordance with ASTM C 42 and shall be drilled full depth (or thickness) through the pour horizontally or vertically as applicable.
 - b. Recovery of less than 95 percent shall be considered to indicate defective concrete requiring corrective action by the Contractor.
 - c. 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 shall be taken at the sole expense of the Contractor.
 - d. All test core holes shall be filled by the Contractor by pressure grouting from the bottom upward, or from the inside out, as the case may be.
 - e. All voids, honeycombing, seams, or other defects shall be cleaned out and filled by pressure grouting with cement or sand-cement by the Contractor to the Engineer's satisfaction. Additional cores may be required to verify grouting, which shall be at the sole expense of the Contractor.
- 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. Such samples shall be taken 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. Any mix proportion constituents may be sampled by the Engineer 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 provide a planned schedule and Quality Control Plan for all production for the Work of the Contract.
- E. Precast Concrete: Arrange for the fabricator to provide the Engineer with a set of approved shop drawings for the Work of the Contract. Allow the Engineer to have access to the shop drawings at all times and to make copies of them at any time. 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.

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, \bar{X} , as defined in 4.01.D.3., the Lot sample standard deviation, S_N , as defined in 4.01.D.4., for the specified number of Sublots, n , and 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 shall be based on the concrete application for a Lot, and the criteria defined below.

<u>Performance Parameters</u>	<u>Minimum PWL</u>
Flexural 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 G.2.

** 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.

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 efficiencies found to exist as specified in 4.01.G. shall govern, and the Contractor shall either:

1. remove and replace the concrete in that particular Lot at no cost to the Authority, or
2. accept a deduction of 50% of the Base Price per cubic yard, as indicated on the Contract Drawings, for that particular Lot of concrete.

**TABLE 2
PERFORMANCE CRITERIA PARAMETERS**

Category/ Application	Water/Cement Ratio (W/C)	%Air	Permeability	Bond Strength	Compressive Strength	Flexural Strength	Pavement Thickness
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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:	0.42	*	---	---	---	---	---

Category III - Elevated Structural Overlays

	I	I	I	P	I	---	---
LQL:	---	*	---	150 psi	***	---	---
UQL:	0.42	*	**	---	---	---	---

Category IV - Structural (exposed to freeze-thaw and/or sulfates, in addition to chlorides or a marine environment)

	I	I	P	---	I	---	---
LQL:	---	*	---	---	***	---	---
UQL:	0.42	*	**	---	---	---	---

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
- ** - 1500 Coulomb counts for mixes without a corrosion inhibitor and 2000 Coulomb counts for mixes with a corrosion inhibitor
- *** - the proportion compressive strength at 28 days
- P - Used to Calculate Pay Factor per cubic yard. It denotes the concrete property that shall be used to calculate payment for a given concrete application. No incentive payments shall 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 & Unbonded Overlay (Category I) Final Pay Factor: The Pay Factor for Pavement Thickness shall 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, \bar{X} , by calculating the average of all Sublot test values.
4. Find the Lot sample standard deviation, S_N , by using the following formula:

$$S_N = \sqrt{\frac{d_1^2 + d_2^2 + d_3^2 + \dots + d_n^2}{n - 1}}$$

Where:

S_N = standard deviation of the Sublot test values

d_1, d_2, \dots = deviation from the individual Sublot test values

X_1, X_2, \dots from the Average value, \bar{X} , that is,

$$d_1 = (X_1 - \bar{X}), d_2 = (X_2 - \bar{X}), \dots, d_n = (X_n - \bar{X})$$

n = number of Sublots

5. Find the Lower Quality Index, Q_L , by subtracting the Lower Quality Limit, LQL, from the Average value, \bar{X} , and dividing the result by S_N .

$$Q_L = \frac{\bar{X} - LQL}{S_N}$$

6. Find the Upper Quality Index, Q_U , by subtracting the Average value, \bar{X} , from the Upper Quality Limit, UQL, and dividing the result by S_N .

$$Q_U = \frac{UQL - \bar{X}}{S_N}$$

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 entering Table 4, "Percent of Lot Within Tolerance Limit (PWL) (Standard Deviation Method)" with Q_L and/or Q_U using 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

<u>Percent Within Limits (PWL)</u>	<u>Compressive Strength Pay Factor</u>
98 - 100	0.02 (PWL-100) + 0.06
95 - 97	0.0
55 - 94	(PWL-95)/100
0 - 54	-0.50

<u>Percent Within Limits (PWL)</u>	<u>Permeability & Bond Strength Pay Factor</u>
91 - 100	0.006 (PWL - 90)
80 - 90	0.0
55 - 79	0.00017PWL ² - 0.0105PWL - 0.30
0 - 54	-0.50

<u>Percent Within Limits (PWL)</u>	<u>Flexural Strength Pay Factor</u>
95 - 100	(PWL-95/100)+.01
55 - 94	(PWL-95)/100
0 - 54	-0.50

<u>Percent Within Limits (PWL)</u>	<u>Pavement Thickness Pay Factor</u>
90 - 100	0.00
55 - 89	(PWL-90)/100
0 - 54	-0.50

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.

<u>Category</u>	<u>Base Prices for Adjustments to Contract Compensation Per Cubic Yd</u>
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

- I. 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.
 - (3) If either or both of the requirements specified in 4.01.G.1.d.1. and 4.01.G.1.d.2. are not met, investigate the in-place compressive strength in accordance with ACI 318-99, 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.d.1. and 4.01.G.1.d.2., the concrete shall be considered deficient, and 4.01.G.1. shall 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 Section 4.01.G.1. If the concrete is accepted by the Engineer, seal cracks in accordance with Specification Section 03734, "Concrete Crack Repair", in a manner approved by the Engineer, and at no cost to the Authority.

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- c. **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.
 2. If the average air content for a Lot exceeds either the LQL or the UQL by more than 1% with the exception of those 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.

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)

<u>PWL</u>	<u>N=3</u>	<u>N=4</u>	<u>N=5</u>	<u>N=6</u>	<u>N=7</u>	<u>N=8</u>
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

DIVISION 3

SECTION 03301

PORTLAND CEMENT CONCRETE, LONG FORM

SUBMITTALS

APPENDIX "A"

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.
- 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 a 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, an independent testing laboratory to verify that the Very High Early Strength Cement meets the compressive strength, absolute drying shrinkage, and setting time requirements, as per 2.02.B at the testing frequency specified therein.
 - c. Brand name and chemical composition of form oil or release agents, evaporation retardant and liquid membrane curing compounds. For Architectural Concrete, also include this information 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.1.d., 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°F to 90°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°F and 90°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.

D. Samples :

1. Concrete ingredients for trial batches 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, provide cement, fly ash, slag, and/or silica fume samples to check the Mill Certification at any time in accordance with 3.05.C of the Specification.
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, provide the methods of proportioning, mixing (including minimum time requirements), transferring and placing the concrete.
 - h. Curing Procedure Plan in accordance with 3.04, including the method and materials for curing.
 - i. Control Joint Location Plan.
 - j. Materials and procedures for filling cracks and patching honeycombs and/or spalls.
2. Daily copy of batch records in accordance with 1.04.A.1.a of the Specification.

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. of the Specification.
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.

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 03420

PRECAST PRESTRESSED CONCRETE FOR BUILDING CONSTRUCTION

PART 1. GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for structural precast prestressed concrete for building construction.
- B. All concrete shall be cast in forms at plant before final placement at the construction site.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

Building Code of the City of New York or the New Jersey Uniform Construction Code

As applicable.

Prestressed Concrete Institute (PCI)

- | | |
|-------------|---|
| PCI MNL-116 | Manual for Quality Control Plants and Production of Precast Prestressed Concrete Products |
| PCI MNL-120 | PCI Design Handbook Precast and Prestressed Concrete |

American Concrete Institute (ACI)

- | | |
|---------|--|
| ACI 211 | Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete |
| ACI 214 | Practice for Evaluation of Strength Test Results of Concrete |
| ACI 301 | Specifications for Structural Concrete for Buildings |
| ACI 318 | Building Code Requirements for Reinforced Concrete (Commentary Included) |

American Society for Testing and Materials (ASTM)

- | | |
|------------|---|
| ASTM A 36 | Structural Steel |
| ASTM A 82 | Cold-Drawn Steel Wire for Concrete Reinforcement |
| ASTM A 153 | Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A 185 | Welded Steel Wire Fabric for Concrete Reinforcement |
| ASTM A 416 | Uncoated Seven-Wire Stress-Relieved Strand for Prestressed Concrete |
| ASTM A 497 | Welded Deformed Steel Wire for Concrete Reinforcement |

ASTM A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 666	Austenitic Stainless Steel, Sheet, Strip Plate and Flat Bar for Structural Applications
ASTM A 775	Epoxy-coated Reinforcing Steel Bars
ASTM A 884	Epoxy-coated Steel Wire and Welded Wire Fabric For Reinforcement
ASTM C 31	Method of Making and Curing Concrete Test Specimens in the Field
ASTM C 33	Concrete Aggregates
ASTM C 42	Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 109	Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm Cube Specimens)
ASTM C 138	Test for Unit Weight, Yield and Air Content (Gravimetric) of Concrete
ASTM C 143	Test Method for Slumped Portland Cement Concrete
ASTM C 150	Portland Cement
ASTM C 171	Sheet Materials for Curing Concrete
ASTM C 173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Air-Entraining Admixtures for Concrete
ASTM C 309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	Standard Specification for Chemical Admixtures for Concrete

American Welding Society (AWS)

AWS D1.1	Structural Welding Code - Steel
AWS D1.4	Structural Welding Code - Reinforcing Steel

American Association of State Highway Transportation Officials (AASHTO)

Division II, AASHTO Standard Specifications for Highway Bridges, Bearing Devices

Steel Structures Painting Council (SSPC)

SSPC SP10	Near-White Metal Blast Cleaning
SSPC-Vis1	Guide to Pictorial Surface Preparation Standards for Painting Steel Surfaces

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. General

1. All design and detailing required by the Contract Drawings for precast prestressed concrete Work shall be in accordance with ACI 318, the Building Code and the criteria of Section 1.03 C.

B. Building Code

Conform to the applicable requirements of the New Jersey Uniform Construction Code (BOCA) or the Building Code of the City of New York.

C. Structural Design Criteria

Precast prestressed concrete components shall be designed based upon the following structural criteria:

1. Allow for expansion and or contraction, without over- stressing the precast unit and connections, or adjoining construction due to a temperature range of 100 degrees F and shrinkage stresses.
2. Withstand all forces generated by load transfer, anchorage, stripping, handling, transportation and erection stresses. Temporary forces generated by construction activity shall also be considered. No damage to members shall be permitted from forces due to these activities.

D. Working Drawings and Calculations

1. Prepare shop fabrication drawings showing prestressing steel profile, reinforcement, openings, embedded products, stirrups, studs, loop inserts, bearing shoes, connections, sleeves, confinement angles, shear ties, estimated camber, prestressing steel deflection on rollers, finishes, and portions of work for which complete details are not indicated; indicate method of supporting and securing those products. Indicate loads used in the design.
2. Prepare design calculations of the precast prestressed concrete units and connections prior to submission of shop drawings. Include design calculations for elastomeric bearing pads. Calculations shall be signed and sealed by a Professional Engineer with a minimum of five years experience in prestressed work, and licensed in the State where the Work is to be performed.
3. Prepare a complete description of erection procedures, including erection drawings, methods of hoisting, shoring, jointing, temporary bracing, temporary connections and methods of erection, setting and installing. All erection drawings, information related to procedures, temporary bracing, etc. shall bear the seal of a Professional Engineer with a minimum of five years experience in erection of prestressed work, and licensed in the State where the Work is to be performed.

E. Connections

Design, detail and provide anchors, dowels, bolts, steel welding inserts, and connecting plates as necessary in connection with the fabrication and erection of precast prestressed concrete members to be held in position rigidly to prevent displacement while concrete is being placed. All welding during manufacture and erection shall be in accordance with AWS D1.1 and AWS D1.4, as applicable.

F. Reinforcing

Conform to requirements of ACI 318. Reinforce all bearing areas against diagonal tension, splitting, rupture and flexure. Place extra ties, stirrups and reinforcing bars at support points. Allow no bearing pressure in edges of unreinforced sections.

G. Concrete Mix Design

1. The precast concrete manufacturer shall design the concrete mix. The following criteria shall apply:
 - a. $f_c = 5,000$ psi minimum.
 - b. $w/c = 0.4$ max
 - c. Air content Range: $5\% \pm 1\%$
 - d. Slump: In accordance with ASTM C 143, but not more than 5 inches or 8 inches when using a high range water reducer.
 - e. Aggregates: Size number 67 and in accordance with ACI 211.
2. The mix design shall be prepared in accordance with ACI 318. The mix design selected shall have been previously evaluated by the concrete producer using established methods of statistical quality control in conformance with ACI 318.

1.04 QUALITY ASSURANCE

A. Precast Concrete Manufacturer Qualifications

1. Precast Plant

Precast prestressed concrete shall be the product of a manufacturer having a minimum of five years experience in casting units of the type shown on the Contract Drawings, and having the capacity and facilities for producing units of the quality specified in this Section.
2. The Engineer will inspect the plant prior to production for production and quality control capabilities.
3. Manufacturer Qualifications

The precast concrete manufacturing plant shall be currently certified by the Prestressed Concrete Institute Plant Certification Program.
4. The plant quality control and engineering shall be under the direction of a licensed Professional Engineer with at least five years experience in this field.

B. Precast Concrete Installer Qualifications

The entity performing installation of precast concrete shall have successfully completed at least two projects involving quantities and complexities similar to those required under this Contract or a minimum of five years experience in erecting structures of similar type as shown on the Contract Drawings.

C. Allowable Tolerances

1. Tolerances prescribed by PCI MNL-116 shall be complied with unless otherwise noted on the Contract Drawings.
2. Accuracy of Tensioning Measurements per PCI MNL - 116.

D. Source Quality Control

1. Quality control, inspection and testing to comply with applicable sections of PCI MNL-116 and the additional requirements contained herein.

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2. The Contractor shall be responsible for achieving the quality of concrete specified in this Section by controlling the concrete mixes, placing, finishing and curing. The concrete quality control technician shall be present in the plant when Work is in progress. The Contractor shall be responsible for mix adjustments, performing necessary tests, correcting deficiencies and taking all other actions necessary to assure quality control. The Contractor shall maintain control charts showing individual test results for aggregate gradation, slump, air content, cement content and compressive strength. Data for slump, air content and compressive strength will be supplied by the Engineer.
3. Only cement approved by either the New York Department of Transportation or the New Jersey Department of Transportation shall be used.
4. **Compressive Strength Tests**
Provide a minimum of 6 cylinders for each 10 cubic yards of batched concrete of the same mix. Statistical evaluation shall be in accordance with ACI 214.
5. **Detensioning Compression Tests**
Test cylinders shall be cast in accordance with ASTM C 31 and shall be cured in the same environment as the member containing the concrete from which the cylinders were taken until detensioning or stripping at which time cylinders will be cured by ASTM C 31. Detensioning shall not take place and forms shall not be stripped until the test cylinders show that the concrete has reached 75 percent of compressive strength.
6. **Air Content**
Tests shall be made at the same time that specimens for compression tests are made. Tests shall be made in accordance with ASTM C 173 or ASTM C 231.
7. **Slump**
Tests shall be made at the same time that specimens for compression tests are made. Tests shall be made in accordance with ASTM C 143.
8. **Unit Weight**
Tests shall be made at the same time that specimens for compression tests are made. Tests shall be made in accordance with ASTM C 138.
9. **Core Tests**
If the compressive strength tests fail to meet the above requirements, core testing shall be made in accordance with ASTM C 42. If the core tests prove unsatisfactory, the unit shall not be used. Core tests shall be performed at no additional cost to the Authority.

1.05 DELIVERY, STORAGE AND HANDLING

- A. The manufacturer's instructions for handling and transportation of prestressed precast concrete units shall be followed.
- B. Lift members at designated points only, using approved lifting inserts.
- C. Do not place members in position which will cause overstress, warp, or twist.

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- D. Handle members to protect from dirt, damage and staining.
- E. Place stored members so that identification marks are discernible.
- F. Separate stacked members by battens across full width of each bearing point.
- G. Stack members so that lifting inserts are accessible and undamaged.
- H. For facade panels, in addition to the requirements above, place non-staining resilient spacers of even thickness between units and support units during shipment on non-staining shock absorbing material.

1.06 SUBMITTALS

- A. For Submittals see Appendix A.
- B. Do not deliver any precast prestressed members to the construction site until all approvals have been obtained.

PART 2. PRODUCTS

2.01 MATERIALS

- A. Portland Cement
 - 1. ASTM C 150, Type I or III standard light gray throughout unless otherwise shown on the Contract Drawings.
 - 2. Use same brand, type, and source of supply throughout.
- B. Admixtures
 - 1. Air Entraining Agent: ASTM C 260.
 - 2. Water Reducers, Water Reducer - Retarders, High Range Water Reducers and High Range Water Reducer - Retarders shall conform to ASTM C 494. They shall not contain lignosulfonic acids or their salts. Any combination of admixtures used shall not result in the addition of chloride ions in excess of the equivalent of 0.25 pounds per cubic yard of calcium chloride nor shall any individual admixture contain more than 0.4% chloride ions.
- C. Aggregates: ASTM C 33, size number 67 and in accordance with ACI 211.
- D. Water: Potable and free from foreign materials in amounts harmful to concrete.
- E. Reinforcing Bars: ASTM A 615, deformed Grade 60, epoxy coated per ASTM A 775, unless otherwise shown on the Contract Drawings.
- F. Steel Wire
 - 1. ASTM A 82 - Cold Drawn Steel Wire
 - 2. ASTM A 185 - Welded Steel Wire Fabric
 - 3. ASTM A 497 - Welded Deformed Steel Wire

4. Steel wire shall be epoxy coated per ASTM A 884 unless otherwise shown on the Contract Drawings.
- G. Tie Wires
- Minimum 16-gage annealed type. Provide nylon, plastic or epoxy coated wire for use with epoxy-coated reinforcing bars and steel wire.
- H. Tendons for Pretensioning: ASTM A 416, Grade 270.
- I. Anchors, Inserts and Embedded Items
1. Steel shapes, plates, bars.
Structural quality, hot-rolled carbon steel complying with ASTM A 36, unless otherwise shown on the Contract Drawings.
 2. Stainless steel plates, bars: ASTM A 666.
 3. Anchor Bolts
ASTM A 36, Anchor bolts, regular hexagon nuts and carbon steel washers.
 4. Finish of steel hardware units.
Steel hardware units shall be hot-dip galvanized per ASTM A 153, unless otherwise shown on the Contract Drawings.
 5. Headed Studs: AWS D1.1.
- J. Curing Materials
1. Liquid Membrane Forming Compounds: ASTM C 309.
 2. Sheet Materials: ASTM C 171.
- K. Grout
- A premix product (only water to be added at the construction site), containing shrinkage-compensating, non-metal portland cement based material, meeting the following requirements:
1. Compressive Strength
When tested in accordance with ASTM C 109, the strength shall not be less than values shown on the Contract Drawings.

Shrinkage 3 and 7 day test specimens shall show complete shrinkage correction as compared with the original height of the specimen.
 2. Setting Time
The initial setting time shall be sufficiently long so as to permit time for thorough mixing and normal conveying, handling and placing for the type of grouting operation being considered. Materials that produce very rapid set, or flash set, such that the mortar would require tempering, are not acceptable.

L. Elastomeric Bearing Pads
Chloroprene (Neoprene)

Conform to Division II, Bearing Devices of AASHTO Standard Specifications for Highway Bridges.

M. Miscellaneous Materials

1. Shims: Hot-dipped galvanized steel per ASTM A 153 or plastic. ("Korolath" as manufactured by Korolath of New England, Hudson, Mass. or approved equal.)

2. Joint Fillers and Joint Sealants

The manufacturer shall provide all required joint filler and joint sealant recess details and notches to insure a watertight installation. The manufacturer shall review the joint filler and joint sealant installation procedures and details to ensure compliance with the manufacturer's design intent. The form release agent shall be compatible with the joint sealant system.

2.02 FABRICATION

- A. Fabrication shall be governed by the provisions of PCI MNL 116 and any additional requirements contained herein.

B. Formwork

1. Construct forms to withstand tensioning and detensioning operations.
2. Construct forms to maintain units within the tolerances specified in 1.04 C herein with radius or chamfer at corners.
3. Securely attach anchorage devices to formwork in locations not affecting position of main reinforcement or placing of concrete.
4. Forms shall be made of steel.

C. Reinforcement

1. Fabricate and place concrete reinforcement as shown on Contract Drawings and on approved shop drawings in accordance with ACI 301.
2. Bend all concrete reinforcement cold. Heating of bars or steel wire is prohibited.
3. Clear concrete reinforcement of loose rust, mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
4. Additional reinforcing shall be provided to resist all tensile stresses incurred during initial prestressing, handling and erection.
5. Steel Wire Fabric: Supply in flattened sheets or mats.
6. Reinforcing Bar Accessories: Shall be of a non-corrosive type to suit the condition.
7. All reinforcement including steel wire fabric in precast concrete shall be epoxy coated unless otherwise noted on the Contract Drawings.
 - a. Reinforcing steel shall be free from slivers, rust, grease and oil. Additionally, uncoated steel shall pass bend test (displaying freedom from cracks) prior to being accepted for coating application.

- b. The surface to be coated shall be blast cleaned in accordance with SSPC-SP10. After blasting, the cleaned surface of the bar shall be defined by SSPC-Vis-1, ASa 2-1/2 or CSa2-1/2, as applicable.
- c. Repair sheared and cut ends and damaged coating with an epoxy patching material conforming to ASTM A 775 for the reinforcing bars and ASTM A 884 for the steel wire, in accordance with the patching material manufacturer's recommendation.

D. Casting

1. Place concrete in continuous operation to prevent formation of seams.
2. Where ends of strands will not be enclosed or covered, cut flush, power tool clean in accordance with coating manufacturer's recommendation and immediately paint tendon ends with two coats of epoxy mastic. Cover with a high strength mortar bonded with an epoxy resin, bonding agent.
3. Where units are to receive concrete topping for curbs or sidewalks, or where top of unit is recessed to receive concrete topping at locations such as drains, joints, and connections, provide raked finish for bonding with concrete topping in accordance with ACI. Liquid curing compounds shall not interfere with bonding.
4. Include cast-in weld plates where required for anchorage or lateral bracing to structural steel and adjacent precast members as shown on the Contract Drawings.
5. Provide block-outs for openings as required.
6. Provide permanent markings in precast units to identify pickup points and location in structure.
7. Curing of precast concrete shall be in accordance with the approved curing procedures.

E. Prestressing

1. The tension to which the strand is to be prestressed shall be established by the jack pressure reading on a calibrated gauge of approved type and verified by measurement of strand elongation. Means shall be provided for measuring the elongation of the strand to at least the nearest 1/8-inch. When the gauge reading and elongation measurement disagree by more than 5 percent, the cause of the discrepancy shall be found and corrected.
2. Strands shall not be spliced within a member.

F. Finishes

1. Concrete finishes shall be as shown on the Contract Drawings and shall conform to PCI MNL-116 Division III, Section 5 with additional requirements as follows: Fill all air pockets and holes over 1/2 inch in diameter using a sand-cement paste. For exposed areas, form offsets or fins over 1/8 inch shall be ground smooth. Finished surfaces shall be smooth, even textured, uniform in color and free of surface defects or blemishes.
2. All exposed non-galvanized carbon steel anchors and plates shall be painted with two coats of zinc-rich epoxy polyamide paint. Finish coat shall be as directed by the Engineer.

3. Touch up exposed damaged galvanized surfaces with two coats of zinc-rich epoxy polyamide paint.

G. Cracksn

Do not deliver any units which exhibit cracks in production at the plant unless approved otherwise by the Engineer. Units which are cracked by handling, shipping, erection and connecting operations shall be rejected and returned to the plant unless accepted otherwise by the Engineer. Acceptability of the units is at the sole discretion of the Engineer. Any remedial work ordered by the Engineer shall be at no additional cost to the Port Authority. The cause of the cracking shall be eliminated from the subsequent precast units.

PART 3. EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which precast prestressed concrete units are to be installed. Do not proceed with the Work until unsatisfactory conditions have been corrected to the satisfaction of the Engineer.
- B. Inspect bearing surfaces of structure to ensure they are smooth, level and free of debris.
- C. Verify that required inserts and anchors for connection to precast prestressed concrete units have been erected.

3.02 ERECTION

- A. Coordinate erection of precast prestressed concrete units according to the shop drawings.
- B. Coordinate and perform welding as required to suit connection design and structural requirements, complying with AWS D1.1 and AWS D1.4.
- C. The Contractor shall provide that the precast concrete manufacturer have available at the construction site a trained representative of the said manufacturer, at no additional cost to the Authority.
- D. Ensure that precast prestressed concrete units have been accurately set as shown on the Contract Drawings and that members have been shored during erection where necessary to minimize camber between adjacent units.
- E. Erection tolerances prescribed by PCI MNL-120 shall be complied with unless otherwise noted on the Contract Drawings.
- F. Set precast prestressed concrete units on bearing pads specified in 2.01 L herein with bearing surface not less than that shown on the approved shop drawings.
- G. Do not cut holes or install sleeves, without the written permission of the Engineer, larger than size permitted by precast prestressed concrete manufacturer for pipe, conduits duct or other penetrations after fabrication.
- H. Do not cut reinforcing or prestressing strands without written approval of the manufacturer and as acceptable to the Engineer.

- I. Field cut holes for openings, with the written permission of the Engineer, in slab only, that do not disturb prestressing strands in accordance with the manufacturer's instructions. No holes are to be cut through stems of tees.

3.03 REPAIRS

- A. Make field repairs to damaged areas of the reinforcing bar coating. The material used for field repair shall be that supplied by the coating applicator in accordance with the patching material manufacturer's recommendation. Field repair shall be required wherever the area of coating damaged exceeds the cross-sectional area of the reinforcing bar. Field repair shall not be allowed on bars that have severely damaged coatings as determined by the Engineer. Replace the damaged reinforcing bars. A severely damaged coating is defined as a coating that has a total damaged area greater than 5 percent of surface of the reinforcing bar.
- B. Correct precast prestressed concrete units that do not conform to the specified requirements, by whatever means and in whatever manner that may be directed by the Engineer, at no additional cost to the Authority.
- C. Erected precast prestressed concrete units may be rejected, at the sole discretion of the Engineer for any of but not limited to the following reasons:
 - 1. Exceeding the installation tolerances specified in 1.04 herein.
 - 2. Damaged during installation operations.
 - 3. Having exposed-to-view surfaces that develop surface finish deficiencies.
 - 4. All rejected precast prestressed concrete units shall be removed and replaced.

END OF SECTION

SECTION 03420

PRECAST PRESTRESSED CONCRETE FOR BUILDING CONSTRUCTION

APPENDIX "A"

SUBMITTALS

The following 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".
- B. Catalog Cuts, Material Certification and Test Results
 - 1. As per Division 1 "Shop Drawings, Catalog Cuts and Samples".
 - 2. Product Data: Submit the following, including name of manufacturer and supplier:
 - a. Cements, each type
 - b. Aggregates, each type. (Aggregates are to be from approved D.O.T. sources)
 - c. Admixtures
 - d. Reinforcing bars and prestressing steel
 - e. Steel wire fabric reinforcement
 - f. Concrete
 - g. Welding electrodes
 - h. Studs
 - i. Embedments, inserts and anchors
 - j. Elastomeric bearing pads
 - k. Non-shrink grout
 - l. Liquid curing compounds
 - m. Joint fillers and joint sealants
 - 3. Submit the following certifications and test reports:
 - a. PCI Certification Program Certificate.
 - b. Current certified calibrations for stressing jacks and compression testing machine.
 - c. Material certifications, source, brand name and test results (where required) of cement, fine and coarse aggregate, and concrete admixtures following guidelines of Appendix "B". Provide certification of no detrimental Alkali Silica Reaction (ASR) between cement and fine and coarse aggregates.
 - d. Certification of compatibility and five-year performance record for liquid membrane, if used under conditions specified in 2.02 D.

- e. Certification that Water Reducers, Water Reducer - Retarders, High Range Water Reducers and High Range Water Reducer - Retarders conform to the requirements of 2.01 B submitted with Appendix "B" "Concrete Materials and Mix Design Data".
- f. Test reports and certification from an approved testing laboratory showing that all component materials including strands, steel, and bearing pads conform the requirements of this Section.
- g. Certified mill test reports for metal reinforcement and wire fabric.
- h. Certification from the applicator of epoxy that the epoxy coated reinforcing bars meet the requirements of ASTM A 775.
- i. Certification from the applicator of epoxy that the epoxy coated steel wire fabric meets the requirements of ASTM A 884.
- j. Current certification of welders for welding reinforcement, shop and field connection in accordance with the requirements of AWS.
- k. Brand name and chemical composition of form oil, and curing compounds (liquid membrane).
- l. Q.C. Test records of all concrete placed.
- m. Records of magnitude of prestressing pressures both by force and elongation.
- n. Precast concrete manufacturer qualifications.
- o. Precast concrete installer qualifications.

C. Samples

- 1. As per Division 1 "Shop Drawings, Catalog Cuts and Samples".
- 2. Concrete ingredients for trial batches. At the request of the Engineer furnish these to the Engineer in whatever quantities he may require at least 35 days prior to concrete placement.
- 3. At the request of the Engineer, submit cement samples to check the mill certification at any time.

D. Construction Procedures and Quality Control and Assurance Documents

- 1. Submit complete description of forming, positioning reinforcement, casting, prestressing, finishing, curing, detensioning, and lifting, including the following:
 - a. Details and locations of lifting devices.
 - b. Strand pattern and elevation view of each member.
 - c. Jack clearances and jacking procedures and procedure for measuring elongation, slippage, and abutment yield.
 - d. Method of measuring initial tensioning forces, final tensioning forces, and tension elongation.
 - e. Curing times and procedures.
 - f. Estimated elapsed time between all operations, and predicted deformation at all stages.

- g. Minimum concrete compressive strengths at initial prestress and 28 days and the initial prestress to be applied.
 - h. Show location of precast prestressed sections with same identification marks used in fabrication.
 - i. Finishes.
 - j. Welding.
- 2. Submit erection drawings and procedures under 1.03 D.3.
 - 3. Submit Quality Control and Quality Assurance Plan and Procedures.
- E. Design Computations
- Submit design calculations under 1.03 D.2.
- F. Concrete Mix Design
- 1. Submit Appendix "B" - "Concrete Materials and Mix Design Data" at least 35 days prior to concrete placement.
 - 2. To substantiate mix design submit all data and field results in accordance with Appendix "B" "Concrete Materials and Mix Design Data" to the Manager of Materials with a copy to the Engineer.
 - 3. Submit a written request to the Engineer for approval, if pumping is proposed as a method of concrete placement with proposed mix design in accordance with Appendix "B" "Concrete Materials and Mix Design Data". Submittal shall include pumping scheme, pump description, line diameter and line length.
 - 4. Submit a 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 design in accordance with Appendix "B" "Concrete Materials and Mix Design Data".

END OF APPENDIX "A"

SECTION 03420

PRECAST PRESTRESSED CONCRETE FOR BUILDING CONSTRUCTION

APPENDIX "B"

CONCRETE MATERIALS AND MIX DESIGN DATA

A. Materials

Cement: Type _____ Source/Brand _____
Fineness _____
Sand: Modulus _____ Source _____
Coarse Aggregate: Size _____ Class _____ Source _____
Admixtures
(Source/Brand): Air Entraining Agent _____
Non-Chloride Accelerator _____
Retarder _____
Water Reducer _____
Water Reducer - Retarder _____
High Range Water Reducer _____
High Range Water Reducer - Retarder _____

B. Mix Design

Proposed method of placement:

Proportion of Ingredients:

Cement _____ lbs./cu. yd.
Sand _____ lbs./cu. yd.
Coarse Aggregate _____ lbs./cu. yd.
Water _____ lbs./cu. yd.
Admixtures (specify): _____
Air Entraining Agent: _____ ozs./cu. yd.

Mix Properties:

Strength at 28 days: $f_c =$ _____ psi

Slump _____ inches

Water/Cement ratio _____

Air Entrainment _____ %

Sand/Coarse Aggregate ratio _____

Unit Weight _____ lbs./cu. ft.

C. Conformance with ACI 318

Attach a report on mix design and test/statistical data documenting conformance with ACI 318, Chapter 5.

END OF APPENDIX "B"

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

- A. 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.
- B. Submit manufacturer's instructions and methods for handling, storage, mixing and placing of the grout, for approval.

END OF APPENDIX "A"

DIVISION 5
SECTION 05120
STRUCTURAL STEEL

PART 1 - GENERAL

1.01 SUMMARY

This Section specifies requirements for structural steel.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

Standard Specifications for Highway 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 A 325 or ASTM A 490 Bolts

Quality Certification Program

American Society for Non-destructive Testing (ASNT)

SNT-TC-1A Recommended Practice

American Welding Society (AWS)

D 1.1 Structural Welding Code, Steel

D 1.5 AASHTO/AWS Bridge Welding Code

QC1 Certification of Welding Inspectors

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Connection Design and Detailing

1. Show complete details on shop drawings. For all Work, other than structural steel for bridges, 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. Prepare for the Engineer's review all design and detailing for any alternative connections proposed by the Contractor. Have all connection design and detailing prepared by the Contractor 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. Shop drawings shall contain all dimensional and geometric information. Do not order, fabricate or deliver any materials to the construction site before 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 he 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. Indicate all welds 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 bear the signature and seal of the Professional Engineer.
6. Submit shop drawings in complete packages so that individual parts and the assembled unit may be reviewed together. Submit index sheets 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 will not in any way relieve the Contractor from responsibility for the adequacy of the design of the connections and all required detailing, the responsibility for proper fitting of the Work in strict conformance with Contract requirements or from the necessity of furnishing material and workmanship required by Contract Drawings and Specifications in addition to that indicated on the shop drawings.
 8. Submit a complete set of stamped, approved drawings to the Engineer's representative at the fabrication shop prior to the commencement of any fabrication.
- C. Erection Drawings
1. 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.

1.04 QUALITY CONTROL

A. Requirements

1. Verify that the entity performing the Work of this Section has a minimum of three years experience in structural steel work involving complexities similar to those required under this Contract and employs labor and supervisory personnel experienced in this type of Work.
2. When the total quantity of steel furnished under this Contract exceeds 10 tons, ensure that the fabrication shop is certified under the AISC certification program as Category Sbd for conventional steel building structures or Sbr for simple steel bridges, unless a higher category is shown on the Contract Drawings. A list of certified fabrication shops for each Category may be found on the following website:

www.aisc.org/find/FindCertifiedCompany.aspx?id=5542

3. Submit Contractor's Quality Control Plan to the Engineer for review and approval. Upon request arrange for the Engineer to inspect the fabrication shop to verify that 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. Qualify welding processes and welding operators in accordance with the applicable AWS Welding Code and submit certification that welders to be employed in the Work have satisfactorily passed AWS qualification tests.
- C. Maintain a Quality Control Plan for both fabrication and erection of structural steel to ensure that all installations conform to the requirements of the

Contract Drawings and Specifications. The Quality Control Plan 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. Employ non-destructive testing personnel that meet ASNT SNT-TC-1A Level II qualifications and an AWS Certified Welding Inspector (CWI).

For bridge work where "Fracture Critical Members" are shown on the Contract Drawings, 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. Arrange for each shipment to be accompanied by a mill certification report that shows mill test results for the included production lots. Allow the Engineer 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, the corresponding lot of bolts will be rejected. Remove and replace at no cost to the Authority any bolts already installed from a failed lot or heat number.
3. Perform sampling 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., label the containers 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 Section 11.5.6.4.2).

E. In addition to performing field inspection, inspect structural steel at the fabricating shop.

F. Inspect and test welds at the fabricating shop in accordance with AWS D1.1 (AWS D 1.5 for bridge members) and as follows:

1. Arrange for all welds to be visually inspected by an AWS Certified Welding Inspector (CWI), certified in accordance with AWS-QC1.
2. Non-destructively test all full penetration welds for 100 percent of the weld length by radiographic or ultrasonic methods, as approved by the Engineer, unless otherwise noted.

3. Non-destructively test areas of suspected defects found visually in partial penetration and fillet welds 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. Coordinate all Work and timely notify the Engineer 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 not less than 25% of that required of the Contractor. Notify the Engineer and the Materials Engineering Unit 15 days prior to the start of fabrication.
 - I. Supply equipment and personnel, at no cost to the Authority, to assist in moving members as necessary for adequate access to enable the Authority to properly perform Quality Assurance inspections and testing. Coupons of material may also be requested and shall be cut in the presence of the Engineer at no cost to the Authority. Provide a desk and adequate workspace for the Authority shop inspector. Provide access to telephones, fax machines and copy machines at all times.

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 by the contractor and shall accompany each shipment. Any material that is shipped to the construction site that is not stamped or included on the shipment report and noted as "Accepted" on said shipment report will immediately be rejected by the Engineer and shall not be unloaded at the construction site. Application of the inspector's stamp does not imply that the material will not be rejected by the Engineer 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. Properly drain structural steel. Provide adequate shoring and protection to prevent distortion and other damage. Store structural steel on timber and not on mud or cinders and handle steel so as not to damage shop paint. All sections which are to be placed in ground storage shall be kept readily accessible for inspection.

1.07 SUBMITTALS

- A. 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 A 325 or A 490 Bolts." In the case of bridge work, conform to AASHTO Standard Specifications for Highway Bridges, Division II, Section 11.5.6.

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 entitled Grouting (Non-Metallic).

F. Paint: In accordance with Section 09910 entitled Painting.

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.

Any fabrication performed without prior approval of these items will not be accepted. In addition, arrange for a copy of all signed approvals, including the supporting documentation, to be in the possession of the fabrication shop prior to the commencement of fabrication and to be made available to the Engineer 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 that 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. Achieve 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 Division II, Section 11 of the AASHTO Standard Specifications for Highway Bridges:
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.

2.03 SHOP PAINTING

- 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 that 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 in Section 09910 entitled "Painting".
- E. Notify the Materials Engineering Unit 10 days in advance of painting so arrangements can be made to inspect surface preparation prior to coating. In addition to inspecting surface preparation and coating the Engineer will also perform tests to confirm blast profile, dry film thickness and adhesion. Allow the Engineer to select samples of coatings for testing.

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

At least 21 days prior to the start of the structural steel erection ascertain by accurate survey the location, alignment and elevation of anchor bolts embedded in concrete under other Sections. Prior to the start of steel erection correct all discrepancies between the Contract Drawings and Specifications and the as-built conditions, as approved by the Engineer.

3.02 ERECTION

A. Workmanship

Erect all Work 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

Furnish and install 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. Furnish and install temporary guy lines to achieve proper alignment of structures as erection proceeds.

C. Temporary Planking

Furnish and install 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 them. Clean bearing surfaces and other surfaces that 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 entitled "Painting".

F. Bolting with high strength bolts shall conform with AISC Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts, or in the case of bridge work, AASHTO Standard Specifications for Highway Bridges, Division II, Section 11.5.6.

- G. Perform grouting in accordance with Section 03602 entitled Grouting (Non-Metallic).

3.03 FIELD TESTS

- A. Inspect 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. Furnish an approved calibrated torque wrench for the purpose of checking proper tensioning of bolts by the Contractor as well by the Engineer.
- C. Inspect and test field welding in accordance with 1.04F and the Contractor's quality control plan for erection.
- D. The Engineer will perform quality assurance testing for bolted connections. Furnish equipment, provide access and assign two workers for a total duration of 20 days at no cost to the Authority to assist the Engineer as and when required by him.
- E. The Engineer will perform quality assurance testing for welds in accordance with 1.04H. Furnish equipment and provide access to assist the Engineer.
- F. If the quality assurance testing performed by the Engineer indicates that the connections checked do not meet the requirements of Codes and Standards, furnish equipment, provide access and assign two workers at no cost to the Authority to assist the Engineer in testing all the field connections.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

SUBMITTALS

APPENDIX "A"

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of DIVISION 1 – GENERAL PROVISIONS:

A. Shop Drawings

1. Connection Design and Detailing as per 1.03 A. prior to submitting job standards.
2. Job standards as per 1.03 B.5. prior to submitting detailed shop drawings.
3. Prior to the commencement of fabrication, approval of shop drawings for all structural steel as per 1.03 B.
4. Erection drawings as per 1.03 C.

B. Catalog Cuts, Material Certification, Welder Qualifications, Welding Procedure Specifications and Test Results:

1. Catalog cuts and manufacturer's literature on paint and grout specified under this section.
2. Prior to commencing with fabrication of steel, submit certified copies of all mill reports covering the chemical and physical properties of all steel used in this Contract. 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.
3. Prior to commencing fabrication, submit mill certificates for high strength bolts as described in 1.04 D.1.
4. 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.
5. Inspection and test results from fabrication shop as per 1.04 F within five calendar days of inspections and tests.
6. Inspection and test results from field tests as per 3.03 within five calendar days of inspections and tests.
7. Prior to commencing with fabrication of steel, welder qualifications and welding procedure specifications in accordance with 1.04 B.

C. Quality Control Documents

1. Submit a copy of the fabrication shop's Quality Control Plan as outlined in 1.04 C. The plan, 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 and 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, submit a revised schedule 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.

D. 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 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 manufacturer'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

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". 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.
 - 2. Layout of electrical distribution ducts and trenches in cellular metal floor.
- B. Catalog Cuts, Materials Certification and Test Results
 - 1. As per Division 1 "Shop Drawings, Catalog Cuts and Samples".
 - 2. The Contractor shall submit certification that welders to be employed in the Work have satisfactorily passed AWS qualification tests.
 - 3. 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.
 - 4. Test data, calculations or design charts for self tapping screws prepared by the screw manufacturer.
- C. Samples

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.
- D. Construction procedures and Quality Assurance Documents
 - 1. Submit manufacturer's recommended installation instructions.

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

- A. 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. <u>American Welding Society, Inc. (AWS)</u>
AWS D1.1	Structural Welding Code – Steel.
AWS D1.3	Structural Welding Code – Sheet Steel. <u>The Society for Protective Coatings (SSPC)</u>
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 building codes which would apply if the Authority were a private corporation.

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**

BPE 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 (INTERIOR AND EXTERIOR CONSTRUCTION)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL REQUIREMENTS:

A. Product Data

Manufacturer's product information and installation instructions for each item of steel framing system, gypsum sheathing board and accessories.

B. Shop Drawings

1. For special components and installations not fully dimensioned or detailed in the manufacturer's product data.
2. Include placing drawings for framing members showing size and thickness designations, number, type, location and spacing. Indicate welds, type and location of mechanical fasteners, anchorage, connections, supplemental strapping, bracing, bridging, reinforcing, splices, accessories and details required for complete installation.

C. Certifications

1. Mill certificates signed by manufacturer of cold-formed metal framing certifying that its products comply with material requirements of this Section, including uncoated steel thickness, yield strength, tensile strength, total elongation and galvanized coating thickness.
 - a. In lieu of mill certificates, submit test reports from a qualified independent testing agency evidencing compliance with material requirements of this Section.

D. Construction and Installation Procedures

For prefabricated (panelized) framing installations, submit construction sequencing plan.

E. Design Calculations

Submit calculations for loads and stresses of metal framing or trusses, sealed by a professional engineer registered in the state where the Work is to be erected.

F. Qualifications

1. Testing Agency: Submit qualifications of testing agency.
2. Professional Engineer: Demonstrate capabilities and experience. Include list of completed projects with project names, addressees, names of architects and owners.
3. Welder: Evidence of current AWS certification.

END OF APPENDIX "A"

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.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	<u>American National Standards Institute (ANSI)</u>
ANSI A 14.3	Safety Requirements for Fixed Ladders.
	<u>American Society of Mechanical Engineers (ASME)</u>
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.
	<u>American Society for Testing and Materials (ASTM)</u>
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 Coating (Hot-Dip) on Iron and Steel Hardware.

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 786	Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
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 1028	Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
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 Method 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.
	<u>American Welding Society, Inc. (AWS)</u>
AWS D1.1	Structural Welding Code – Steel.
AWS D1.3	Structural Welding Code – Sheet Steel.
	<u>Code of Federal Regulations (CFR)</u>
29 CFR Part 1910, Subpart D	Fixed Ladders.
	<u>The Society for Protective Coatings (SSPC)</u>
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 A 36.
3. **Rolled Steel Floor Plates:** ASTM A 786.
4. **Steel Bar Grating:** ASTM A 1011 or ASTM A 36.
5. **Steel Tubing:** ASTM A 500, cold-formed; or ASTM A 501, hot-rolled; for exterior installations. Steel tubing shall be hot-dip galvanized coated per ASTM A 53.
6. **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.
7. **Brackets, Flanges and Fittings:** Cast or formed metal of the same type material and finish as supported construction.
8. **Gray Iron Castings:** ASTM A 48, Class 30.
9. **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. **Wood Screws:** Flat head, carbon steel, ASME B18.6.1.
 6. **Lock Washers:** Helical, spring type, carbon steel, ASME B18.21.1.

7. Plain Washers: Round, carbon steel, ASME B18.22.1.
8. 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: Alloy Group 1 stainless steel bolts complying with ASTM F 593 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 type, complying with ASTM C 1107, as manufactured by one of the following, or approved equal, for specified application:

1. Non-Metallic:

"Five Star Grout", Five Star Products, Inc., Fairfield, CT
"Masterflow 713 Plus", Master Builders, Inc. (Degussa), Cleveland, OH
"NS Grout", Euclid Chemical Co., Cleveland, OH

2. Metallic:

"Embeco 636 Plus", Master Builders, Inc. (Degussa), Cleveland, OH
"Five Star Metallic Grout", Five Star Products, Inc., Fairfield, CT
"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 A 123.
- b. Iron and steel hardware: ASTM A 153.

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, if any

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. 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. 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. Secure assembled safety cage to ladder rails and adjacent construction shown.
2. 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 C 1028.
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:

American Safety Tread Co., Inc., Helena, AL
Balco Inc., Wichita, KS
Safe-T-Metal Co., Inc., Mineola, NY
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:

American Safety Tread Co., Inc., Helena, AL
Balco Inc., Wichita, KS
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 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.

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 A 780.

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 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:

	<u>The Engineered Wood Association (APA)</u>
APA Form No. E 30	Engineered Wood Construction Guide.
APA Form No. E 445S	Performance Standards and Qualification Policy for Structural-Use Panels.
	<u>American Society of Mechanical Engineers (ASME)</u>
B18.6.1	Wood Screws (Inch Series).
B18.2.1	Square and Hex Bolts and Screws, Inch Series.
	<u>American Society for Testing and Materials (ASTM)</u>
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM A 307	Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
ASTM A 563	Carbon and Alloy Steel Nuts.
ASTM D 226	Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
ASTM D 5516	Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures.

ASTM D 5664	Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire-Retardant Treated Lumber.
ASTM F 1667	Driven Fasteners: Nails, Spikes, and Staples.
	<u>American Wood Preservers Association (AWPA)</u>
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.
	<u>Building Officials and Code Administrators International, Inc. (BOCA)</u>
	National Building Code.
	<u>Council of American Building Officials (CABO)</u>
CABO NER-272	Pneumatic or Mechanically Driven Staples, Nails, P-Nails and Allied Fasteners for Use in All Types of Building Construction.
	<u>Redwood Inspection Service (RIS)</u>
	Standard Specifications for Grades of California Redwood Lumber.
	<u>Society of Automotive Engineers-American Iron and Steel Institute (SAE-AISI)</u>
	System for Designating Carbon and Alloy Steels.
	<u>Southern Pine Inspection Bureau (SPIB)</u>
	Standard Grading Rules for Southern Pine Lumber.
	<u>U.S. Dept. of Commerce (DOC)/National Institute for Standards and Technology (NIST)</u>
DOC PS 1	U.S. Product Standard for Construction and Industrial Plywood.
DOC PS 20	American Softwood Lumber Standard.
	<u>West Coast Lumber Inspection Bureau (WCLIB)</u>
Standard No. 17	Grading Rules for West Coast Lumber.
	<u>Western Wood Products Association (WWPA)</u>
	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 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.

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 B 18.6.1
 - 2. Bolts: ASTM A 307, Grade A; with ASTM A 563 hex nuts and flat washers.
 - 3. Lag Bolts: ASME B18.2.1
 - 4. Nails and Staples: ASTM F 1667
 - 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 A 153.
- D. Miscellaneous

Building Paper: ASTM D 226, 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 AWWA Standard C 2 (Lumber) and AWWA 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 water-borne preservatives after fabrication of item. Preservative type shall comply with AWWA 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/m³)
 - b. Above ground use: 0.25 pcf (4.0 kg/m³)
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 AWWA 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 AWWA C 20 and AWWA 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 E 84 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 AWWA treatment Type A High Temperature (HT) at interior applications, and AWWA Exterior type for exterior or interior applications.
4. Treatment type shall have been tested for strength retention after exposure to elevated temperatures; ASTM D 5664 for lumber, ASTM D 5516 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.

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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

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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.

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.
3. Cavity 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 C 578 | Specification for Rigid, Cellular Polystyrene Thermal Insulation. |
| ASTM C 1303 | 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 E 84 | 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 C 578, 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 E 84.
 2. Thermal Resistance (R)
15 year time-weighted average Long-Term Thermal Resistance (LTTR) as determined per ASTM C 1303.
 3. Edges
Square, except for use with metal framed cavity wall systems which shall have shiplap interlocking edges for additional air and moisture barrier protection.

2.03 ACCESSORIES

- A. Adhesive for Bonding Insulation
For cavity walls, type shall be as recommended by insulation manufacturer, compatible with dampproofing or air barrier, if any. 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 attachment.

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. Cavity Wall Insulation

1. Install small pads of adhesive, approximately 1 inch long by 3/4 inch high, spaced 12 inches on center both ways on inside face of insulation. Fit courses of insulation onto wall ties and other confining obstructions in cavity. Butt edges tightly both ways and stagger vertical joints, with the exception of ends at expansion or control joints. Press units firmly against inside wythe of masonry.
2. Secure insulation by locating metal wall tie pintle section firmly against face of insulation board or attach insulation to substrate using wall anchors designed to fasten through the insulation to the structural substrate as specified in Division 4 Section on brick masonry.
3. Install joint tape of type recommended by insulation manufacturer at all insulation joints where shown on the Contract Drawings.

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:

- A. **Product Data**
Manufacturer's product literature and installation instructions for insulation and accessories.
- B. **Samples**
6-inch square sample of each rigid insulation type and protection board type in thickness specified.
- C. **Certifications**
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:

A. Product Data

Manufacturer's product literature, handling and installation instructions for insulation, facers, anchors, adhesives and accessories.

B. Certifications

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

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 literature, handling and installation instructions for insulation, vapor retarder and accessories.
- B. **Certifications**
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:

<u>American Society for Testing and Materials (ASTM)</u>	
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.

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 RectorSeal Corporation;
 - 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 Markets Division;
 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; Specified Technologies, 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

- A. Product data for each type of product specified.
 - 1. Certification by firestopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are nontoxic to building occupants.
- B. 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.
 - 1. 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.
 - 2. 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.
- C. Product certificates signed by manufacturers of firestopping products certifying that their products comply with specified requirements.
- D. 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.
- E. 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 07410

PREFORMED ROOF PANELS

PART 1. GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for preformed stainless steel batten type roof panel system, accessories and trim ("preformed roof panels"), structurally supported directly by a solid substrate and including related flashings and accessory components as shown on the Contract Drawings.
- B. Structural framing and substrate surface support is specified in other Sections of these Specifications.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM E 699	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 E 1592	Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Air Pressure Difference
ASTM E 1646	Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
ASTM E 1680	Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems

Underwriters Laboratory (UL)

UL 580 Tests for Uplift Resistance of Roof Assemblies
UL Roofing Materials and Systems Directory

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

- A. General: Furnish and install 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.

- B. **Air Infiltration:** Furnish and install manufactured roof panel assemblies that have permanent resistance to air leakage through assembly of not more than 0.09 cfm/sq. ft. of fixed roof area when tested according to ASTM E 1680 at a static-air-pressure difference of 4.0 lb/sq. ft.
- C. **Water Penetration:** Furnish and install manufactured roof panel assemblies having no water penetration as defined in the test method when tested according to ASTM E 1646 at a minimum differential pressure of 20 percent of inward acting, wind-load design pressure of not less than 6.24 lb/sq. ft. and not more than 12.0 lb/sq. ft.
- D. **Wind-Uplift Resistance:** Furnish and install roof panel assemblies that meet requirements of UL 580 for Class 90 wind-uplift resistance.
- E. **Structural Performance:** Furnish and install manufactured roof panel assemblies capable of safely supporting design loads with vertical deflection no greater than L/240 based on tests of manufacturer's standard units according to ASTM E 1592 by a qualified independent testing and inspecting agency.
- F. **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.
- G. **Furnish and install positive drainage to exterior for moisture entering or condensation occurring within panel system.**

1.04 QUALITY ASSURANCE

- A. **Furnish and install 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 and 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 who has completed metal roof panel projects similar in material, design and extent to that shown on the Contract Drawings for Work of this Contract and with a record of successful in-service performance.
- D. **Professional Engineer Qualifications:** Engage 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:** Engage an independent testing agency with the experience and capability to conduct the testing indicated without delaying the Work, as documented according to ASTM E 699.

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 SUBMITTALS

For submittal requirements, see Appendix "A".

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, furnish and install one of the following preformed roof panel systems, or approved equal:

Englert, Perth Amboy, New Jersey
Follansbee, Follansbee, WV

2.02 MATERIALS

- A. Terne coated stainless steel sheet, type 304 dead soft stainless steel. Thickness required for structural performance, but not less than the manufacturer's recommended minimums for applications shown on the Contract Drawings, and not less than 28 gauge, 0.015" thick.
- B. Metal Finish: terne coat on both sides with a zinc/tin alloy (50% zinc, 50% tin) to a thickness of 20 microns and micro-embossed under high pressure rollers to create a low reflective surface.
- C. 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 in type 316 stainless steel or as recommended by the manufacturer. Furnish and install metal-backed neoprene washers under heads of exposed fasteners bearing on weather side of panels. 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:
 - a. Furnish and install components required for a complete roofing system, including custom preformed fascia, scuppers, gutter, trim, copings, corner

- units, closures, clips, seam covers, battens, flashings, sealants, gaskets, fillers, closure strips and similar items. Match materials/finishes of preformed panel
- b. 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. Furnish and install closure strips where indicated or necessary to ensure weathertight construction.
 - c. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release paper backing. Furnish and install permanently elastic, nonsag, nontoxic, nonstaining tape.
 - d. Elastomeric Joint Sealant: ASTM C 920, of base polymer, type, grade, class and use classifications required to seal joints in panel roofing and remain weather tight. Use 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: gaskets, joint fillers and sealants where shown on the Contract Drawings and where required for weatherproof performance of panel systems. Furnish and install types of gaskets and sealants/fillers shown on the Contract Drawings or, if not otherwise shown, types recommended by panel manufacturer.
- D. Furnish and install felt underlayment and building-paper slip 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 backsides of metal panels with bituminous coating where panels 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.

- 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

SECTION 07410

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**
Three 12 inch square samples, of each exposed finish material.
- C. **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 and licensed to practice in the jurisdiction where the construction site is located.**
- 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.

END OF APPENDIX "A"

DIVISION 7

SECTION 07419

STAINLESS STEEL WALL AND ROOF PANELS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Custom concealed-fastener, lap-seam stainless steel wall and roof panels for the Service Building ("metal wall and roof panels").
- B. Related Sections:
 - 1. Section 05400 "Cold-Formed Metal Framing and Sheathing System" for support framing.
 - 2. Section 05580 "Sheet Metal Fabrications" for flashing and other sheet metal work that is not part of metal wall and roof panel assemblies.
 - 3. Section 07920 "Sealants" for sealants not otherwise specified in this section.

1.02 DEFINITION

- A. Metal Wall and roof panel Assembly: Describes the panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight wall and roof system.

1.03 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal wall and roof panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation or construction.
- B. Preformed metal panel system shall withstand inward and outward wall loading shown on the Contract Drawings with a maximum deflection of $L/180$. Where shown on the Contract Drawings furnish and install preformed panel systems which have been pretested and certified by the manufacturer for the following:
 - 1. Structural Deflection: ASTM E 72
 - 2. Water Penetration and Air Infiltration: AAMA Standard Test TM-1
- C. Air Infiltration: Air leakage through assembly of not more than 0.02 cfm per sq. ft. for gross wall areas, with 4 lbs. per sq. ft. differential.
- D. Water penetration: No significant, uncontrolled leakage at 41 lbs. per sq. ft. pressure with spray test.

- E. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of wall and roof panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal wall and roof panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures and accessories; and special details. Distinguish between factory-, shop- and field-assembled work.
 - 1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing, coping and trim.
 - b. Reveals, corners and joints.
 - c. Anchorage system.
 - d. Scuppers, vents and other penetrations.
- C. Samples for Initial Selection: For each type of metal wall and roof panel indicated with factory-applied finishes:
 - 1. submit samples of trim and accessories involving color and finish selection.
 - 2. include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal wall and roof Panels: 12 inches square with an example of finished edges and closed back. Include fasteners, closures and other metal wall and roof panel accessories.
 - 2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
 - 3. Accessories: 12-inch-long Samples for each type of accessory.
- E. Delegated-Design Submittal: For metal wall and roof panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Coordination Drawings: Exterior elevations drawn to scale and coordinating penetrations and wall-mounted items.
- G. Qualification Data: For Installer, professional engineer and testing agency.
- H. Material Certificates: For thermal insulation and vapor retarders, signed by manufacturers.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

- J. Maintenance Data: For metal wall and roof panels, to include in maintenance manuals.
- K. Warranties: Sample of special warranties.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer. Engage an installer who has five (5) years of experience installing insulated metal panels; who has completed four (4) similar projects; who has a record of successful in-services performance for the past five (5) years and who will provide a project superintendent with a minimum of three (3) years of experience working on installations similar in size and complexity.
- B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- C. Qualified professional engineer where required shall be licensed in good standing to practice in the state of New Jersey.
- D. Source Limitations: Obtain each type of metal wall and roof panel from single source (i.e., from a single manufacturer).
- E. Fire-Resistance Ratings: Where indicated, furnish and install metal wall and roof panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- F. Mockups: Build mockups to verify selections made under sample submittals, to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall, roof and corner panel, approximately one bay wide by one story high by full thickness, including insulation, supports, attachments and accessories in location as directed by Engineer.
 - 2. Approval of mockups will not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- G. Preinstallation Conference: Set up and conduct conference at Project site.
 - 1. Meet with the Engineer, metal wall and roof panel Installer, metal wall and roof panel manufacturer's representative, structural-support Installer and installers whose work interfaces with or affects metal wall and roof panels, including installers of doors, windows and louvers.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal wall and roof panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special siding details, wall penetrations, openings and condition of other construction that will affect metal wall and roof panels.

6. Review temporary protection requirements for metal wall and roof panel assembly during and after installation.
7. Review wall and roof panel observation and repair procedures after metal wall and roof panel installation.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal wall and roof panels and other manufactured items so as not to be damaged or deformed. Package metal wall and roof panels for protection during transportation and handling.
- B. Unload, store and erect metal wall and roof panels in a manner to prevent bending, warping, twisting and surface damage.
- C. Stack metal wall and roof panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering. Store metal wall and roof panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall and roof panels in contact with other materials that might cause staining, denting or other surface damage.
- D. Retain strippable protective covering on metal wall and roof panel for period of metal wall and roof panel installation.

1.07 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall and roof panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall and roof panel fabrication, and indicate measurements on Shop Drawings.

1.08 COORDINATION

- A. Coordinate metal wall and roof panel assemblies with scuppers, flashing, trim and other adjoining work to provide a leakproof, secure and noncorrosive installation.

1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall and roof panel assemblies that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking and puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 2. Warranty Period: Five (5) years from date of Substantial Completion.

- B. **Special Warranty on Panel Finishes:** Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall and roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. **Exposed Panel Finish:** Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling or failure of paint to adhere to bare metal.
 2. **Finish Warranty Period:** 10 years from date of Substantial Completion.
- C. All warranties shall run to the Authority's benefit and shall grant the Authority a direct right of action against the Manufacturer.

PART 2 - PRODUCTS

2.01 PANEL MATERIALS

- A. **Stainless-Steel Sheet:** ASTM A 240/A 240M, Type 316, fully annealed.
1. **Surface Preparation:** Remove tool and die marks and stretch lines, or blend into finish.
 2. **Polished Finish:** Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - b. Non-directional Angel Hair finish.
- B. **Panel Sealants:**
1. **Sealant Tape:** Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Furnish and install permanently elastic, nonsag, nontoxic nonstaining tape 1/2 inch wide and 1/8 inch thick.
 2. **Joint Sealant:** ASTM C 920; elastomeric polyurethane, polysulfide or silicone sealant; of type, grade, class and use classifications required to seal joints in metal wall and roof panels and remain weathertight; and as recommended in writing by metal wall and roof panel manufacturer.
 3. **Butyl-Rubber-Based, Solvent-Release Sealant:** ASTM C 1311.

2.02 MISCELLANEOUS MATERIALS

- A. **Panel Fasteners:** Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs and other suitable fasteners designed to withstand design loads. Furnish and install concealed fasteners in matching metal same as wall and roof panels. Furnish and install EPDM, PVC or neoprene sealing washers.

2.03 CONCEALED-FASTENER, LAP-SEAM METAL WALL AND ROOF PANELS

- A. **General:** Furnish and install factory-formed metal wall and roof panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. **Reveal-Joint, Concealed-Fastener Metal Wall and Roof Panels** as indicated on the drawings: Custom formed with vertical panel edges and flat pan between panel edges; with narrow reveal joint between panels.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Metal Sales and Service, Inc., Kennett Square, PA
 - b. Approved Equal
2. **Material:** Stainless steel sheet, 16 gauge (0.060") nominal thickness.
 - a. **Exterior Finish:** Non-directional Angel Hair finish and paint (3-coat fluoropolymer) where indicated on the drawings.
 - b. **Color:** Custom color as selected by the Engineer.

2.04 ACCESSORIES

- A. **Wall and Roof Panel Accessories:** Furnish and install components required for a complete metal wall and roof panel assembly including scupper, trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips and similar items. Match material and finish of metal wall and roof panels, unless otherwise indicated.
1. **Closures:** closures at eaves and rakes, fabricated of same metal as metal wall and roof panels.
 2. **Backing Plates:** Furnish and install metal backing plates at panel end splices, fabricated from material same as face.
 3. **Closure Strips:** Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal wall and roof panel profile. Furnish and install closure strips where indicated or necessary to ensure weathertight construction.
- B. **Flashing and Trim:** Formed from 26 gauge minimum thickness, 316 stainless steel. Furnish and install flashing and trim as required to seal against weather and to achieve finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals and fillers. Finish flashing and trim with same finish system as adjacent metal wall and roof panels.

2.05 FABRICATION

- A. **General:** Fabricate and finish metal wall and roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal wall and roof panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

- D. Sheet Metal Accessories: Fabricate scuppers, coping, flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Seams: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams and solder.
 3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall and roof panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall and roof panel manufacturer for application but not less than thickness of metal being secured.

2.06 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall and roof panel supports and other conditions affecting performance of work.
 1. Examine wall framing to verify that structural panel support members and anchorage have been installed within alignment tolerances required by metal wall and roof panel manufacturer.
 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall and roof panel manufacturer.
 3. Verify that weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration and water penetration.
 4. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

- B. Examine roughing-in for components and systems penetrating metal wall and roof panels to verify actual locations of penetrations relative to seam locations of metal wall and roof panels before metal wall and roof panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected to Engineer's satisfaction.

3.02 METAL WALL AND ROOF PANEL INSTALLATION

- A. General: Install metal wall and roof panels according to manufacturer's written instructions in orientation, sizes and locations indicated on Drawings. Anchor metal wall and roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal wall and roof panels.
 - 2. Flash and seal metal wall and roof panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall and roof panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal wall and roof panel work proceeds.
 - 6. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as necessary for waterproofing.
 - 7. Align bottom of metal wall and roof panels and fasten with self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Furnish and install weathertight escutcheons for pipe and conduit penetrating exterior walls.
- B. Fasteners: Use 316 type stainless-steel fasteners.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal wall and roof panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers and sealants where required for weathertight performance of metal wall and roof panel assemblies. Furnish and install types of gaskets, fillers and sealants recommended by metal wall and roof panel manufacturer.

3.03 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Furnish and install components required for a complete metal wall and roof panel assembly including scuppers, trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions and SMACNA's "Architectural Sheet Metal Manual." Furnish and install concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling or tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect and test completed metal wall and roof panel installation, including accessories.
- B. Remove and replace metal wall and roof panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Perform additional tests and inspections, at no cost to the Authority, to determine compliance of replaced or additional work with specified requirements.

3.05 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films as metal wall and roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall and roof panel installation, clean finished surfaces as recommended by metal wall and roof panel manufacturer. Maintain in a clean condition during construction.
- B. After metal wall and roof panel installation, clear weep holes and drainage channels of obstructions, dirt and sealant.
- C. Replace metal wall and roof panels that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07419

STAINLESS STEEL WALL AND ROOF 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, 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

END OF APPENDIX "A"

SECTION 07530**FULLY ADHERED
SINGLE-PLY THERMOPLASTIC MEMBRANE ROOF SYSTEM
WITH MECHANICALLY FASTENED INSULATION****PART 1. GENERAL****1.01 SUMMARY**

- A. This Section specifies requirements for fully adhered, reinforced, single-ply thermoplastic membrane roof systems, applied over either a stable, structurally sound substrate or mechanically attached roof insulation, as shown on the Contract Drawings.
- 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, adhesives, separation sheets, flashing, reglets, fasteners, wood blocking, cants, pitch pockets, insulation, form board, tapered insulation, 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. Roof expansion joints (Division 7).
 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 the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM C 518	Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties
ASTM D 638	Test Method for Tensile Properties of Plastics
ASTM D 751	Method of Testing Coated Fabrics
ASTM D 1622	Test Method for Apparent Dry Density of Rigid Cellular Plastics
ASTM D 2898	Test Method for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
ASTM D 4434	Poly (Vinyl/Chloride) Sheet Roofing

ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96	Test Method for Water Vapor Transmission of Materials
	<u>American Wood Preservers' Association (AWPA)</u>
AWPA C 20	Structural Lumber-Fire-Retardant Treatment by Pressure Processes
	<u>Factory Mutual Engineering Corp. (FM)</u>
1-28	Loss Prevention Data Sheet - Insulated Steel Deck
Class Number 4470	Approval Standard - Class I Roof Covers
Approval Guide	
	<u>United States Product Standard (PS)</u>
PS20	American Softwood Lumber Standard
	<u>Underwriters Laboratories, Inc. (UL)</u>
	Building Materials Directory

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Roof System shall conform to the following:

1. UL Listing

Provide labeled materials which have been tested and listed in UL "Building Materials Directory" for application shown on the Contract Drawings, with "Class A" rated materials/system for roof slopes shown on the Contract Drawings.

2. Windstorm Resistance

Provide Class 1-90 windstorm resistance rating, in accordance with FM Data Sheet 1-28 and the FM Approval Guide, chapter entitled "Building Materials", section entitled "Roof Coverings - Class I Fire & 1-60 or 1-90 Windstorm Rated, Built-up (Multi-ply) & Single Ply".

- a. At perimeter install 1.5 times as many insulation fasteners as indicated in the FM Approval Guide under 1-90 Windstorm, as illustrated in FM Data Sheet 1-28, figures 9, 10, and 11. At corners, where the parapet height is less than 36 inches in height, install two times as many insulation fasteners as indicated in the FM Approval Guide under 1-90 Windstorm, as illustrated in FM Data Sheet 1-28, figures 9, 10, and 11.

B. Primary membrane sheet shall conform to the following:

1. Requirements of 1.03 A of this Section
2. ASTM D 4434; Table 1
3. ASTM D 751
4. ASTM D 638
5. Sheet shall be reinforced PVC, designed for fully adhered application, with a minimum thickness of 80 mils.

6. Provide manufacturer's standard polyester "fleece" backing, where required for substrates shown on the Contract Drawings.
 7. Color

Grey or White, as shown on the Contract Drawings or, if not shown, as directed by the Engineer.
- C. Insulation Mechanical Fasteners
- Conform to the requirements of Paragraph 5.6 of FM class number 4470 Approval Standard.
- D. Insulation
- Provide insulating materials which are Factory Mutual Class
1. Submit certified test results and letter from manufacturer certifying that roof insulation complies.

Provide noncombustible insulation, with the minimum thermal resistance aged minimum R-value as shown on the Contract Drawings when tested in accordance with ASTM C 518, or in thicknesses shown on the Contract Drawings.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Surfaces

Shall be dry before and throughout entire installation process.
- B. 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.
- C. Roof installation can not proceed which ambient temperatures fall below 32 F.
- D. Comply with the USEPA "National Emission Standards for Hazardous Air Pollutants, 40 CFR Part 61, Subpart M".
- E. Precipitation

Roofing materials shall not be applied during precipitation and shall not applied in the event there is a probability of precipitation during application. The Contractor shall take adequate precautions to ensure that materials, and applied roofing are protected from possible moisture damage or contamination.

1.05 QUALITY ASSURANCE

- A. The Contractor shall certify to the Engineer that the entity of performing application is approved by the manufacturer of the roofing system, has a minimum of five years 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. Arrange for the roofing job superintendent, the roofing foreman and a representative of the roofing applicator and manufacturer to 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 addressed at this meeting with the Engineer.

C. Job Control

1. Arrange for a qualified representative of the roofing manufacturer to 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 will 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 performed membrane roofing system and appurtenances will be conducted by the Engineer and the manufacturer's technical 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 Partial or Final Completion will be issued by the Engineer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in 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 materials above ground in a weather-protected environment.

- G. Provide continuous protective covering for those materials that 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, including maintaining proper temperature ranges during storage.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

1.08 GUARANTEE

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, or approved equal:
 1. "Trocal SR-80", HPG International Inc., Somerset, NJ
 2. "G410 roof covers", 80 Mil, Sarnafil Roofing Systems, Canton, MA
 3. Ultra Ply, Firestone Building Products Co., Carmel, IN
 4. GenFlex RM, GenFlex Roofing Systems, Maumee, OH

2.02 MATERIALS

- A. Primary membrane sheet
 - See 1.03 for requirements.
- B. Insulating Materials
 1. General
 - Provide in sizes to fit applications shown, selected from manufacturer's standard thicknesses, widths, and lengths.
 - a. Provide tapered boards where shown as sloping. Fabricate with taper of 1/4 inch per foot, unless otherwise shown.

2. **Perlite Board Roof Insulation**
Where shown, provide rigid boards produced by combining expanded perlite and fibers with binders, coated or impregnated one side, to comply with ASTM C 728; r-value of 2.78 at 75 degrees F.
 3. **Perlite/Polyisocyanurate Composite Board Roof Insulation**
Where shown, provide rigid thermal composite insulation with polyisocyanurate closed-cell foam core with rigid perlite board laminated to one side and manufacturer's standard facing laminated to other side; complying with FS HH-I-1972/3, Class 1.
 4. **Polyisocyanurate Board Roof Insulation**
Where shown, provide rigid, cellular, thermal insulation with polyisocyanurate closed-cell foam core and manufacturer's standard facing laminated to both sides; complying with FS HH-I-1972/2, Class 1.
- C. Auxiliary Insulation Materials**
1. **Mastic Sealer**
Type recommended by insulation manufacturer for bonding edge joints and filling voids.
 2. **Mechanical Anchors**
Corrosion-resistant type as recommended by insulation manufacturer for deck type shown.
- D. Wood Nailers and Blocking**
- PS20 "Standard No. 2" Lumber of species eligible for UL listing, where shown on the Contract Drawings or required by primary membrane sheet manufacturer, and conforming to the following:
1. **Fire Retardant Treatment**
AWPA C20, exterior type, halogen and sulphate-free or equal treatment approved by primary membrane sheet manufacturer.
 2. Shall show no increase in fire hazard classification when tested in accordance with ASTM D 2898, Method A.
 3. Sized so that no field rip cuts or milling is required after treatment. Only end cuts and hole drilling are permitted.
 4. Identify each piece "FR-S" with UL brand mark, or other testing agency mark as approved by the Engineer.
- E. Metal Flashing**
- Minimum 24 gage galvanized steel sheet, coated with a, minimum 40 mils, PVC coated, as shown on the Contract Drawings or required by the primary membrane sheet manufacturer.

F. Miscellaneous Materials and Accessories

1. Sheet Seaming

Primary membrane sheet manufacturer's standard materials for sealing lapped joints, including edge sealer to cover exposed membrane edges, if required.

2. Slip Sheet (for alterations only)

As required by primary membrane sheet manufacturer to protect membrane from incompatible materials.

3. Walkway Pads

Prefabricated concrete pavers, or other type designed specifically for protection of membrane roofing as recommended by the primary membrane sheet manufacturer. Provide at location(s) shown on the Contract Drawings.

4. Membrane Adhesive

Product recommended by primary membrane manufacturer for substrates shown on the Contract Drawings.

5. Air Barrier

PVC air barrier, 7 mil thick, as supplied by membrane manufacturer.

PART 3. EXECUTION

3.01 EXAMINATION

Ensure that installation of other construction upon or penetrations through roof deck are complete, and that roof drains are completely installed with rim elevation set to provide recess so that flashed drain will not allow ponded water.

3.02 PREPARATION

- A. Clean substrate of dust, debris and other detrimental substances. Remove standing water.
- B. Remove sharp projections and prepare substrate in accordance with recommendations of the primary membrane sheet manufacturer.

3.03 INSTALLATION

- A. Start installation only in the presence of the primary membrane sheet manufacturer's representative, and comply with the manufacturer's requirements.
- B. Install treated wood nailers and blocking as shown on approved shop drawings.
- C. At metal deck locations, install 7 mil PVC air barrier
- D. Install slip sheet, of a type acceptable to and where recommended by the primary sheet membrane manufacturer.

E. Insulation

Extend insulation over entire surface to be insulated. Form cant strips, crickets, saddles and tapered areas as shown on the Contract Drawings or required by primary membrane sheet manufacturer for complete drainage of membrane.

1. Do not install more insulation than can be covered with membrane before the end of each workday or before the start of inclement weather. In the event of atmospheric precipitation before the installation of the membrane is completed, the unprotected portions of the insulation shall be removed, as directed by the Engineer, and replaced by the Contractor at no extra cost to the Authority.

F. PVC Membrane

1. Start installation only in the presence of the primary membrane sheet manufacturer's representative, and comply with the manufacturer's requirements and approved shop drawings.
2. Unroll membrane over prepared substrate. Do not stretch. Lap adjoining sheets and bond and seal. Install flashing and counterflashing.
3. Provide temporary seal and make watertight at terminations of Roof System at the end of each workday or before start of inclement weather.

G. Walkway Protection

Install at locations shown on the Contract Drawings in accordance with the primary sheet manufacturer's requirements.

3.04 FIELD TEST

- A. When directed by the Engineer, perform test of roof areas by a continuous application of water over roof areas for not less than 8 hours.
- B. Throughout test period and after water shut off, no leaks shall be evident. No standing or ponding water shall remain on roof area(s) 24 hours after water shut off. In the event of leaks or ponding water, repair and retest.
- C. Upon satisfactory completion of field tests, post a permanent identification sign on the interior side of each roof access door or hatch. Such signs shall contain the following:
 1. The name and telephone number of the primary membrane sheet manufacturer.
 2. Authority Contract number and date of roof system installation.
 3. Notification that "No modifications to, or penetrations through the Roof System may be performed without prior written approval of the Roof System manufacturer".

END OF SECTION

SECTION 07530

FULLY ADHERED SINGLE-PLY THERMOPLASTIC MEMBRANE ROOF SYSTEM WITH MECHANICALLY FASTENED INSULATION

APPENDIX "A"

SUBMITTALS

- A. Certificates
1. Submit written evidence of approval of the Contractor or other entity performing the Work by the membrane roofing system manufacturer.
 2. Submit evidence of Underwriters' Laboratories acceptance of the proposed roofing system for a Class A rating, as required by this Section.
 3. 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 with 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.
 4. 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, four hundred fifty pounds (450) for formed metal and lightweight concrete decks, and six hundred pounds (600) for structural concrete decks.
 5. The Contractor shall submit the Manufacturer's stamped and signed approvals along with samples required by this Section.
- B. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:
1. Shop Drawings

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.

 - a. 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.
 - b. 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.

- c. Shop drawings shall indicate all the proprietary names of the materials being used for this Contract.
- 2. **Samples and Manufacturer's Literature**

Submit prior to ordering materials:

Samples of each element of the roofing system to be used including fasteners, flashings and sealants in triplicate for approval by the Engineer. Sample sizes shall be as follows:
 - a. Twelve (12) inch square of base and primary membrane sheet.
 - b. Twelve (12) inch square of roof insulation system.
 - c. Twelve (12) inch long by six (6) inch girth of metal flashing material or metal covered composite material.
 - d. Twelve (12) inch length of metal fascia.
 - e. Twelve (12) inch square of vapor seal membrane sheet (if indicated on the Contract Drawings.)
- 3. **Product Data**

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.
- 4. Verification of material physical properties by an independent laboratory. Provide certification stamp and authorized signature for laboratory.
- 5. Where products of GAF Corporation or of its subsidiaries including U.S. Intec, Inc. (USI), Tri Ply, and GAF Materials Corporation (GAF MC) are used in this Contract, prior to issuance of Certificate of Final Completion submit copies of materials invoices with costs for all such products to the Engineer.
- C. Submit to the Engineer one copy of USDOL Material Safety Data Sheets (MSDS) for all hazardous chemicals utilized during the Work.
- D. **Job Schedule**

Prior to the Pre-Installation Meeting, submit proposed schedule for performing the Work.

END OF APPENDIX "A"

SECTION 07530

FULLY ADHERED SINGLE-PLY THERMOPLASTIC MEMBRANE ROOF SYSTEM WITH MECHANICALLY FASTENED INSULATION

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 _____, 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 of the Specifications of the subject Contract.
 2. On a date agreeable to the Contractor 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 Contractor shall inspect the roofing system for defects, including:
 - a. Actual leaks and damage to the roofing system,
 - b. Separations or slippage of membrane or any signs of movement of the roof membrane,
 - c. Buckles, cracks, splits and open seams and
 - d. Any other defects that would lessen the service life of the roofing system.
 - e. After such inspection the Contractor shall perform all required repairs, to the satisfaction of 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.

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, distortions, splitting or cracking of substrate, separations between roof sections or between roof sections and parapets (except where expansion joints are provided), 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" hereinafter. 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 Contract and this Contractor's Guarantee 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. Any costs for removing or replacing traffic wearing surfaces not installed by the Contractor, which shall be compensated on a Net Cost basis in accordance with Paragraph D. of this Guarantee.
 3. Damage from direct lightning strikes.
 4. Damage caused specifically by hail as proven to the satisfaction of the Authority.

D. Net Cost Work

The Contractor will be compensated for the Work specified in Paragraph C.2 of this Guarantee 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 of Extra Work. Compensation for said Net Cost Work shall not be charged against the total amount of compensation authorized for Extra Work.

(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 07530

FULLY ADHERED SINGLE-PLY THERMOPLASTIC MEMBRANE ROOF SYSTEM WITH MECHANICALLY FASTENED INSULATION

APPENDIX "C"

MANUFACTURER'S GUARANTEE

- A. In order to induce the Port Authority of New York and New Jersey (the "Authority") to approve the roofing system manufactured by the undersigned for installation under Authority Contract _____, hereafter referred to as the "Contract" or "the subject Contract", the undersigned agrees to the following for the benefit of the Authority.
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 twenty (20) 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 of the Specifications of the subject Contract.
 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:
 - a. Actual leaks and damage to the roofing system,
 - b. Separations or slippage of membrane or any signs of movement of the roof membrane,
 - c. Buckles, cracks, splits and open seams and
 - d. Any other defects that would lessen the service life of the roofing system. After such inspection the manufacturer shall perform all required repairs, to the satisfaction of 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.

4. For repairs or replacement of portions thereof required under this Guarantee which the manufacturer demonstrates to the full and complete satisfaction of the Engineer are necessitated by damage which has resulted from structural failures, settling, shifting, distortions, splitting or cracking of substrate, 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. Any costs for removing or replacing traffic wearing surfaces not installed by the Contractor, which shall be compensated on a Net Cost basis in accordance with Paragraph C of this Guarantee.
3. Damage from direct lightning strikes.
4. Damage caused specifically by hail as proven to the satisfaction of the Authority.

C. Net Cost Work

The Contractor will be compensated for the Work specified in Paragraph B.2 of this Guarantee 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 of Extra Work. Compensation for said Net Cost Work shall not be charged against the total amount of compensation authorized for Extra Work.

(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"

SECTION 07530

SINGLE-PLY THERMOPLASTIC MEMBRANE ROOF SYSTEM WITH MECHANICALLY FASTENED INSULATION

APPENDIX "D"

REROOFING PROVISIONS

- A. 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. In addition, remove and reinstall items not required by Paragraph A. above, as directed by the Engineer at the net cost of such Work as specified in Paragraph C below.
- B. Do not proceed with application of roofing system until all defects in the existing roof or deck structure are corrected as directed by the Engineer. Correction of such defects will be compensated at the net cost of such Work as specified in Paragraph C below.
- C. Net Cost Work

The Contractor will be reimbursed for the Work specified in Paragraphs A and B above 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 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 APPENDIX "D"

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.; Addison, 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:

A. Product Data

Submit the manufacturer's technical product data, and dimensioned drawings indicating fastening method and installation 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:

	<u>American Architectural Manufacturers Association (AAMA)</u>
AAMA CW-13	Structural Sealant Glazing Systems.
	<u>American Society for Testing and Materials (ASTM)</u>
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
Urespan 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., Beechwood, 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^{set} 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

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 for each joint sealant product, sealant backing, primer and accessory required, and instructions for joint preparation and sealant application.

B. Samples

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.

C. Certifications

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.

D. Test Reports

1. Preconstruction field adhesion test report results per 1.03 C when field adhesion tests are directed by the Engineer.
2. 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.

E. Qualifications

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.

END OF APPENDIX

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:

	<u>American National Standards Institute, Inc. (ANSI)</u>
ANSI A 115	Series Door and Frame Preparation
	<u>American Society for Testing and Materials (ASTM)</u>
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 366	Steel, Carbon, Cold-Rolled Sheet, Commercial Quality
ASTM A 525	General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process
ASTM A 526	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A 569	Steel, Carbon (0.15 maximum percent), Hot-rolled Sheet and Strip, Commercial Quality
ASTM B 117	Method of Salt Spray (Fog) Testing
ASTM C 236	Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
ASTM E 90	Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions

ASTM E 152	Methods for Fire Tests of Door Assemblies
ASTM E 413	Classification for Determination of Sound Transmission Class
ASTM F 476	Test Methods for Security of Swinging Door Assemblies
	<u>Door and Hardware Institute (DHI)</u>
	Recommended Locations for Builders Hardware for Custom Steel Doors and Frames
	<u>National Fire Protection Association (NFPA)</u>
NFPA 80	Fire Doors and Windows
	<u>Steel Structures Painting Council (SSPC)</u>
SSPC - PT-2	Cold Phosphate Surface Treatment
SSPC - PT-4	Hot Phosphate Surface Treatment
	<u>Underwriters Laboratories, Inc. (UL)</u>
	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 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 of one of the following or approved equal:

A. Hollow Metal and Thermal Rated Doors, Frames and Panels

American Welding & Mfg. Co., Amweld Building Products Division, Niles, OH
Ceco Corporation, Oak Brook, IL
Curries Mfg., Inc., Mason City, IA
Pioneer Industries/Div. CORE Industries, Inc., Carlstadt, NJ

B. Sound Rated Door and Frame Assemblies

Allied Steel Products, Inc., Miami, FL.
Pioneer Industries/Div. CORE Industries, Inc.
Superior Fireproof Door, Inc., Scranton, PA.

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 A 366; or hot rolled, commercial quality carbon steel, pickled and oiled conforming to ASTM A 569.
2. Exterior Hollow Metal Doors, Panels and Frames

Commercial quality zinc-coated carbon steel conforming to ASTM A 526 with ASTM A 525, G 90, zinc coating, mill phosphatized.
3. Interior and Exterior Hollow Metal Doors, Panels and Frames - Stainless Steel

Commercial-quality stainless steel, AISI Type 302/304, complying with ASTM A 167, exposed finish No. 4 polish.

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 A 153, 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 A 153, 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 B 117 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 F 476 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 E 152 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 E 90 and STC classified in accordance with ASTM E 413. 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 C 236.

- I. 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 than 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 partitions.
 - 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. 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

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.
- 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. 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.
 4. 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.
- F. Provide coordinator device for pairs of doors equipped with closers and astragal, prepared for vertical rod exit device.
- G. 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.
- H. Provide resilient silencers for all interior metal doorframes, 3 per single doorframe, 2 per double doorframe, unless acoustic or smoke seal is scheduled on Appendix "B".
- I. 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 doorstep 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.

Insert * or ** adjacent to manufacturers below as appropriate for the Contract.

<u>Item</u>	<u>Manufacturer</u>	<u>Symbol</u>
Locks/Latches	Best	B
	Corbin	C
	Yale	Y
Cylinders	Best	B
	Corbin	C
	Yale	Y
Butts/Hinges	Hager	H
	McKinney	MC
	Stanley	ST
Exit/Panic Devices	Corbin	C
	Yale	Y
	Von Duprin	V
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	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

Insert * or ** adjacent to manufacturers below as appropriate for the Fill-in below and add or delete set numbers as appropriate for Contract.

HW1	[For Each Door No.]
HW2	[For Each Door No.]
HW3	[For Each Door No.]
HW4	[For Each Door No.]
HW5	[For Each Door No.]
HW6	[For Each Door No.]
HW7	[For Each Door No.]
HW8	[For Each Door No.]
HW9	[For Each Door No.]
HW10	[For Locker(s) in Room(s) No.]

END OF APPENDIX "B"

DIVISION 8
SECTION 08805
GLASS AND GLAZING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for glass and glazing.

- A. Refer to Section 07920 of these Specifications regarding silicone sealants for elastomeric glazing sealant.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Architectural Manufacturers Association (AAMA)

- | | |
|-------------|---|
| AAMA 800 | Voluntary Specification and Test Methods for Sealants |
| AAMA TIR-A7 | Sloped Glazing Guidelines |

American National Standards Institute (ANSI)

- | | |
|-------------|--|
| ANSI Z 97.1 | Glass Methods Used in Buildings/Test Methods |
|-------------|--|

American Society for Testing and Materials (ASTM)

- | | |
|-------------|---|
| ASTM C 509 | Specification for Elastomeric Cellular Performed Gasket and Sealing Material |
| ASTM C 542 | Specification for Lock-Strip Gaskets |
| ASTM C 716 | Specification for Installing Lock-Strip Gaskets and Infill Glazing Materials |
| ASTM C 864 | Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers |
| ASTM C 1036 | Flat Glass |
| ASTM C 1048 | Heat Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass |
| ASTM C 1115 | Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories |
| ASTM C 1172 | Specification for Laminated Architectural Flat Glass |
| ASTM E 773 | Seal Durability of Sealed Insulating Glass Units |
| ASTM E 774 | Sealed Insulating Glass Units |

Code of Federal Regulations (CFR)

16 CFR Part 1201 Safety Standard for Architectural Glazing Materials

Flat Glass Marketing Association (FGMA)

FGMA Glazing Manual

Insulating Glass Certification Council (IGCC)

IGCC Certified Product Directory - Sealed Insulating Glass

Laminated Safety Glass Association (LSGA)

LSGA Design Guide

Safety Glazing Certification Council (SGCC)

Certified Products Directory - Safety Glazing Material Used in Buildings

TM-3000 Vertical Glazing Guidelines

TB-3001 Sloped Glazing Guidelines

Underwriters Laboratories Inc. (UL)

Building Materials Directory

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the Work.
1. Normal thermal movement is defined as that resulting from an ambient temperature range of 120 degrees F and from a consequent temperature range within glass and glass framing members of 180 degrees F.
 2. Deterioration of insulating glass is defined as failure of hermetic seal due to causes other than breakage and improper practices for maintaining and cleaning, which result in intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coating, if any, resulting from seal failure, and any other visual evidence of seal failure or performance.
 3. Deterioration of laminated glass is defined as the development of manufacturing defects including edge separation or delamination that materially obstructs vision through glass.
 4. Deterioration of coated glass is defined as defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's directions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Environmental Conditions

Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when joint substrates are wet due to rain, frost, condensation or other causes. Install liquid sealants at ambient and substrate temperatures above 40 degrees F.

1.05 QUALITY ASSURANCE

A. Glazing Standards

Comply with recommendations of glass product manufacturers and organizations below, except where more stringent requirements are specified or shown on the Contract Drawings. Refer to these publications, as applicable, for definitions of glass and glazing terms not otherwise defined in this Section or other referenced standards.

1. FGMA Publications: "FGMA Glazing Manual."
2. AAMA Publications: AAMA TIR-A7 "Sloped Glazing Guidelines" and "Glass Design for Sloped Glazing".
3. LSGA Publications: "LSGA Design Guide".
4. SIGMA Publications: TM-3000 "Vertical Glazing Guidelines" and TB-3001 "Sloped Glazing Guidelines".

B. Safety Glazing Standard

Where safety glass is shown on the Contract Drawings or required by the Engineer, provide type of products which comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for category II materials.

1. Subject to compliance with the requirements of this Section, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to the Engineer.

C. Fire Resistance Rated Wired Glass

Where shown on the Contract Drawings, provide wired glass products that are identical to those tested per ASTM E 152 for door, ASTM E 163 for windows and are labeled and listed in the UL Building Materials Directory or other testing and inspecting agency acceptable to the Engineer.

D. Insulating Glass Certification Program

Where insulating glass is shown on the Contract Drawings, provide units permanently marked either on spacers or at least one component pane of units with certification label of one of the following testing agencies:

1. Insulating Glass Certification Council (IGCC).
2. Associated Laboratories, Inc. (ALI).
3. National Certified Testing Laboratories (NCTL).

E. Field-Constructed Mock-Up

Construct mock-ups to match glazing systems required, including typical pane size, framing system, and glazing materials and methods. Obtain Engineer's approval of the field-constructed mock-ups before proceeding with the Work. Retain mock-ups in undisturbed condition during construction as a standard for judging completed Work. Prepare mock-ups for the following types of glass in locations directed by Engineer.

1. Spandrel glass.
2. Insulating glass of each type.

F. Single Source Responsibility for Glass

To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each kind and condition of glass shown on the Contract Drawings and composed of primary glass obtained from a single source for each type and class required.

G. Provide certification from glass producer/fabricator that glass producer/fabricator has reviewed all glazing details and thicknesses and finds same suitable for the purpose intended in accordance with his published literature and in accordance with this Specifications Section. This shall include a written wind load and thermal stress analysis showing a probability of failure of no greater than 8 units per thousand for insulating glass units and 8 lites per thousand for monolithic glass at the design loads and local climatic thermal conditions.

H. Glass producer/fabricator shall make regular inspections (maximum interval semi-monthly) of glazing Work in progress at the point of glazing for both mock-up and job production units to verify that glazing is proceeding in accordance with his recommendations. Glass producer/fabricator shall submit inspection reports to the Engineer within three days of such inspections. For curtain wall systems and other systems utilizing glass which require mock-ups, if any, glass producer/fabricator shall attend the mock-up test at no additional cost to the Authority.

1.06 DELIVERY, STORAGE, AND HANDLING

Protect glass and glazing materials during delivery, storage and handling to comply with the manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and from other causes.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

1.08 WARRANTY

A. General

Warranties shall be in addition to, and not a limitation of, other rights the Authority may have under the Contract.

B. Manufacturer's Special Warranty on Laminated Glass

Provide written warranty signed by manufacturer of laminated glass, that within the specified warranty period indicated below, the manufacturer shall furnish labor and materials to replace those laminated glass units which develop manufacturing defects.

1. Manufacturer's standard but not less than 4 years after date of issuance of the Certificate of Final Completion.

C. Manufacturer's Special Warranty on Coated Glass Products

Provide written warranty signed by manufacturer of coated glass that within the specified warranty period indicated below, the manufacturer shall furnish labor and materials to replace those coated glass units which develop manufacturing defects.

1. Manufacturer's standard but not less than 5 years after date of issuance of the Certificate of Final Completion.

D. Manufacturer's Special Warranty on Insulating Glass

Provide written warranty signed by manufacturer of insulating glass that within the specified warranty period indicated below, the manufacturer shall furnish labor and materials to replace those insulating glass units developing manufacturing defects.

1. Manufacturer's standard but not less than 10 years after date of issuance of the Certificate of Final Completion.

- E. For definitions of "manufacturing defects", see definition of "deterioration" in 1.03 of this Section.

PART 2. PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the requirements of this Section, provide products of one of the following, or approved equal, for each of the following types of glass, where shown on the Contract Drawings:

1. Polished Wired Glass

Asahi Glass Co. Ltd., Tokyo, Japan
Pilkington Sales (North America) Limited.; Don Mills ON

2. Patterned Wire Glass

Guardian Industries Corp.; Carleton, MI

3. Heat-Treated, Laminated, and Insulating Glass

Floral Glass; Hauppauge, NY
Guardian Industries Corp.
Viracon, Inc.; Owatonna, MN

4. Coated Glass

Guardian Industries Corp.
Interpane Coatings, Inc.; Clinton, NC
PPG Industries, Inc.; Pittsburgh, PA
Viracon, Inc.; Owatonna, MN

2.02 MATERIALS

A. Glass Products

1. Primary Glass Standard

Provide primary glass which complies with ASTM C 1036 requirements, including those indicated by reference to type, class, quality, and, if applicable, form, finish, mesh and pattern.

2. Heat-treated Glass Standard

Provide heat-treated glass which complies with ASTM C 1048 requirements, including those indicated by reference to kind, condition, type, quality, class, and, if applicable, form, finish, and pattern.

3. Sizes

Fabricate glass to sizes required for glazing openings shown on the Contract Drawings with edge clearances and tolerances complying with recommendations of glass manufacturer. Provide thicknesses required in this Section unless shown otherwise on the Contract Drawings.

B. Provide the following primary glass products, where shown on the Contract Drawings:

1. Wired glass

Type II (patterned and wired glass, flat), Class 1 (clear) Quality q8 (glazing); complying with ANSI Z97.1; 1/4 inch thick; of form and mesh pattern indicated below, where shown on Contract Documents.

- a. Polished Wired Glass: Form 1 (wired, polished both sides), Mesh m1 (diamond).
- b. Polished Wired Glass: Form 1 (wired, polished both sides), Mesh m2 (square).
- c. Patterned Wire Glass: Form 2 (patterned and wired), Mesh m1 (diamond).

C. Provide the following heat-treated glass products for use in sealed insulating glass units and/or spandrel and other coated glass specified in this Section, where shown on the Contract Drawings. All heat strengthening and tempering shall be by the horizontal process, and processed in such a manner as to have all roller distortion in a horizontal direction as installed on the building. All fully tempered glass shall be heat soaked (checked) at glass surface temperatures of not less than 400°F for 4 hours. Heat strengthened glass shall be at the low end of allowable compressive strength for heat strengthened glass. Glass manufacturer shall provide quality control testing records to establish that his criteria has been met.

1. Uncoated Clear Heat-Treated Float Glass

Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), thickness as shown on the Contract Drawings, kind as follows where specified in this Section or shown on the Contract Drawings:

- a. Kind HS (heat strengthened)
- b. Kind FT (fully tempered)

2. Uncoated Tinted Heat-Treated Float Glass

Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 2 (tinted heat absorbing and light reducing), Quality q3 (glazing select), thickness as shown on the Contract Drawings, with tint as selected from manufacturer's standards tints and of kind as follows where specified in this Section or shown on the Contract Drawings.

- a. Kind HS (heat strengthened)
- b. Kind FT (fully tempered)

3. Ceramic-Coated Heat-Treated Spandrel Glass

Condition B (spandrel glass, one surface ceramic coated), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), thickness as shown on the Contract Drawings, with ceramic coating applied to second surface and complying with the following requirements:

- a. Kind HS (heat strengthened)
- b. Color

As shown on the Contract Drawings or, if not shown, as selected by Engineer from manufacturer's standard colors.

- c. Adhered Backing

Laminate manufacturer's standard adhered scrim backing to ceramic-coated surface.

- d. Fallout Resistance: Provide spandrel units identical to those passing fallout resistant test for spandrel glass specified in ASTM C 1048.

e. **Rigid Glass-fiber Insulation**

Applied to inside face of spandrel glass in thicknesses shown on the Contract Drawings, using manufacturer's recommended adhesive. Insulation shall have a "k" value of 0.26.

4. **Coated Monolithic Glass Products**

a. **General:** Performance characteristics designated for coated monolithic glass products are nominal values based on manufacturer's published test data for glass products 1/4 inch thick, unless otherwise shown on the Contract Drawings. Comply with requirements specified including those for primary and heat-treated float glass products as they relate to properties of glass to which coatings are applied.

b. U-values are expressed as Btu/hour x sq. ft. x deg. F.

c. Provide heat-treated coated float glass of kind indicated or, if not otherwise indicated, Kind HS (heat strengthened) where recommended by manufacturer to comply with system performance requirements specified and Kind FT (fully tempered) where coated safety glass is shown on the Contract Drawings.

d. Provide Kind HS (heat-strengthened) coated floated glass or provide Kind FT (fully tempered) products where coated safety glass is designated or required.

e. Provide one of the two following coating processes, as shown on the Contract Drawings:

(1) **Pyrolytically Coated Glass Products:** Float glass with solar-reflective metallic oxide coating applied pyrolytically either during initial manufacture or during heat treatment.

(2) **Sputter-Coated Glass Products:** Float glass with metallic oxide or metallic nitride coating deposited by magnetic sputtering process after manufacture and heat treatment (if any).

f. **Coated, Heat-Treated Spandrel Glass:** Class of glass, tint (if any), and type, color, and location of coating matching that shown on the Contract Drawings for vision lites and complying with the following:

(1) Kind HS (heat strengthened), or Kind FT (fully tempered), as shown on the Contract Drawings.

(2) **Fallout Resistance:** Provide spandrel units identical to those passing ASTM C 1048 fallout resistance test for spandrel glass.

(3) **Factory apply manufacturer's standard opacifier of the following material to second surface of lites with manufacturer's standard opacifier complying with GTA Specification No. 89-1-6.**

- D. Provide the following laminated glass products where specified in this Section or shown on the Contract Drawings:
1. General

Comply with ASTM C 1172 for kinds of laminated glass shown on the Contract Drawing and other requirements specified, and refer to primary and heat-treated glass requirements relating to properties of uncoated glasses making up laminated glass products.
 2. Plastic Interlayer

Provide interlayer for laminating panes of glass, with a proven record of showing no tendency to bubble, discolor or lose physical or mechanical properties after laminating and installation, in clear or colors and of thickness specified in this Section.

 - a. Interlayer shall be polyvinyl butral sheets, Saflex by Monsanto Co. or Butacite by E.I. du Pont de Memoirs & Co., Inc.; or urethane acrylate resin, Uvekool, by UCB Chemicals Corp.; or approved equal.
 3. Laminated Safety Glass

Two panes of glass of equal thickness, laminated together with 0.030-inch thick plastic interlayer to produce glass free of foreign substances and air or glass pockets and complying with the following requirements:

 - a. Glass Characteristics

Float glass, complying with requirements for Class 1 (clear), Kind HS (Heat Strengthened), minimum 1/8-inch thick each pane with clear interlayer for inner and tinted interlayer for outer panes, of color shown on the Contract Drawings.
 4. Laminated Sloped Glass

Two panes of glass of equal thickness, laminated together with a 0.060-inch thick plastic interlayer and complying with the following requirements:

 - a. Glass Characteristics

Float glass, complying with requirements for Class 1, Kind HS (Heat Strengthened), 3/16-inch thick (each pane with clear interlayer for inner panes and tinted interlayer for outer panes), of color shown on the Contract Drawings.
- E. Sealed Insulating Glass Units
1. General

Provide preassembled units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E 774 performance classification Class A as well as with other requirements specified for glass characteristics, air space, sealing system, sealant, spacer material, corner design and dessicant. Units shall be dual seal and shall be tested in accordance with ASTM E 773.

- a. For properties of individual glass panes making up units, refer to product requirements specified elsewhere in this Section applicable to types, classes, kinds and conditions of glass products shown on the Contract Drawings.
 - b. Provide 1/2-inch airspace, unless otherwise shown on the Contract Drawings.
 2. See Appendix "B" for information on insulating glass units and sloped insulating glass units.
 3. Sealing System
Dual seal; primary sealant: polyisobutylene; secondary sealant: silicone.
 4. Spacer Material
Manufacturer's standard metal.
 5. Dessicant
Manufacturer's standard; either molecular sieve or silica gel or blend of both.
 6. Corner Construction
Manufacturer's standard corner construction.
- F. Elastomeric Glazing Sealants and Preformed Glazing Tapes
1. Provide products of type shown on the Contract Drawings and complying with the following requirements:
 - a. Compatibility
Select glazing tapes proven compatible with specified sealants and with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
 - b. Suitability
Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants and tapes which have performance characteristics suitable for applications shown on the Contract Drawings and conditions at time of installation.
 - c. Elastomeric Sealant
Designation ES-1 in accordance with Section 07920 entitled "SILICONE SEALANTS" of these Specifications.
 - (1) Provide color of exposed sealants shown on the Contract Drawings or, if not shown, as selected by Engineer from manufacturer's standard colors.

(2) Preformed Butyl-Polyisobutylene Glazing Tape

Provide manufacturer's standard solvent-free butyl-polyisobutylene formulation with a solids content of 100 percent; complying with AAMA 800; in extruded tape form; non-staining and non-migrating in contact with nonporous surfaces; packaged on rolls with a release paper on one side; with or without continuous spacer rod as recommended by manufacturers of tape and glass for application shown on the Contract Drawings.

G. Glazing Gaskets

1. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C 542, black.
2. Dense Compression Gaskets: Molded or extruded gaskets of one of the materials indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
 - a. Neoprene, ASTM C 864,
 - b. EPDM, ASTM C 864,
 - c. Silicone, ASTM C 1115, or
 - d. Thermoplastic polyolefin rubber, ASTM C 1115.
3. Soft Compression Gaskets: Extruded or molded closed-cell, integral-skinned gaskets of one of the materials indicated below, complying with ASTM C 509, Type II, black, and of profile and hardness required to maintain watertight seal:
 - a. Neoprene,
 - b. EPDM,
 - c. Silicone, or
 - d. Thermoplastic polyolefin rubber.

H. Miscellaneous Glazing Materials

1. Cleaners, primers and sealers shall be the type recommended by sealant or gasket manufacturer.
2. Setting Blocks

Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.
3. Spacers

Neoprene, EPDM or silicone blocks, or continuous extrusions, as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application shown on the Contract Drawings.

4. Edge Blocks

Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.

5. Compressible filler rods (where shown on the Contract Drawings) Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with 5-10 psi compression strength for 25 percent deflection.

PART 3. EXECUTION

3.01 EXAMINATION

The entity performing glazing shall inspect glass framing for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. Do not allow glazing work to proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

Clean glazing channels and other framing members to receive glass, immediately before glazing. Remove coatings that are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.

3.03 INSTALLATION

A. General

1. Comply with combined printed recommendation of glass manufacturers, of manufacturers of sealants, gaskets and other glazing materials, except where more stringent requirements are shown on the Contract Drawings, including those of referenced glazing standards.
2. Glazing channel dimensions as shown on the Contract Drawings are intended to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.
3. Protect glass from edge damage during handling and installation; use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge that would occur in vicinity of setting blocks so that these are located at top of opening. Remove from construction site and dispose of glass units with edge damage or other imperfections of kind that, when installed, weakens glass and impairs performance and appearance.
4. Apply primers to joint surfaces where required for adhesion of sealants, as determined by sealant-substrate testing.

B. Glazing

1. Install elastomeric setting blocks of proper size in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6 inches from corner, unless shown otherwise on the Contract Drawings. Set blocks in thin course of compatible sealant that is acceptable for heel bead use.
2. Provide spacers inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 united inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used for glazing. Provide 1/8 inch minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.
3. Provide edge blocking to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.
4. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.
5. Gasket Glazing (Dry)
 - a. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.
 - b. Secure compression gaskets in place with joints located at corners to compress gaskets producing a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
 - c. Install gaskets so they protrude past face of glazing stops.
6. Sealant Glazing (Wet)
 - a. Install continuous spacers between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel weep systems until sealants cure. Secure spacers in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
 - b. Force sealants into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.
 - c. Tool exposed surfaces of sealants to provide a substantial "wash" away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.
7. Lock-Strip Gasket Glazing

Comply with ASTM C 716 and gasket manufacturer's printed recommendations. Provide supplementary wet seal and weep system unless otherwise indicated.
8. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement. Miter cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent pull away at corners; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.04 PROTECTION

- A. Protect exterior glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less often than once a month, for build-up of dirt, scum, alkali deposits or staining. When examination reveals presence of these forms of residue, remove by method recommended by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, abraded or damaged in other ways including natural causes, accidents and vandalism prior to issuance of a Certificate of Final Completion.
- E. Wash glass on both faces not more than 4 days prior to final inspection. Wash glass by method recommended by glass manufacturer.

END OF SECTION

SECTION 08805

GLASS AND GLAZING

SUBMITTALS

APPENDIX "A"

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Products Data

Manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions.

B. Samples

For verification purposes, 12-inch square samples of each type of glass shown on the Contract Drawings except for clear single pane units, and 12 inch long samples of each color required (except black) for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative of adjoining framing system in color.

C. Certificate

Submit certificates from respective manufacturers attesting that glass and glazing materials furnished for the Contract comply with the requirements of this Section.

1. Separate certification will not be required for glazing materials bearing manufacturer's permanent labels designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to the Engineer.

D. See 1.05 E for requirements for mock-ups.

END OF APPENDIX "A"

SECTION 08805
GLASS AND GLAZING
APPENDIX "B"

INSULATING GLASS AND SLOPED INSULATING GLASS DATA SHEET

- A. Provide the following types of insulating glass units where shown on the Contract Drawings:

Select from the following glass types, tints, thicknesses, etc. as appropriate for the Work of the Contract]

1. Type IG 1

Kind HS (heat strengthened), inner and outer lites consisting of two 1/8 inch thick clear panes laminated together for each lite. Inner and outer lites to have clear interlayers.
2. Type IG 2

Kind HS, inner and outer lites consisting of two 1/8 inch thick clear panes laminated together for each lite. Inner lite to have clear interlayer; outer lites to have bronze tinted interlayer.
3. Type IG 3

Kind FT (fully tempered), 1/4-inch thick clear inner and outer lites.
4. Type IG 4

Kind FT, 1/4-inch thick bronze tinted outer lite and 1/4 inch thick clear inner lite.
5. Type IG 5
 - a. Kind HS (heat strengthened), 1/4-inch thick clear inner lite and 1/4-inch thick green tinted outer lite with Low-E coating on surface #2.
 - b. Provide one of the following manufacturers/products, or approved equal:
 - (1) Guardian Industries, NU-40
 - (2) Viracon, Inc., VE2-40
6. Type IG 6 (at sloped glazing)
 - a. Kind HS, inner lite consisting of two 1/4-inch thick clear panes laminated together and 1/4-inch thick green tinted outer lite; low-E coating on surface #2 and 50% white dot #6 ceramic frit on surface #6.
 - b. Overall thickness: 1-5/16"
 - c. Provide one of the following manufacturers/products:
 - (1) Guardian Industries, NU-40
 - (2) Viracon, Inc., VE2-40

END OF APPENDIX "B"

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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

1. 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 minimum 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:

A. Product Data

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.

B. Certifications

1. **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.
2. **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 09253
GYPHUM DRYWALL - INTERIOR CEILINGS AND SOFFITS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for interior gypsum drywall ceilings and soffits, including suspension systems, furring and accessories.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

<u>American Society for Testing and Materials (ASTM)</u>	
ASTM A 641	Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
ASTM A 653	Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
ASTM C 475	Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
ASTM C 635	Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
ASTM C 636	Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
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 840	Specification for Application and Finishing of Gypsum Board.
ASTM C 919	Practice for Use of Sealants in Acoustical Applications.
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 1396	Specification for Gypsum Board.
ASTM E 119	Test Methods for Fire Tests of Building Construction and Materials.
<u>Gypsum Association (GA)</u>	
GA-216	Specifications for the Application and Finishing of Gypsum Board
GA-600	Fire Resistance Design Manual.
<u>Underwriters Laboratories Inc. (UL)</u>	
	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. Design Criteria and Standards for Suspension System

1. For Work in New York City, metal suspension systems shall conform to the Building Code of the City of New York except that metal deck tabs shall not be used for top hanger attachment.

- a. In addition, the ceiling suspension system shall conform to the seismic design requirements contained in the Building Code of the City of New York, Local Law 17-95, using an effective peak velocity-related acceleration of 0.15, except revise Table 23-P by adding after II.3:

4. Anchorage for suspended ceilings weighing more than 4 psf [Value of C_p] without the weight of light fixtures. .75

2. For Work in New Jersey, metal suspension systems shall conform to ASTM C 635 and ASTM C 636 except for design and installation of hangers and their top and bottom connections. For the design and installation of hangers and their top and bottom connections, the above ASTM standards shall be revised as follows:

- a. The hanger and its connections shall safely carry the total supported load plus 200 pounds located at midspan.
- b. Hangers for suspending carrying channels or main runners shall be 1/4 inch diameter galvanized steel rods, or 1/8 inch by 1 inch galvanized steel flat bars or No. 9 gage galvanized, soft annealed, mild steel wire.
- c. In addition, the ceiling suspension system shall conform to the seismic design requirement contained in the NJ Uniform Construction Code. Seismic Design Category shall be as shown on the Contract Drawings.

1.04 ENVIRONMENTAL REQUIREMENTS

A. General

Comply with more restrictive of ASTM C 840 requirements and manufacturer's written recommendations for environmental conditions before, during and after application of gypsum board.

1. Room Temperatures

For screw attachment of gypsum board to framing, maintain not less than 40 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 gypsum boards from a single manufacturer. Obtain ancillary materials from manufacturer recommended by the manufacturer of gypsum boards.
3. Obtain trim accessories from either the same manufacturer that supplies gypsum board or from a manufacturer acceptable to gypsum board manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer.
- 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 otherwise damaged.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Grid Suspension Systems

Where direct hung grid suspension systems are shown on the Contract Drawings, furnish and install products of one of the following, or approved equal:

1. Non-Fire Rated

Armstrong World Industries, Inc., Lancaster, PA; "Drywall Grid Systems"
BPB America Inc., Tampa, FL; "Drywall Grid System"
Chicago Metallic Corp., Chicago, IL; "640-C Drywall Furring System"
USG Interiors, Inc., Chicago, IL; "Drywall Suspension System"

2. Fire Rated

Armstrong World Industries, Inc., Lancaster, PA; "Drywall Grid Systems"
Chicago Metallic Corp., Chicago, IL; "Fire-Front 650-C Drywall Furring System"
USG Interiors, Inc., Chicago, IL; "Drywall Suspension System"

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 Corp., Chicago, IL

2.02 MATERIALS

A. Ceiling Support Materials and Systems For Suspended or Furred Ceilings

1. General

- a. Size ceiling support components to comply with ASTM C 754, unless otherwise shown on the Contract Drawings or specified herein.
- b. Sheet Steel Components: Corrosion resistant steel complying with ASTM C 645.
- c. Protective Coating: G40 hot-dip galvanized per ASTM A 653, unless otherwise specified.
- d. Direct hung grid suspension systems shall conform to ASTM C 635, heavy-duty.

2. Hangers

Hangers for suspending carrying channels shall be 1/4 inch diameter galvanized steel rods or 1/8 inch by 1 inch galvanized steel flat bars.

3. Hanger Anchorage Devices

Screws, clips, bolts, cast-in-place concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and suitable for the use intended as proven through standard construction practices or by certified test data.

4. Channels

Cold-rolled steel, minimum base metal thickness of 0.0538 inch (16 gage), allowable bending stress of 18,000 psi, protected with galvanizing complying with ASTM A 653 for G60 coating designation, and as follows:

- a. Carrying Channels: 1-1/2 inch deep by 7/16 inch wide flanges, 508 lbs. per 1000 feet galvanized, as shown on the Contract Drawings.

5. Furring Members

Hat-shaped channel, minimum base metal thickness of 0.0179 inch (25 gage).

- a. Where shown on the Contract Drawings as "resilient", furnish manufacturer's special type designed to reduce sound transmission through ceiling.

6. Furring Anchorages

ASTM A 641; 0.0625 inch diameter (No. 16 gage), Class 1 galvanized wire ties or manufacturer's standard wire-type clips, bolts, nails or screws as recommended by furring manufacturer and complying with ASTM C 754.

B. Gypsum Board

ASTM C 1396; of types, thickness and edge configuration as indicated below, in maximum lengths available to minimize end-to-end butt joints.

1. Type: Regular, unless otherwise shown on the Contract Drawings. Furnish Type X or Type C for fire-resistant rated assemblies and where shown on the Contract Drawings.
2. Edges: Tapered and featured (rounded or beveled) for prefilling.
3. Thickness: 1/2 inch, unless otherwise shown on the Contract Drawings.

C. Drywall Trim Accessories

Manufacturer's standard trim accessories of types shown on the Contract Drawings for drywall Work, formed of galvanized steel with either knurled and perforated or expanded flanges for nailing or stapling, and beaded for concealment of flanges in joint compound; complying with ASTM C 1047. Furnish corner beads, L-type edge trim-beads, U-type edge trim-beads and one-piece control joint beads.

D. Joint Treatment Materials

Comply with ASTM C 475 for gypsum board installation and with the recommendations of manufacturers of both the panel products and the joint treatment materials for each application shown on the Contract Drawings.

1. Joint Tape for Paper-Faced Gypsum Board: Paper reinforcing tape.
2. Joint Compound: Ready-mixed, vinyl-type for interior use. Furnish two separate grades; one specifically for bedding tapes and filling depressions, and one for topping and sanding.

E. 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

F. Miscellaneous Materials

1. General: Furnish auxiliary materials for gypsum drywall Work of type and grade recommended by the gypsum board manufacturer.
2. Gypsum Board Screws: Comply with ASTM C 1002.
3. 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 PREPARATION

- A. Coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling hangers in a manner that will develop their full strength and at spacings required to support ceiling.
 1. Furnish concrete inserts and similar devices to be installed under other Sections before ceiling installation begins.

3.02 INSTALLATION

A. General

1. Install materials in accordance with the manufacturer's printed instructions, in compliance with governing regulations and fire-resistance rating requirements shown on the Contract Drawings.
2. Suspension System Installation Standard: ASTM C 636.
3. Metal Support Installation Standard: ASTM C 754, and as specified herein.
4. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
5. Do not bridge building expansion joints with support system; frame both sides of joints with furring or other support as shown on the Contract Drawings.

B. Ceiling Support Suspension Systems

1. Secure hangers to structural support by connecting directly to structure where possible; otherwise, connect to inserts, clips or other anchorage devices or fasteners as shown on the Contract Drawings.
2. Space main runners 4 feet on center and space hangers 4 feet on center along runners, unless otherwise shown on the Contract Drawings.
3. Level main runners to a tolerance of 1/8 inch in 12 feet measured both lengthwise on each runner and transversely between parallel runners.
4. Wire-tie or clip furring members to main runners and to other structural supports as shown on the Contract Drawings. Do not support wires from mechanical or electrical equipment occurring above ceiling.
5. **Grid Suspension System**

Attach perimeter wall track, angle or trim wherever support system meets vertical surfaces. Mechanically join main beam and cross furring members to each other and butt-cut to fit into vertical surface device.
6. Space furring members 16 inches on center, unless otherwise shown on the Contract Drawings.
7. Install auxiliary framing at termination of drywall Work, and at openings for light fixtures and similar Work, as required for support of both the drywall construction and other Work shown on the Contract Drawings for support thereon.

C. Gypsum Board Installation

1. Install ceiling boards in the direction and manner that will minimize the number of end-butt joints, and which will avoid end joints in the central area of each ceiling. Stagger end joints by at least 1 foot.
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 edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
4. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.
5. Form control joints and expansion joints with space between edges of adjoining boards, prepared to receive trim accessories.
6. Where sound-rated drywall Work is shown on the Contract Drawings (STC rating), including Work on resilient furring, seal the Work at perimeters, at control and expansion joints, at openings and penetrations with a continuous bead of acoustical sealant. Comply with ASTM C 919 and manufacturer's recommendations for location of beads, and close off sound-flanking paths around or through the Work.

D. Application Methods

1. Install gypsum board ceilings and soffits prior to wall/partition board application to the greatest extent possible.
2. Apply gypsum boards to supports with screws.

E. Drywall Trim Installation

1. 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.
2. Install metal cornerbead at outside corners of drywall Work.
3. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed. Furnish trim with face flange to receive joint compound. Install L-type trim where Work is tightly abutted to other Work. Install U-type trim where edge is exposed, revealed, gasketed or sealant-filled (including expansion joints).
4. Install metal control joint where shown on the Contract Drawings per ASTM C 840 requirements.

F. Finishing of Gypsum Drywall

1. Finish Level Standard: ASTM C 840.
2. 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.
3. Apply joint tape at joints between gypsum boards using taping joint compound, except where trim accessories are shown on the Contract Drawings.
4. Apply topping joint compound in three coats (not including prefill of openings in base), and sand between last two coats and after last coat.
5. Finish Levels

Finish gypsum boards to the levels shown on the Contract Drawings, performed in accordance with ASTM C 840.

3.03 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 09253

GYPNUM DRYWALL – INTERIOR CEILINGS AND SOFFITS

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 and installation instructions for each metal support, steel framing system and gypsum drywall component, and other data showing compliance with the requirements of this Section.

B. Shop Drawings

Reflected ceiling plans, prepared for installation purposes, drawn accurately to 1/4 inch = 1 foot scale and coordinated with related mechanical, electrical, communication, fire suppression and other Work above, penetrating or connected to ceiling or soffit. Show ceiling suspension members, method of anchorage to building structure and framing for supported items.

C. Samples

1. Set of 12 inch long samples of grid suspension system main runner and furring cross members with couplings.
2. Set of 12 inch long samples of exposed moldings and trim for each type and color required.

D. Certifications

1. Submit certificates from manufacturer of grid suspension systems certifying that their products comply with the requirements of this Section.
2. 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.
3. 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 09310
CERAMIC TILE

PART 1. GENERAL**1.01 SUMMARY**

This Section specifies requirements for ceramic wall and floor tile.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American National Standards Institute (ANSI)

- ANSI A 108.4 Ceramic Tile Installed with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive
- ANSI A 108.5 Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
- ANSI A 10 Installation of Grout in Tilework
- ANSI A 118.4 Latex-Portland Cement Mortar
- ANSI A 136.1 Organic Adhesives for Installation of Ceramic Tile, Type 1 and Type 2
- ANSI A 137.1 Ceramic Tile

American Society for Testing and Materials (ASTM)

- ASTM C 503 Marble Building Stone (Exterior)

Method of Evaluating Ceramic Floor Tile Installation Systems

- ASTM C 920 Elastomeric Joint Sealants
- ASTM C 1028 Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method

Tile Council of America (TCA)

Handbook for Ceramic Tile Installation

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile shown on the Contract Drawings to be installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
1. Level Surfaces: Minimum 0.6.
 2. Step Treads: Minimum 0.6.
 3. Ramp Surfaces: Minimum 0.8.

- B. Load-Bearing Performance: For ceramic tile shown on the Contract Drawings to be installed on floor or walkway surfaces, provide installations rated for one or more of the following load-bearing performance levels, as shown on the Contract Drawings, based on testing assemblies according to ASTM C 627.

- 1. Extra Heavy: Passes cycles 1 through 14.
- 2. Heavy: Passes cycles 1 through 12.
- 3. Moderate: Passes cycles 1 through 10.
- 4. Light: Passes cycles 1 through 6.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature at not less than 50 degrees F in tiled areas during installation and for not less than 3 days after completion, unless a higher temperature is required by the manufacturer's instructions.
- B. Vent temporary heaters, if used, to exterior to prevent damage to tile work from carbon dioxide buildup.

1.05 QUALITY ASSURANCE

- A. Source of Materials

Provide materials obtained from one source for each type and color of tile, setting material, grout and sealant.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store tiles in original grade-sealed cartons with seals unbroken and labels intact until time of use.
- B. Keep materials dry until ready for use. Prevent damage or contamination by water, freezing or other causes.

1.07 SPARE PARTS (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:

- A. Floor and Wall Tiles

Not less than one box for each 50 boxes or fraction thereof, for each type, color and pattern.

- B. Trim Units

Not less than 5 linear feet of each type and color of trim.

1.08 SUBMITTALS

See Appendix "A" for submittal requirements.

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PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide tile setting and grouting materials by one of the following manufacturers:

Bostik; Middleton, MA
DAP, Inc.; Dayton, OH
Laticrete International, Inc.; Bethany, CT
Mapei Corporation; Garland, TX

2.02 MATERIALS

A. General

1. Provide material(s), color(s), gloss(es) and pattern(s) from the manufacturer's shown on the Contract Drawings. If color(s), gloss(es) and pattern(s) are not shown, provide as selected by the Engineer from samples submitted in accordance with Appendix "A" A.2 of this Section.
2. Comply with ANSI A 137.1 for Type(s) and Grade(s) of tile shown on the Contract Drawings. Furnish tile complying with "Standard Grade" requirements.
3. Comply with specified ANSI standard for tile installation materials.
4. Unless otherwise shown on the Contract Drawings, provide tile trim and accessories that match color and finish of adjoining flat tile.

B. Unglazed Ceramic Mosaic Tile

Where shown on the Contract Drawings, in accordance with 2.01 A of this Section and as follows:

1. Type: Natural Clay
2. Wearing Surface: Without abrasive content, except provide slip-resistant tile where shown.
3. Nominal Face Dimensions: 1 inch x 1 inch or 2 inches x 2 inches as shown.
4. Nominal Thickness: 1/4 inch unless otherwise shown.
5. Face: Plain with cushion or square edges as shown.

C. Glazed Ceramic Mosaic Tile: Where shown on the Contract Drawings, in accordance with 2.01 A of this Section and as follows:

1. Type: Natural clay.
2. Nominal Face Dimensions: 2 inches x 2 inches, unless otherwise shown.
3. Nominal Thickness: 1/4 inch, unless otherwise shown.
4. Face: Plain with cushion or square edges as shown.

D. Glazed Wall Tile

Where shown on the Contract Drawings, in accordance with 2.01 A of this Section and as follows:

1. Nominal Face Dimensions: 4 1/4 inch x 4 1/4 inch unless otherwise shown.
2. Nominal thickness: 5/16 inch, unless otherwise shown.
3. Face: Plain with cushion edge, unless otherwise shown.
4. Glaze: Bright, unless otherwise shown.

E. Thresholds

Where shown on the Contract Drawings, marble threshold(s) complying with ASTM C 503 requirements for exterior use and abrasion resistance of 12 or greater for use subject to heavy foot traffic. Utilize marble type and color, and threshold size and edge configuration as shown.

F. Floor Setting Material

Latex Portland Cement Mortar, ANSI A 118.4.

G. Wall Setting Material

Organic Adhesive, ANSI A 136.1, Type I. Provide primer sealer where recommended by manufacturer.

H. Grouting Material

Manufacturer's preblended compound of Portland cement, selected and graded aggregates, color pigments and chemical additives gauged with latex additive to comply with manufacturer's directions; color as shown on the Contract Drawings or, if not shown, color shall be as selected by Engineer from manufacturer's custom colors.

I. Water: Clean and Potable

J. Miscellaneous Materials

1. Single component sealant for floor to wall joint and perimeter of floor penetrations shall be Dow-Corning Corp., Midland, MI "795 Silicone Building Sealant", color as shown on the Contract Drawings; or approved equal conforming to ASTM C 920, Type S, Grade NS, Class 25, use T.
2. Tile Cleaner

Product specifically acceptable to manufacturers of tile and grout as manufactured by one of the following, or approved equal:

Aqua Mix; Santa Fe Springs, CA
Hillyard, Inc., St. Joseph, MO

3. Cleavage Membrane: Chlorinated polyethylene (CPE) waterproof/crack isolation membrane for thin-bed ceramic tile applications, Dal-Seal TS manufactured by Dal-Tile, Dallas, TX, or approved equal.

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2.03 MIXES

Proportion and mix components in accordance with the manufacturer's instructions.

PART 3. EXECUTION

3.01 EXAMINATION

Examine surfaces to receive tile work. Do not proceed with tile work until surfaces and conditions comply with the tolerances specified below. Ensure that installation conditions comply with 1.03 of this Section and surfaces conform to the following before proceeding with tile installation(s):

A. Floors

1. Maximum variation in sub-floor surface: 1/8 inch in 8 feet.
2. Where floor drains are shown on the Contract Drawings, the subfloor slope shall be a minimum of 1/4 inch per foot in the direction of the floor drain.

B. Walls

1. Maximum variation in surface: 1/8 inch in 8 feet.
2. Maximum height of abrupt irregularities: 1/16 inch.

3.02 INSTALLATION

A. General

1. Comply with applicable installation methods of TCA Handbook for Ceramic Tile Installation for installation conditions shown on the Contract Drawings and applicable parts of ANSI A 108.4, A 108.5 and A 108.10 installation standards.
2. Unless otherwise shown on the Contract Drawings, extend tile into recesses and under or behind equipment and fixtures to form a complete covering without interruptions. Neatly terminate work at obstructions, edges and corners without disrupting pattern or joint alignment.
3. Perform cutting and drilling of tile without marring visible surfaces. Grind cut edges of tile abutting trim, finish or built-in items. Fit tile closely to openings and penetrations so that collars, plates or covers will overlap tile.
4. Unless otherwise shown on the Contract Drawings, lay tile in grid pattern. Layout tile and center tile fields in both directions in each space or on each wall area.
5. Unless otherwise shown on the Contract Drawings, provide uniform joint widths. Use setting templates for installations greater than 1,000 sq. ft. in area.
6. Provide sealant filled joints at wall/floor terminations, around floor drains, around floor penetrations; and at control, contraction, expansion and isolation joints shown on the Contract Drawings; or if not shown at spacings and locations recommended in TCA Handbook for Ceramic Tile Installation, and approved by the Engineer.

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B. Floor Installation

Install ceramic mosaic tile as follows:

1. Concrete Subfloor, Interior: TCA F113
2. Mortar

ANSI A 118.4: Latex-Portland Cement.
3. Grout: Latex-Portland Cement.
4. Where Chlorinated polyethylene (CPE) membrane is shown on the Contract Drawings: Install membrane following manufacturer's printed instructions over a thin-bed of mortar. Ensure that all edges of membrane at walls and other protrusions are turned up a minimum of 4 inches and properly lapped and sealed and attached to vertical backing material. Proceed with tile installation in accordance with TCA F 113 or F 102, as applicable.

C. Wall Installation

Install glazed wall tile as follows:

1. Solid backing, interior: TCA W223.
2. Gypsum Board, Interior: TCA W242
3. Organic Adhesive: ANSI A108.4
4. Grout: Latex-Portland Cement

D. Cleaning

Upon completion of placement and grouting, clean ceramic tile surfaces so they are free of grout haze and foreign matter.

3.03 PROTECTION

- A. Leave finished tile work clean and free of cracked, chipped, broken, unbonded or otherwise defective tile.
- B. When recommended by tile manufacturer(s), apply a neutral protective cleaner to completed tile installation(s).
- C. Protect tile installation(s) with approved method during construction period.
- D. Prohibit foot and wheel traffic from using tiled floors for at least 3 days after grouting is completed.
- E. Before issuance of the Certificate of Final Completion, remove protective coverings and rinse neutral cleaner, if any, from tile surfaces.

END OF SECTION

SECTION 09310

CERAMIC TILE

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

Submit manufacturer's technical information and installation instructions for materials furnished under this Section.
 2. Samples
 - a. For Selection Purposes

When color(s) and pattern(s) are not shown on the Contract Drawings, submit manufacturer's color charts consisting of actual tiles or sections of tiles showing full range of color(s) and pattern(s) available for each type of tile shown. Include samples of grout and sealant involving color selection.
 - b. For Verification and Testing

Samples of each type, pattern, and color required, not less than 24 inches square on hardboard backing and grouted and the following:
 - c. Full size samples for each type and color of trim.
 - d. Six-inch long sample of thresholds, if any.
- B. Certification

Furnish Master Grade Certificates, as specified in ANSI A 137.1, for each shipment and type of tile, signed by the manufacturer and the entity performing installation work.
- C. Submit to the Engineer one copy of U.S. Department of Labor Material Safety Data Sheets (MSDS) for all hazardous chemicals utilized during Work of this Section.
- D. List of extra stock in accordance with 1.07 of this Section.

" END OF APPENDIX A "

DIVISION 9**SECTION 09503****LAY-IN PANEL ACOUSTICAL CEILINGS****PART 1. GENERAL****1.01 SUMMARY**

This Section specifies requirements for exposed grid lay-in panel acoustical ceilings, including suspension systems and accessories.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

- American Society for Testing and Materials (ASTM)
- ASTM C 423 Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- ASTM C 635 Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- ASTM C 636 Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
- 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 413 Classification for Rating Sound Insulation.
- ASTM E 1110 Classification for Determination of Articulation Class.
- ASTM E 1111 Test Method for Measuring the Interzone Attenuation of Ceiling Systems.
- ASTM E 1264 Classification for Acoustical Ceiling Products.
- ASTM E 1414 Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
- ASTM E 1477 Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.

Ceilings and Interior Systems Construction Association (CISCA)

Acoustical Ceilings Use & Practice.

Underwriters Laboratories Inc. (UL)

Fire Resistance Directory.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Fire Performance Characteristics

1. Fire-Resistance Ratings

When required, hourly-rated fire-resistant acoustical ceiling systems are shown by reference to design designation in UL's *Fire Resistance Directory*, or in the listing of another qualified testing and inspecting agency for floor, roof or beam assemblies in which acoustical ceilings function as a fire protective membrane.

- a. Test Standard: ASTM E 119.
- b. Furnish and install protection materials for lighting fixtures and air ducts to comply with requirements of rated assembly shown on the Contract Drawings.

2. Surface Burning Characteristics

Acoustical ceiling units shall comply with ASTM E 1264 for Class A, as determined by testing identical products in accordance with ASTM E 84 by a testing and inspecting agency acceptable to the Engineer. Components shall display appropriate marking of applicable testing and inspecting agency.

- a. Flame Spread: 25 or less.
- b. Smoke Developed: 50 or less.

B. Design Criteria and Standards for Suspension System

1. For Work in New York City, metal suspension systems shall conform to the Building Code of the City of New York except that metal deck tabs shall not be used for top hanger attachment.

- a. In addition, the ceiling suspension system shall conform to the seismic design requirements contained in the Building Code of the City of New York, Local Law 17-95, using an effective peak velocity-related acceleration of 0.15, except revise Table 23-P by adding after II.3:

4. Anchorage for suspended ceilings weighing more than 4 psf [Value of C_p] without the weight of light fixtures. .75

2. For Work in New Jersey, metal suspension systems shall conform to ASTM C 635 and ASTM C 636 except for design and installation of hangers and their top and bottom connections. For the design and installation of hangers and their top and bottom connections, the above ASTM standards shall be revised as follows:

- a. The hanger and its connections shall safely carry the total supported load plus 200 pounds located at midspan.
- b. Hangers for suspending carrying channels or main runners shall be 1/4 inch diameter galvanized steel rods, or 1/8 inch by 1 inch galvanized steel flat bars or No. 9 gage galvanized, soft annealed, mild steel wire.
- c. In addition, the ceiling suspension system shall conform to the seismic design requirement contained in the NJ Uniform Construction Code and its subcode the IBC/2000. Seismic Design Category shall be as shown on the Contract Drawings.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Ensure that the following space enclosure conditions have been met before installing interior acoustical ceilings:
1. Space is enclosed and weatherproof.
 2. Wet-work in space, including concrete, terrazzo, plastering and painting, is completed and nominally dry.
 3. Work above ceilings is complete.
 4. Ambient conditions of temperature and humidity are continuously maintained at values near those to be used for final occupancy.
 5. When a pressurized return air plenum is used, operate the ventilation system 48 hours before installing acoustical ceiling panels to cleanse ducts.

1.05 QUALITY ASSURANCE

- A. When required by Appendix "A" or when required by the Contract Drawings, submit calculations for the ceiling suspension system. Calculations shall be prepared and sealed by a professional engineer, licensed in the state where the Work is to be performed, indicating compliance with the Design Criteria.
- B. Single Source Responsibility
- Obtain acoustical panel units through one source from a single manufacturer. Obtain suspension system components through one source from a single manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical ceiling units to construction site in original, unopened packages. Store them in a fully enclosed space, protected against damage from moisture, direct sunlight, surface contamination and other causes.
- B. Before installing acoustical ceiling units, allow them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping.

1.07 MAINTENANCE

- A. Extra Materials

Where requirement for extra materials is shown on the Contract Drawings, deliver to the Engineer, prior to issuance of the Certificate of Final Completion, extra materials described below matching products installed. Package with protective covering for storage and identify with appropriate labels.

1. Acoustical Ceiling Units: Full size units in quantity equal to 2 percent of installed quantity.
2. Exposed Suspension System Components: Each component in quantity equal to 2 percent of installed quantity of each component.

1.08 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. Acoustical Ceiling Panels

Armstrong World Industries, Inc., Lancaster, PA
BPB America Inc., Tampa, FL
USG Interiors Inc., Chicago, IL

B. Metal Suspension Systems

Armstrong World Industries, Inc., Lancaster, PA
BPB America Inc., Tampa, FL
Chicago Metallic Corp., Chicago, IL
USG Interiors, Inc., Chicago, IL

2.02 MATERIALS

A. Standards for Acoustical Ceiling Panels

1. Manufacturer's standard units complying with ASTM E 1264 classifications as designated by reference to criteria for type, pattern, edge and joint details, and the following:
 - a. Noise Reduction Coefficient (NRC) Ratings: Established in accordance with ASTM C 423.
 - b. Articulation Class (AC) Ratings for open-plan spaces, if any: Established in accordance with ASTM E 1111, classified per ASTM E 1110.
 - c. Ceiling Attenuation Class (CAC) Ratings: Determined in accordance with ASTM E 1414, classified per ASTM E 413, with ceilings continuous at partitions and supported by a metal suspension system of type appropriate for ceiling unit of configuration shown.
 - d. Light Reflectance (LR) Coefficient: Determined in accordance with ASTM E 1477.
2. Colors, Textures and Patterns
Furnish products to match appearance characteristics shown or, if not otherwise shown, as selected by Engineer from manufacturer's standard colors, surface textures and patterns available for acoustical ceiling units of quality designated.

3. Acoustical Ceiling Panels

See Contract Drawings for acoustical ceiling unit criteria for panel size, thickness, type, texture, pattern, finish, NRC or AC range, CAC range, light reflectance, edge details and antimicrobial treatment, if any. Acoustical ceiling panel configuration shall be as shown on the Contract Drawings.

B. Metal Suspension Systems

1. Manufacturer's standard system roll-formed from hot-dip galvanized cold rolled steel sheet, or as otherwise shown on the Contract Drawings. Suspension system type and details shall be as shown on the Contract Drawings.

2. Finish

Manufacturer's standard factory-applied finish for type of system shown on the Contract Drawings. For exposed members and accessories with painted finish, color shall be as shown on the Contract Drawings or, if not shown, as selected by the Engineer from the manufacturer's full range of standard colors.

- a. High Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high humidity locations are shown on the Contract Drawings.

C. Accessories

1. Edge Moldings and Trim

Metal or extruded aluminum of types and profiles as shown on Contract Drawings or, if not shown, manufacturer's standard molding for edges and penetrations of ceiling which fits with type of edge detail and suspension system shown.

- a. For circular penetrations of ceilings, if any, furnish edge moldings fabricated to diameter required to fit penetration exactly.
- b. For narrow faced suspension systems, furnish suspension system manufacturer's standard edge moldings which match width and configuration of exposed runners.
- c. For lay-in panels with reveal edge details, provide stepped edge molding which forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

2. Hold-Down Clips

Where shown on the Contract Drawings, furnish manufacturer's standard hold-down clips spaced system spaced per manufacturer's recommendations, design to prevent ceiling panel flutter.

3. Impact Clips

Where shown on the Contract Drawings, furnish manufacturer's standard impact clip system design to absorb impact forces against lay-in panels.

4. Acoustical Sealant: As recommended by manufacturer of acoustical ceiling panel.

PART 3. EXECUTION

3.01 PREPARATION

A. Coordination

Furnish layouts for inserts, clips or other supports required to be installed by other trades for support of acoustical ceilings. Coordinate layout and installation of acoustical ceiling units and suspension system components with other Work supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system components, if any, and partition system, if any.

B. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other Work.

C. Measure each ceiling area and establish layout of acoustical ceiling units to balance border widths at opposite edges of each ceiling, avoiding use of less-than-half-width panels at borders. Comply with approved reflected ceiling plan Shop Drawings.

3.02 INSTALLATION

A. General

1. Install materials in accordance with the manufacturer's printed instructions, and in compliance with governing regulations, fire-resistance rating requirements shown on Contract Drawings and CISCA Standards applicable to the Work.
2. Suspension System Installation Standard: ASTM C 636.
3. Arrange acoustical units and orient directionally-patterned units, if any, in manner shown on approved of reflected ceiling plan Shop Drawings.

B. Suspended Lay-In Panel Acoustical Ceiling Installation

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions; offset resulting horizontal force by bracing, countersplaying or other equally effective means.
 - a. Locate hangers not less than 6 inches from each end and spaced 4 feet along each carrying channel or direct-hung runner, unless otherwise shown. Support hangers only from building structural members. Do not attach hangers to steel deck tabs, to steel roof deck or permanent metal forms. Level to tolerance of 1/8 inch in 12 feet.
 - b. Secure hangers by bolting either directly to structures or to inserts, eye-screws or other devices which are secure and appropriate for substrate, and which will not deteriorate or fail with age, corrosion or elevated temperatures.
2. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent or kinked suspension members.

3. Install edge moldings at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units. Miter corners and connect securely where moldings intersect.
 - a. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - b. Screw-attach moldings to substrate at intervals not exceeding 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12 feet. Use concealed fasteners on moldings and trim.
4. Install acoustical panels in coordination with suspension system, with edges undamaged, resting on and concealed by support suspension members, and supported by wall moldings. Scribe and cut panels to fit accurately at borders and at penetrations.
 - a. Install hold-down clips in areas where shown on the Contract Drawings, or required by governing regulations or for fire-resistance ratings. Space as recommended by ceiling panel manufacturer.
 - b. Install impact clips in areas where shown on the Contract Drawings. Space as recommended by ceiling panel manufacturer.
5. Finished Work shall be free from dents, tool marks, warpage, buckles, open joints, misaligned joints, edge damage, soiling, smudges, discolorations or other defects.

3.03 FIELD QUALITY CONTROL

Site Inspection

Lighting shall be in place and operational prior to inspection of acoustical panel ceiling systems so that lighting conditions upon inspection correspond to final building occupancy conditions.

3.04 ADJUSTING AND CLEANING

Clean exposed surfaces of acoustical ceilings, including trim, edge moldings and suspension members. Comply with the manufacturer's written instructions for cleaning and touch-up of minor finish damage. Remove and replace Work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, at no cost to the Authority.

END OF SECTION

SECTION 09503

LAY-IN PANEL ACOUSTICAL CEILINGS

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, installation and maintenance instructions for each type of acoustical ceiling unit and suspension system required.

B. Shop Drawings

Reflected ceiling plans, prepared for installation purposes, drawn accurately to 1/4 inch = 1 foot scale and coordinated with related mechanical, electrical, communication, fire suppression and other Work above, penetrating or connected to acoustical ceiling, showing the following:

1. Ceiling suspension members, method of hanger attachment to building structure.
2. Ceiling-mounted Work, including lighting fixtures, diffusers, grilles, speakers, sprinklers and special moldings.
3. Trim configuration, molding details and material type.

C. Samples

1. Minimum 12 inch square corner samples of each acoustical panel type, pattern and color required.
2. Set of 12 inch long samples of exposed moldings and suspension system components, including main runner and cross tee, for each color and system type required.

D. Certifications

Submit certificates from manufacturers of acoustical ceiling units and suspension systems certifying that their products comply with the requirements of this Section.

E. Design Calculations

Submit structural calculations for suspension system and connections, signed and sealed by a professional engineer licensed in the state in which the Work is to be performed.

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 1.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	<u>American Society for Testing and Materials (ASTM)</u>
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.
	<u>Federal Specifications (FS)</u>
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.
	<u>National Fire Protection Association (NFPA)</u>
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:

A. Product Data

1. Manufacturer's technical data for each type of resilient flooring, wall base and accessory, including installation and maintenance instructions.
2. One copy of U.S. Department of Labor Material Safety Data Sheets (MSDS) for all hazardous chemicals utilized during Work of this Section.

B. Shop Drawings

Complete layouts and design of the installation(s). Include a schedule of all materials to be furnished and installed as Work of this Section.

C. Samples

1. 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.
2. 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.
3. Two one-foot lengths of each base and stair material for each selected color for verification.

D. Certifications

1. Certifications required by 1.04 B.
2. Certification by tile manufacturer that products supplied for tile installation comply with local regulations controlling use of volatile organic compounds (VOCs).

E. Spare Parts

Extra stock in accordance with 2.02 I.

END OF APPENDIX "A"

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. Galvanized 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.

- 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 D 521	Standard Methods for Chemical Analysis of Zinc Dust
ASTM D 523	Test Method for Specular Gloss
ASTM D 562	Standard Test Method for Consistency of Paints Using the Stormer Viscometer
ASTM D 1475	Standard Test Method for Density of Paint, Varnish, Lacquer, and Related Products
ASTM D 2369	Standard Test Method 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 3359	Standard Test Method for Measuring Adhesion by Tape Test
ASTM D 4263	Standard Test Method for Moisture in Concrete by the Plastic Sheet Method
ASTM D 4285	Standard Test Method for Indicating Oil or Water in Compressed Air
ASTM D 4414	Standard Test Method for Measurement of Wet Film Thickness by Notch Gages
ASTM D 4417	Standard Test Method 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 6386	Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM F 1869	Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Sub-Floor using Anhydrous Calcium Chloride

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 D 4263.
 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 F 1869.
- 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 Structural Steel - Requirements

All painting of structural 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 structural 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. 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. At least 10 days prior to painting, notify the Engineer.
- c. Do not paint steel until approval to proceed is given by the Engineer.

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 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. 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 D 4285 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 D 4417. 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 D 6386 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 1.03A.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 rusting 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 D 4414. 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 D 3359 or ASTM D 4541 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

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.

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.

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 D 562.
 - b. Percent Total Solids by Weight, ASTM D 2369.
 - c. Volatile Organic Compounds (VOC), ASTM D 2369.
 - d. Weight per Gallon, ASTM D 1475.
 - e. Volume Nonvolatile Matter, ASTM D 2697.
 - f. Pigment Content, ASTM D 2371.
 - g. Percent Metallic Zinc in Primer, ASTM D 521.
 - h. Specular Gloss of Finish Coat, ASTM D 523.
 - 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

A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

1. 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

2. Samples

- a. 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.
- b. 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.

Identify each sample as to manufacturer, color name and number, location and application.
- c. 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.

B. 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.

- C. Submit the paint applicator's qualifications and/or experience.
- D. Submit a copy of the quality control program, as required by 1.04 C.2, if requested by the Engineer.
- E. Submit instructor qualifications and training records for blasters and painters as required by 1.04 C.1.b, if requested by the Engineer.
- F. Submit copy of daily inspection reports if requested by the Engineer.

END OF APPENDIX "A"

SECTION 09910

PAINTING

APPENDIX "B"

PAINT SCHEDULE

A. Exterior

<u>Surface</u>	<u>System Designation</u>	<u>Primer</u>	<u>Manufacturer's Product</u>	<u>2nd Coat</u>	<u>Manufacturer's Product</u>	<u>Top Coat</u>	<u>Manufacturer's Product</u>
Steel Gloss	S-1G	Organic Zinc Rich	Carboline Carbozinc 859	Epoxy	Carboline Carboguard 888	Aliphatic Polyurethane Gloss	Carboline Carbothane 134 HG
			Ameron Amercoat 68 HS		Ameron Amercoat 399		Ameron Amercoat 450 HS
			SW Zinc Clad III HS PPG Aquapon Zinc 97-670		SW Macropoxy 646 PPG Pitt-Guard DTR Epoxy 97-946		SW Acrolon 218 HS PPG Ultra Urethane 95-812
Steel Gloss	S-2G	Inorganic Zinc Rich	Carboline Carbozinc 11 HS	Epoxy	Carboline Carboguard 893	Aliphatic Polyurethane Gloss	Carboline Carbothane 134 HG
			International Interzinc 22 HS		International Intergard 475 HS		International Interthane 990 HS
			Ameron Dimetcote 9 HS		Ameron Amercoat 385		Ameron Amercoat 450 HS

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<u>Surface</u>	<u>System Designation</u>	<u>Primer</u>	<u>Manufacturer's Product</u>	<u>2nd Coat</u>	<u>Manufacturer's Product</u>	<u>Top Coat</u>	<u>Manufacturer's Product</u>
Steel Semi-Gloss	S-1S	Organic Zinc Rich	Carboline Carbozinc 859	Epoxy	Carboline Carboguard 888	Aliphatic Polyurethane Semi-Gloss	Carboline Carbothane 133 LH
			Ameron Amercoat 68 HS		Ameron Amercoat 399		Ameron Amercoat 450 SA
			SW Zinc Clad III HS PPG Aquapon Zinc 97-670		SW Macropoxy 646 PPG Pitt-Guard DTR Epoxy 97-946		SW Acrolon 218 HS PPG HB Urethane 95-8800
Steel Semi-Gloss	S-2S	Inorganic Zinc Rich	Carboline Carbozinc 11 HS	Epoxy	Carboline Carboguard 893	Aliphatic Polyurethane Semi-Gloss	Carboline Carbothane 133 LH
			Ameron Dimetecote D9 HS		Ameron Amercoat 385		Ameron Amercoat 450 SA
			International Interzinc 22 HS		International Intergard 475 HS		International Interthane 870
Steel Semi-Gloss	S-3S	Aluminum Epoxy Mastic	Carboline Carbomastic 15	Epoxy	Carboline Carboguard 890	Aliphatic Polyurethane Semi-Gloss	Carboline Carbothane 133 LH
			Ameron Amerlock 2 AL		Ameron Amercoat 385		Ameron Amercoat 450 SA
			SW Epoxy Mastic Aluminum II		SW Macropoxy 646		SW Acrolon 218 HS
Galvanized & Aluminum Gloss	N-1G	Primer	K&L 9400 Aqua-Kolor SW Pro-Cryl B66 - 310 Series Mercury Series 2100		N/A	Acrylic Gloss	K&L KLW-1 Series SW DTM Acrylic B66-100 Series Mercury Series 2150 DTM

<u>Surface</u>	<u>System Designation</u>	<u>Primer</u>	<u>Manufacturer's Product</u>	<u>2nd Coat</u>	<u>Manufacturer's Product</u>	<u>Top Coat</u>	<u>Manufacturer's Product</u>
Galvanized & Aluminum Semi-Gloss	N-1S	Primer	K&L KL 9400 Aqua-Kolor SW Pro-Cryl B66 - 310 Series Mercury Series 2100		N/A	Acrylic Semi-Gloss	K&L KLW 2 Series SW DTM Acrylic B66-200 Series Mercury Series 2150 DTM SG
Galvanized & Aluminum (Marine & Bridge)	N-2S	Epoxy Primer	Carboline Carboguard 888 SW Macropoxy 646 Ameron Amercoat 385		N/A	Aliphatic Polyurethane	Carboline Carbothane 133 LH SW Acrolon 218 HS Ameron Amercoat 450SA
Galvanized & Aluminum (Marine & Bridge) Gloss	N-2G	Epoxy Primer	Carboline Carboguard 888 Ameron Amercoat 385 SW Macropoxy 646		N/A	Aliphatic Polyurethane Gloss	Carboline Carbothane 134 HG Ameron Amercoat 450 HS SW Acrolon 218 HS
Steel, Semi-Gloss	S-8	MC Urethane Zinc	Wasser MC-Zinc Xymax MonoZinc ME III Ameron Amercoat 430	MC Urethane	Wasser MC-Ferrox B Xymax MonoFerro Pur Ameron Amercoat 433	MC Urethane	Wasser MC-Luster Xymax MaxCoat LH Ameron Amercoat 434
Steel, Semi-Gloss	S-9	Zinc Rich	Carboline Carbozinc 859	Urethane	Carboline Carbothane 134HG	Fluorocarbon	Carboline Carboxane 950

<u>Surface</u>	<u>System Designation</u>	<u>Primer</u>	<u>Manufacturer's Product</u>	<u>2nd Coat</u>	<u>Manufacturer's Product</u>	<u>Top Coat</u>	<u>Manufacturer's Product</u>
			Tnemec 90-97 Tneme-Zinc		Tnemec Series 1075 Endurashield II		Tnemec Fluoronar 1071
Steel	S-10	Zinc Rich	Tiger Drylac 69/90350 Dryzinc Carboline Carbozinc 859	N/A		TGIC Polyester, Superdurable	Tiger Drylac Series 38 TCI Powder Coatings Super Durable
Aluminum Semi-Gloss	N-3	Epoxy	Carboline Carboguard 888 Tnemec Epoxoline II Series N69	Urethane	Carboline Carbothane 133 LH Tnemec Series 1075 Endurashield II	Fluorocarbon	Carboline Carboxane 950 Tnemec Fluoronar 1071

B. Interior – Not applicable, see Interior – Sustainable Design below.

C. Overcoat Systems – Not applicable

D. Interior - Sustainable Design

Gypsum Board Flat	GB-2F	Acrylic Sealer	PPG 9-900 Pure Performance Interior Latex Primer Mercury Series 5900 SW Harmony B11W900 Benjamin Moore ECO SPEC Latex 231	Acrylic	PPG 9-100 Pure Performance Flat Interior Latex Mercury Series 6900 SW Harmony Latex Flat B5 Series Benjamin Moore ECO SPEC Latex 219	Acrylic Flat	PPG 9-100 Pure Performance Flat Interior Latex Mercury Series 6900 SW Harmony Latex Flat B5 Series Benjamin Moore ECO SPEC Latex 219
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<u>Surface</u>	<u>System Designation</u>	<u>Primer</u>	<u>Manufacturer's Product</u>	<u>2nd Coat</u>	<u>Manufacturer's Product</u>	<u>Top Coat</u>	<u>Manufacturer's Product</u>
Gypsum Board Semi-Gloss	GB-2S	Acrylic Sealer	PPG 9-900 Pure Performance Interior Latex Primer SW Harmony B11W900 Mercury Series 5900 Benjamin Moore ECO SPEC Latex 231	Acrylic	PPG 9-500 Pure Performance Semi-Gloss Interior Latex SW ProMar B31W2200 Mercury Series 8900 Benjamin Moore ECO SPEC Latex Enamel 224	Acrylic Semi-Gloss	PPG 9-500 Pure Performance Semi-Gloss Interior Latex SW Harmony B31W2200 Mercury Series 8900 Benjamin Moore ECO SPEC Latex Enamel 224
Steel Semi-Gloss	S-19S	Acrylic Steel Primer	PPG 90-712 Series Pitt-Tech DTM Industrial Enamel Carboline Carbocrylic 3359 DTM SW Pro-Cryl Universal Primer	Acrylic	PPG Acrylic Semi-Gloss 7-374 Series Carboline Carbocrylic 3359 SW DTM Acrylic B66-200 Series	Acrylic Semi-Gloss	PPG Acrylic Semi-Gloss 7-374 Series Carboline Carbocrylic 3359 SW DTM Acrylic B66-200 Series
Galvanized & Aluminum Semi-Gloss	N-7S	Primer	PPG 90-712 Series Pitt-Tech DTM Industrial Enamel Carboline Carbocrylic 120 SW Pro-Cryl Universal Primer	N/A		Acrylic Semi-Gloss	PPG Acrylic Semi-Gloss 7-374 Series Carboline Carbocrylic 3359 SW DTM Acrylic B66-200 Series

<u>Surface</u>	<u>System Designation</u>	<u>Primer</u>	<u>Manufacturer's Product</u>	<u>2nd Coat</u>	<u>Manufacturer's Product</u>	<u>Top Coat</u>	<u>Manufacturer's Product</u>
Concrete Floor Color Finish	CF-5	Epoxy	PFG MegaSeal WB 98-6637 Series Carboline Carboguard 1340 SW ArmorSeal 33 B58 AQ33/B60VQ33		N/A	Epoxy	PFG MegaSeal WB 98-7631 Series Carboline Sanitile 555 SW ArmorSeal 700 HS

END OF APPENDIX

DIVISION 10
SECTION 10431
MULTI-MESSAGE PRISM SIGNS

PART 1 – GENERAL

1.01 SUMMARY

This section specifies requirements for multi-message prism signs.

1.02 REFERENCES

The following is a list of the publications referenced in this section:

International Organization for Standardization
ISO 9001: 2008 Quality Management Systems – Requirements.

1.03 QUALITY ASSURANCE

The manufacturer shall be ISO 9001 Certified with a minimum of five years experience in the manufacturing, sales and support of prism signs for transportation or traffic applications.

The signs shall be shipped with certified factory test results.

The sign manufacturer shall provide a toll-free customer service telephone number for technical support.

1.04 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 coverings as part of final clean-up.
- E. Touch up any damage to finishes to match adjacent surfaces to the satisfaction of the Engineer.

1.05 WARRANTY AND WARRANTY SERVICE

A. Warranty

1. The completed work as specified herein, including all materials and labor, shall be warranted by the Contractor for a period of not less than one year, to be free from defects in design workmanship and materials. Further, the Contractor shall warrant that the completed systems including all components (except those which are not in contract) are of sufficient size and capacity to fulfill satisfactorily the requirements of these specifications.
2. The one-year warranty period shall begin upon final acceptance of the completed work.
3. For purposes of warranty consideration, final acceptance shall be defined as the date on which the Authority formally acknowledges acceptance of the completed work in writing.
4. Completed work includes all punch list items being corrected and all submittals received and approved. The warranty will not begin on beneficial use of the system.
5. The Contractor shall not be responsible for repair or maintenance of any not in contract equipment unless these systems or equipment have been specified as being part of this contract. The Contractor shall notify the Authority in writing if such equipment requires repairs to operate properly with the systems.
6. The warranty shall include full preventative maintenance and service on all equipment, components and systems. Preventative maintenance shall include, at a minimum, quarterly inspections and servicing of all equipment to insure continued operation in accordance with manufacturers' specifications as well as the specifications stated herein. All four inspections shall provide a detailed inspection matrix as the report document, which must be submitted each time, with the inspector's initials and date. The contractor must submit an inspection plan stating the work to be accomplished for each type of equipment inspected based on manufacturer's suggested maintenance plan. Provide additional text on what documentation needs to be submitted to the owner when equipment has failed, and must be reported. Visits shall be scheduled 72 hours in advance with the Authority.

B. Warranty Service

1. In the event that defects in the materials and/or workmanship are identified during the warranty period, the Contractor shall provide all labor and materials as may be required for prompt correction of the defect.
2. During the warranty period, the Authority shall determine if the failure is catastrophic or non-catastrophic.
3. A catastrophic failure shall be classified as a failure of a piece of equipment or related cabling that affects the functional use of the Changeable Message Signs.
4. A non-catastrophic failure is define as other than above.
5. The Contractor shall, upon receipt of a request for service from the Authority, have service personnel to the Authority's premises, repair and restore the signs or equipment to service as follows:
6. Catastrophic failures - four (4) hours response time: This response shall be in effect 24 hours per day, 7 days per week.
7. Non-catastrophic failure - eight (8) hours response time regardless of the time of call, Monday-Friday.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2 – PRODUCTS

2.01 CONSTRUCTION FEATURES

A. General

The multi-message prism sign model PTC 10-82 modified as necessary to display the specified sign text shall be as manufactured by Dambach, Inc. of N. Attleboro, Massachusetts, Phone No. (800) 737-0383, or approved equal.

2.02 TECHNICAL REQUIREMENTS

The sign prisms shall display the following text pages:

Upper Prism drive
Message 1: E-ZPass Plus

Message 2: CASH/CREDIT CARD
Message 3: LANE

Lower Prism drive

Message 1: ONLY
Message 2: CASH/CREDIT CARD
Message 3: CLOSED

Color, sign size and text font shall be as per contract drawings. Refer to Section 2.03 for product codes for color sheeting.

The sign prisms housing shall be equipped with a 6mm Plexiglas front face providing additional weather protection to the prism segments.

Adjustment of individual prisms, if necessary, shall be accomplished by means of cam-controlled switches supplied by the sign manufacturer.

The sign power supply shall be 120 V / 60 Hz with maximum power consumption not to exceed 750W.

The page-to-page change rate shall not exceed 3.5 seconds.

The prisms shall be driven by DC motors with overload protection connecting to a worm drive shaft connected to a coupler, producing the necessary torque. Chain-driven devices are not permitted.

The sign prisms housing shall be manufactured of 3mm aluminum. The housing exterior finish shall be traffic light grey high quality paint with a high corrosion resistance factor. The housing door shall utilize dust-and-water resistant rubber gaskets. Air circulation within the housing shall be accomplished via the use of filtered vents located on the sides of the housing.

The sign shall be controlled with a remotely located manual switch supplied by the sign vendor.

The sign shall have an automatic cutoff device in the event that undue mechanical resistance is detected during the page-to-page rotations process.

For maintenance personnel, the sign shall be equipped with an electronic means of rotating the prism via control switches on the sign controller board located inside the sign.

2.03 FABRICATION

The overall sign prism housing dimensions shall be 4'-7 7/8" (1,420 mm) high x 9'-8 3/8" (2,956 mm) wide x 10 5/8" deep (270 mm).

Control box dimensions shall be approximately 4" wide by 8" high by 3.5" deep.

The housing weight shall not exceed 700 lbs (318kgs).

The housing shall be equipped with two lifting eyes for installation purposes.

The sign prisms shall be horizontally mounted. Each prism shall be approximately 100mm (4") in height with a minimum of five prisms for each sign face for both the upper and lower prism drives.

The signs shall be equipped with a device wherein the prism segments may be manually rotating by means of a hand-crank in the event of a power failure.

Internal full-length fluorescent lighting shall be provided at both top and bottom of the housing.

Except as specified below, all materials used on the sign face shall be Scotchlite Brand Engineering Grade Reflective Sheeting – series 3200 as manufactured by the Traffic Control Division of the 3M Company, St. Paul, Minnesota 55133, or approved equal.

Refer to Contract Drawings for various colors used on sign faces. Following are the product codes for color sheetings:

Green: 3277

White: 3290

Red: 3272

Purple: Use flood coated Pantone 259C (purple) on white 3290 sheeting.

Use 3M Scotchcal brand non-reflective grade sheeting series 3650 where black color is specified.

The housing shall be equipped with multiple full-length z-bars (stiffeners) at the rear.

The prisms, solid worm gear drive and micro-switches shall be mounted in a torsion-free aluminum sign frame.

Each sign shall be delivered with a control box featuring clearly labeled switches for controlling the display of the following messages, and no others:

Message	1	2	3	4
Upper	E-Zpass Plus	E-Zpass Plus	CASH/CREDIT CARD	LANE
Lower	ONLY	CASH/CREDIT CARD	ONLY	CLOSED

Note: The message identification letters A through D shall not be displayed on the box; the messages shall be displayed on and engraved or printed on the box.

2.04 SPARE MULTI-MESSAGE PRISM SIGNS

The Contractor shall provide one (1) additional sign to be turned over to the Engineer.

PART 3 – EXECUTION

3.01 PREPARATION

Before manufacturing or procurement of equipment, submit detailed specifications, catalog cuts and shop drawings outlining the construction and operation details of all equipment for prior Engineer's approval as specified in Section 1.06 herein. No equipment shall be procured until the Engineer has given written approval.

3.02 INSTALLATION

- A. Install equipment and components in accordance with the Contract Drawings and approved shop drawings.
- B. Set work accurately in location and alignment. Furnish and install anchorage devices and fasteners where necessary for installation and connection to other construction.
- C. Prior to energization, test all field-installed wiring for continuity and hook-up. Tag-identify all terminations.

3.03 FIELD TESTS

- A. The entire sign 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, submit a test plan to the Engineer for approval, outlining all aspects

of the testing, including tests to be performed and the desired results.

- B. Perform the following field tests in the presence of the Engineer to demonstrate the reliability of the sign installation. Give the Engineer a minimum of one-week advance 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 demonstrate the operation and performance of the 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 for field inspection shall be conducted in conformance with standards specified herein, and reported to the Engineer.
- 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. Transformer
 - b. Panelboards
 - c. All 600 volt (nominal) cable connections rated 100 amperes (#3 AWG) or greater
 - d. Other equipment as shown on the Contract Drawings
 2. Arrange for the inspection to be made by an independent inspection company such as Thermo-Scan of Montville, N.J., General Electric Apparatus Service Division, or approved equal. The inspection shall be made with all equipment, motors, lighting fixtures and miscellaneous loads operating and with all equipment covers removed. Submit to the Engineer for approval 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. Any equipment, connections or devices indicated to be operating improperly shall be

replaced or repaired by the Contractor at no cost to the Authority.

- E. Demonstrate to the Engineer the operation of the sign installed under this specification.
1. After completion of all testing, and prior to placing equipment in operation, demonstrate the features and operation of the sign to the Engineer and his designated personnel, so that operational and maintenance personnel are familiarized with the equipment, as follows:
 - a. Transformer
 - b. Panelboards
 - c. Other equipment as shown on the Contract Drawings
 2. Provide the necessary accessories, test equipment, and personnel, for each demonstration.
 3. Coordinate all arrangements for the demonstrations with the Engineer.
 4. Upon the completion of each demonstration, obtain Engineer's approval, documenting that complete demonstrations were provided to the designated personnel.

END OF SECTION

SECTION 10431

MULTI-MESSAGE PRISM SIGNS

APPENDIX A

SUBMITTAL REQUIREMENTS

Submit for approval the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

- A. Submit shop drawings of the multi-message prism sign for approval.

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.

	<u>American Society for Testing and Materials (ASTM)</u>
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.
	<u>National Fire Protection Association (NFPA)</u>
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

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

Product data for each toilet accessory item specified, including construction details relative to materials, dimensions, profiles, thicknesses, mounting methods and specified options and finishes. Furnish setting drawings, templates, instructions, directions for installation of anchorage devices and cutout requirements in other Work.

B. Shop Drawings

Show fabrication and erection of toilet accessories not fully described by product data drawings.

C. Warranty

Prior to issuance of the Certificate of Final Completion, submit manufacturer's warranty to the Engineer for any mirrors furnished.

D. Schedules

Indicating manufacturer, accessory type and model number, quantities, sizes and installation location for each accessory shown on the Contract Drawings.

E. Maintenance Manuals

Submit manufacturer's printed instructions for care and maintenance of installed Work, including replaceable parts and service recommendations.

END OF APPENDIX "A"

DIVISION 12
SECTION 12522
SHADES

PART 1. GENERAL

1.01 SUMMARY

- A. This Section specifies manually operated and motorized roll shades.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM D 1925

National Fire Protection Association (NFPA)

NFPA 701 Fire Tests for Flame Resistant Textiles and Films

NFPA 70 National Electrical Code

Occupational Safety and Health Administration (OSHA)

OSHA Regulation 1910.7

1.03 QUALITY ASSURANCE

A. **Installer Qualifications**

Engage an experienced installer with at least five years experience performing shade installations similar in material, design, and extent to that shown on the Contract Drawings for Work of this Contract and with a record of successful in-service performance.

B. **Source Limitations**

Obtain shades through one source from a single manufacturer.

C. **Fire-Test-Response Characteristics**

Provide shades that are identical to products that pass NFPA 701 Small Scale Test for flame-propagation resistance performed by UL or another testing and inspecting agency acceptable to the Engineer. Identify shades with appropriate markings of applicable testing and inspecting agency.

D. Listing and Labeling

Provide electrically operated fixtures specified in this Section that are listed and labeled.

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" (NRTL) as defined in OSHA Regulation 1910.7.

E. Mock-ups

Before installing shades, construct mock-ups for each type required to verify selections made under Sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-ups to comply with the following requirements, using materials shown on the Contract Drawings for completed Work.

1. Locate mock-ups in the location and of the size shown on the Contract Drawings or, if not shown on the Contract Drawings, as directed by Engineer.
2. Notify Engineer 7 days in advance of the dates and times when mock-ups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Engineer's approval of mock-ups before proceeding with installation of shades.
5. Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed Work.
 - a. Approved mock-ups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

F. Field Measurements

Verify shade openings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating shades without field measurements. Coordinate wall and ceiling construction to ensure actual opening dimensions correspond to established dimensions.

1.04 EXTRA STOCK

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Shade Units: Full-size units equal to 5 percent of amount installed for each size shown on the Contract Drawings, but not less than 1 unit.

1.05 SUBMITTALS

For Submittals, see Appendix "A" to this Section.

PART 2. PRODUCTS

2.01 MATERIALS

A. Products

Subject to compliance with requirements, provide one of the shades indicated in the Shade Schedule in Appendix "B".

2.02 ACCESSORIES

A. Side and Sill Closure Channels

Between side of shade and opening jambs, and between hem bar and opening sill.

1. Finish: Manufacturer's standard, to match shade color or as selected by Engineer from manufacturer's color charts.

B. Electric Motors

UL-approved, low-voltage motor with thermal-overload switch; microprocessor controlled; sized by shade manufacturer for installation shown on the Contract Drawings.

1. Control: Wall switch.

C. Installation Fasteners

Fabricated from metal that is non-corrosive to shade hardware and adjoining construction and to support shades as required by manufacturer's written instructions.

2.03 FABRICATION

A. Components

Non-corrosive, self-lubricating materials.

B. Shade Units

Fill opening with not more than 1/4-inch clearance at jambs and 3/8-inch clearance at sill.

1. Fabricate end-to-end installations with terminations at mullions or other defined vertical separations.
2. Fabricate to fit irregular conditions, such as curved glass configurations - where required.

PART 3. EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of shades. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install shades level and plumb, mounted not less than 1 inch from face of exterior glass, unless otherwise shown on the Contract Drawings.
- B. Install metal parts isolated from concrete or mortar to prevent corrosion.
- C. Install mounting brackets with not less than 2 fasteners per bracket.
- D. Coordinate installation of electrical items, as required for motorized shade installation and as shown on approved shop drawings.

3.03 CLEANING

- A. Clean shade surfaces after installation, according to manufacturer's written instructions.

3.04 DEMONSTRATION FOR MOTORIZED SHADES.

A. Startup Services

Engage a factory-authorized service representative to provide startup service and to demonstrate and the Authority's maintenance personnel as specified below.

1. Test and adjust controls. Replace damaged and malfunctioning controls and equipment.
2. Train the Authority's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
3. Schedule training with the Authority, with at least seven days' advance notice.

END OF SECTION

DIVISION 12

SECTION 12522

SHADES

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:** For each type of shade shown on the Contract Drawings, including dimensions and profiles and rated capacities, for each type of motor assembly required.
 2. **Shop Drawings:** Show location and extent of shades. Show installation details at and relationship to adjoining Work. Include elevations indicating shade units. Indicate location of controls.
 - a. **Motorized Systems:** Indicate location of control panel, wall switches, motor, access to motor, and mounting details. Include wiring diagrams.
 - b. **Include reflected ceiling plans drawn accurately to scale and coordinating penetrations and ceiling-mounted items. Show the following:**
 - (1) Ceiling suspension assembly members.
 - (2) Method of attaching ceiling hangers to building structure.
 - (3) Size and location of access to motor.
 - (4) Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 3. **Samples for Initial Selection:** If manufacturer's colors, textures and patterns are not shown on the Contract Drawings, manufacturer's color charts consisting of actual units or sections of units showing the full range of colors, textures, and patterns available for each type of shade material required.
 4. **Samples for Verification:** Full-size units of each type of shade material required; in sets for each color, texture, and pattern, showing the full range of variations expected in these characteristics.
 - a. **Shade Material:** Not less than 12 inches square, from dye lot used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of material.
 5. **Schedule:** Use same room designations shown on the Contract Drawings in preparing schedule for shades.
 6. **Maintenance Data:** For shades and operating hardware.

END OF APPENDIX "A"

DIVISION 13

SECTION 13129

BUS SHELTER - REFURBISHMENT

PART 1. GENERAL

- 1.01 This Section specifies the requirements for the rehabilitation of the existing Bus Shelters where indicated in the Contract Drawings to be relocated and rehabilitated.

PART 2. PRODUCTS

- 1.02 Aluminum: Refurbish existing aluminum components by cleaning and repainting. Painting system shall be N1-S as indicated in Section 09910 Painting.
- 1.03 Steel: Replace all steel mounting flanges and anchor bolts in kind with galvanized steel as required to relocate existing Bus Shelter. Separate ferrous metal from non-ferrous metals. Apply paint system N1-S as indicated in Section 09910 Painting.
- 1.04 Acrylic Dome Roof: Replace in kind.
- 1.05 Glass: Replace with clear tempered safety glass as indicated on the Contract Drawing.
- 1.06 Sealants shall be as specified in Section 07920.
- 1.07 Bench: Refurbish existing aluminum bench components by cleaning and repainting. Painting system shall be N1-S as indicated in Section 09910 Painting.
- 1.08 Lighting: Replace ballast, lens and lamping in kind.

PART 3. EXECUTION

3.01 INSTALLATION

- A. Install bus shelters on 4-inch-thick concrete bases that are larger than bus shelters in both width and length as indicated on Contract Drawings.
- B. Fasten bus shelters to concrete bases with expansion anchors.
- C. Connect electrical power service to power distribution system according to requirements specified in Division 16.

1.2 ADJUSTING AND CLEANING

- A. After completing installation, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 13129

BUS SHELTERS

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 literature, handling and installation instructions for all Products listed in this Section.

B. Certifications

Manufacturer's certified test reports showing compliance with specified performance values, including densities, fire performance characteristics and compressive resistance.

END OF SECTION

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

<u>Pipe Size</u>	<u>Maximum Hanger Spacing</u>	<u>Minimum Rod Size</u>
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

<u>Pipe Size</u>	<u>Maximum Hanger Spacing</u>	<u>Minimum Rod Size</u>
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

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SECTION 15410

PLUMBING PIPING AND APPURTENANCES

APPENDIX A

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:
1. Detailed piping layout drawings, including hanger and support locations and details.
 2. Catalog cuts, including product data, for the following:
 - a. Fittings and flanges
 - b. Valves
 - c. Hangers and supports
 - d. Sleeves and escutcheons
 - e. Valve tags and piping identification bands
 3. Pipe material and schedule for each piping system
 4. Valve charts and schedules
 5. List of access doors
 6. Hanger and support schedule showing manufacturer's figure No., size, location and features of each required hanger and support.
- B. Submit operation and maintenance manuals, including replacement and spare parts lists, for each type of valve.
- C. Submit field hydrostatic test results.

END OF APPENDIX "A"

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

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- 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

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:
1. Catalog cuts;
 2. Product outlines and dimensions, including required clearance;
 3. Components, materials, weights and assembly details;
 4. Capacity and performance data, if applicable;
 5. Installation procedures.
- B. 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
SUBMITTAL REQUIREMENTS

Submit the following in accordance with requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

- A. Catalog cuts of plumbing fixtures and associated accessories and appurtenances.
- B. Shop drawings indicating dimensions, roughing-in requirements, and method of assembly of components and anchorage.
- C. Product data of each selected model, including rated capacity, fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details and finishes.
- D. Installation procedures
- E. Electrical wiring diagrams.
- F. Maintenance manual for each type of plumbing fixture and accessory, 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

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:
1. Catalog cuts.
 2. Product data including rated capacities, recovery rates, operating weights, specialties and accessories.
 3. Shop drawings indicating dimensions, required clearances, and methods of assembly of components.
 4. 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.
 5. Installation procedures.
- B. Submit certificates of shop inspection and data report required by provisions of ASME Boiler and Pressure Vessel Code.
- C. Submit operation and maintenance manuals, including replacement and spare parts lists.

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

<u>Piping System</u>	<u>Pipe Size</u>	<u>Insulation Minimum Thickness*</u>
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

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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

<u>Equipment</u>	<u>Insulation Thickness</u>
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

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:
1. Catalog cuts of insulation.
 2. Product data and installation procedures for each type, of insulation.
 3. Schedule showing product number, k-factor, thickness, and furnished accessories for each plumbing system requiring insulation.
- B. Submit sample of each insulation type required. Affix label on sample, completely describing product.

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 6.22 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 shell, and stainless steel or monel element capable 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.

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- 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:

<u>Pipe Size</u>	<u>Maximum Hanger Spacing</u>	<u>Minimum Rod Size</u>
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 fireshield, 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.

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- 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.

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- 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.

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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" of Division 9 "FNISHES".

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

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 GENERAL PROVISIONS:
 - 1. Refrigerant piping layout drawings, including hanger and support locations and details.
 - 2. Product data, including catalog cuts for the following:
 - a. Fittings
 - b. Valves and specialties
 - c. Hangers and supports
 - d. Sleeves and escutcheons
 - e. Valve tags and piping identification bands
 - 3. Valve charts and schedules.
- B. Submit operation and maintenance manuals, including replacement and spare parts lists, for each type of valve and specialty.
- C. Submit leak test results.

END OF APPENDIX "A"

DIVISION 15
SECTION 15741
AIR-COOLED CONDENSERS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for air-cooled condensers.

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 State Energy Conservation Construction Code

New Jersey Uniform Construction Code

American Society of Mechanical Engineers (ASME)

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

Air-Conditioning and Refrigeration Institute (ARI)

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 the condensers shall be as specified in the Air-Cooled Condenser Schedule (hereinafter in this Section "Schedules") shown on the Contract Drawings.

1.03 QUALITY ASSURANCE

- A. Condensers, 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.
- C. Condensers shall be subject to factory inspection prior to shipping.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver condensers with factory-installed wooden skids and lifting lugs; pack components in factory-fabricated protective containers.
- B. Handle condensers carefully to avoid damage to components, enclosures, and finish.
- C. Store condensers in clean, dry spaces and protect them from weather.
- D. Comply with the manufacturer's rigging instructions for unloading condensers and moving them to final location for installation.

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, provide factory-fabricated condensers of one of the following manufacturers or approved equal:
 - Carrier Air Conditioning Co./Carrier Corp.
 - Trane Co.
 - York International Corp.

2.02 CONSTRUCTION FEATURES

- A. General
 - 1. Condensers shall be of sizes, arrangements and capacities specified in the Schedules shown on the Contract Drawings.
 - 2. Condensers shall be factory assembled and tested, and shall consist of casings, fans, fan motors, coils and head pressure controls.
- B. Casings
 - 1. Provide casings designed for outdoor installation, complete with weather protection for components and controls, and with removable access panels for required access to controls, fans, motors and drives.
 - 2. Provide lifting lugs to facilitate rigging of units.
 - 3. Provide factory-installed metal grilles for protection of condenser coils during shipping, installation and operation.
 - 4. Provide a NEMA 3R rated control panel with hinged and gasketed door.
- C. Fans
 - 1. Provide direct-driven, propeller-type condenser fan(s).
 - 2. Each fan shall be statically and dynamically balanced.

3. Provide guards for fan protection.
- D. Fan Motors
1. Provide permanently lubricated fan motors with built-in overload protection.
 2. Motors shall be in accordance with requirements specified in the Section entitled "MOTORS AND MOTOR CONTROLLERS".
 3. Select motor characteristics, motor mounting and all accessories as is necessary to satisfy the requirements of the fan motor drive unit in all operating modes.
- E. Coils
1. Coils shall be constructed of aluminum plate fins on mechanically expanded copper tubes.
 2. Coils shall be cleaned, dehydrated, sealed, leak tested at 150 psig and pressure tested at 450 psig.
- F. Head Pressure Control
- Provide fan cycling or fan speed modulation type head pressure control in response to outdoor ambient temperature or condensing pressure as shown on the Schedules.
- G. Vibration Isolation
- Provide vibration isolation in accordance with the requirements specified in the Section of these Specifications entitled "VIBRATION ISOLATION AND CONTROL". Consult with the supplier of vibration isolation devices concerning the selection of the types required.

2.03 SHOP PAINTING

- A. Fan shaft shall be corrosion protected.
- B. Fan blades shall have an iridite or aluminum finish.
- C. Condenser casing shall have baked enamel finish.

2.04 SHOP TESTS

All shop tests may be witnessed by the Engineer. Notify the Engineer 14 days in advance of scheduled tests.

PART 3. EXECUTION

3.01 INSTALLATION

- A. Install condensers in accordance with the manufacturer's installation procedures.
- B. Coordinate the Work of this Section to ensure that the installation of the condensers is not in conflict with the Work performed under other Sections of these Specifications.

-
- C. Verify that the electrical wiring installation is in accordance with the manufacturer's submittal and in accordance with the installation requirements as specified in Division 16 - ELECTRICAL.

3.02 FIELD TESTS

- A. Provide a qualified technical representative of the manufacturer to advise on field tests.
- B. Start up, test, adjust condensers, and verify capacity and efficiency in the presence of the manufacturer's representative.
- C. Provide qualified technical representatives of the manufacturer to instruct and train Owner's Maintenance Personnel in the operation and maintenance of the condensers for a minimum 8 hours.

END OF SECTION

SECTION 15741

AIR-COOLED CONDENSERS

APPENDIX A

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:
 - 1. Catalog cuts.
 - 2. Condenser performance data with rated capacities clearly indicated.
 - 3. Shop drawings indicating dimensions, weight loadings, required clearances, methods of assembly of components, and mounting details.
 - 4. Electrical wiring diagrams for electrical power supply, interlock and control.
 - 5. Installation and start-up procedures.
- B. Submit certified shop test reports.
- C. Submit operation and maintenance manuals, including replacement and spare parts lists.

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

Refer to Appendix A.

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
- Open-Wire Type

Resistance Wires:	80 percent nickel/20 percent
Insulating Bushings:	Ceramic
Support Frame:	Aluminized or galvanized
 - 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 (1-50) 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 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 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 troughs 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 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 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 trades to ensure that the installation of the units is not in conflict with the work performed by other trades.
- 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

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:
1. Catalog cuts
 2. Air handling unit schedules
 3. Certified fan performance pressure-volume, horsepower, and efficiency curves, with system operating conditions indicated.
 4. Certified fan sound power levels at rated capacity at each active band.
 5. Certified coil performance ratings with system operating conditions indicated.
 6. Filter performance characteristics
 7. Damper performance curves
 8. Unit construction details including components, materials, gauges, dimensions, required clearances, and location and size of each field connection
 9. Motor ratings and electrical characteristics
 10. Electrical wiring diagrams
 11. Drive construction and rating
 12. Installation procedures
 13. Field testing procedures
- B. Submit all shop and field test data.
- C. Submit operation and maintenance manuals, including replacement and spare parts lists. Include field and shop test data.

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 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 Contract Drawings.

D. Vibration Isolation

Provide vibration isolation in accordance with requirements specified in the 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 the 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 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 trades to ensure that the installation of fans is not in conflict with the work performed by other trades.
- 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

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 GENERAL PROVISIONS:
1. Catalog cuts of centrifugal fans and accessories
 2. Fan schedules
 3. Certified performance operating curves for pressure-volume relation for each fan, drive, and motor system
 4. Certified sound power levels at rated capacity at each active band
 5. Details of fan construction components, dimensions, materials, gauges, finishes, weights, required clearances, and locations and sizes of field connections
 6. Specialties and accessories
 7. Motor and electrical operating data
 8. Electrical wiring diagrams
 9. Drive construction and rating
 10. Installation procedures
- B. Submit all shop and field test data.
- C. Submit operation and maintenance manuals, including replacement and spare parts lists.

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 Dwg.)	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, trim and angles)	Matching materials of ductwork furnished
Core	<u>Flexible Duct</u> 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

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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 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.

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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

- A. 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 all trades 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 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.

<u>Duct Construction Class</u>	<u>Leakage Class</u>
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

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 GENERAL PROVISIONS:
1. Catalog cuts for all types of furnished accessories.
 2. Ductwork layout, fabrication and installation drawings, including hangars and supports locations and details. Indicate methods of attachment to building structure. Ductwork fabrication drawings shall include longitudinal and transverse jointing methods and details.
 3. Product data, including where applicable, 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:
 - a. Acoustical duct liners
 - b. Flexible duct
 - c. Dampers (manual volume, gravity backdraft, fire, ceiling fire, smoke, combination smoke/fire)
 - d. Ductwork access doors
 - e. Duct turning vanes
 - f. Accessories hardware
- B. Submit duct leakage test data.
- C. Submit certified test data on air flow performance including pressure losses, self-noise power levels and dynamic insertion losses, as is applicable, for the various components and accessories.

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:

<u>Noise Criterion Curve – N C</u>	<u>Sound Meter Readings dBA</u>
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

Carnet 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 the 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 trades to ensure that the installation of air outlets and inlets is not in conflict with the work performed by other trades.

3.02 FIELD TESTS

Arrange for a qualified technical representative of the manufacturer to advise on the field tests specified in the Section 15992 entitled "TESTING, ADJUSTING, AND BALANCING OF AIR AND HYDRONIC SYSTEMS".

END OF SECTION

SECTION 15931

AIR OUTLETS AND INLETS

APPENDIX A

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:
1. Catalog cuts.
 2. Each type, model number, size, service, blade setting angle, cfm, pressure drop and accessories furnished.
 3. Floor/room designation of each air outlet and inlet.
 4. Sound power levels at design flow rates.
 5. Throw and drop at design flow rates.
 6. Material of unit, finish, mounting details and installation procedures.
 7. Certified shop test reports.
- B. Submit three samples of finishes of air outlets and inlets, for approval.

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

For Submittal Requirements, see Appendix A.

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 premium 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

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS, unless otherwise specified in other Sections:
1. Catalog cuts
 2. Motor schedules with full nameplate data including, but not limited to horsepower, voltage, FLA, LRA, speed (rpm), efficiency, phase, frequency, type of insulation, etc.
 3. Motor controller schedules.
 4. Product data for motors, motor controllers, and all other products specified in this Section. Include dimensions, ratings, operating data, and data on features and components.
 5. Manufacturer's installation instruction for specified products.
 6. Power and control wiring diagrams showing connections to power panels, feeders and equipment. Differentiate between manufacturer-installed and field-installed portions of wiring.
 7. Coordination curves of overcurrent protection equipment and interrupting capacities of equipment.
 8. Maintenance data for products.
- Submissions shall be clearly identified with the pertinent motor numbers and the proper control equipment to be wired into the control circuits.
- B. Submit shop test data.
- C. Submit listing of proposed inscriptions for labeling all motor controllers, disconnect devices and other control devices.

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 03), 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

- a. 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

- b. 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.
- c. 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:

<u>Flanged</u>		<u>Male Nipples</u>
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

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of DIVISION 1 - GENERAL PROVISIONS:
1. Catalog cuts of all furnished vibration isolation devices.
 2. Installation procedures for each type of isolation device.
 3. Schedules showing manufacturer's figure number, size, location, and any specific features for each vibration isolation device.
 4. Assembly-type shop drawings for each type of isolator, indicating dimensions, required clearance, and methods of assembly and installation of all components on the construction site.
 5. 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.
 6. Shop drawings showing isolator locations, load on each isolator, deflection, inertia slab dimensions, details of supports and required field installation instructions.
 7. Maintenance data for each type of isolation device.
- B. Submit certified installation inspection report by isolation systems manufacturer.

END OF APPENDIX "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 cost to the Authority.

1.05 SUBMITTALS

Refer to Appendix A.

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

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- 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

Piping System	PIPE, FITTINGS AND VALVES INSULATION MINIMUM THICKNESS (INCHES)					
	Fluid Temp Range, Deg. F	Run-Out* Up to 2"	PIPE SIZES (NPS)			8" and Larger
			Up to 2"	2-1/2" to 4"	5"-6"	
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 Condensate incl. Drip Assembly (For Feed Water)	Any	1.0	1.5	2.0	2.0	2.5

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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.

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- 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

Equipment	Fluid Temp., Degrees F	Insulation	
		Thickness (inches)	Material Type
Steam Flash 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.

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- 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

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS.
 - 1. Catalog cuts of insulation.
 - 2. Product data and installation procedures for each type of insulation.
 - 3. Schedule showing product number, k-value, material thickness and furnished accessories for each HVAC system requiring insulation.
- B. Submit 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

Refer to Appendix A.

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 Section 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

DIVISION 15

SECTION 15992

**TESTING, ADJUSTING, AND BALANCING
OF AIR AND HYDRONIC SYSTEMS**

APPENDIX A

SUBMITTAL REQUIREMENTS

- A. Submit proof that the prepared testing, adjusting and balancing agency meets the requirements of Section 1.04, "Quality Assurance" above, and all other specified requirements.
- B. Prior to performing the work, submit sample blank forms of the test reports that will be submitted by entity performing the work of this Section, indicating all data and parameters to be included.
- C. 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. Submittal of test report shall be in the following format:
 - 1. **Draft Report:** 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 in the same manner specified herein below for the final reports. Submit two complete sets of draft reports. Only one complete set of draft reports will be returned.
 - 2. **Final Report:** Upon verification and approval of draft reports, prepare final reports, type written and organized and formatted as described herein below. Submit two complete sets of final reports.
 - a. **Report Format:** Report forms shall be the standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted and balanced. Include schematic systems 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

- b. **Report Contents:** Provide the following minimum information, forms and data:
- (1) **General Information and Summary:** the inside cover sheet shall identify the testing, adjusting and balancing Agency, Contractor, Owner, Engineer, and Project. Include addresses, and 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.
 - (2) 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.
- c. **Calibration Reports:** Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards 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

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

The following is a listing of publications referenced in this Section:

	<u>American National Standards Institute (ANSI)</u>
ANSI C 2	National Electrical Safety Code.
	<u>American Society of Testing and Materials (ASTM)</u>
ASTM D 178	Standard Specification for Rubber Insulation Matting.
	<u>National Fire Protection Association (NFPA)</u>
NFPA 70	National Electrical Code.
	<u>Occupational Safety and Health Administration (OSHA)</u>

1.03 QUALITY ASSURANCE

- A. Any entity performing Work shall have had experience on at least two projects involving quantities and complexities at least equal to those required under this Division or the applicable Section thereof.
- B. All workmen performing under this Division 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 workman, for review by the Engineer. Only approved workmen shall perform specialty work.
- C. All electrical work shall be performed under the supervision of an electrical contractor, licensed in the state (and the city as required) 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 communications systems, remote control, signaling, and power limited circuits, shall not be installed in any 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.
- H. Asbestos
Asbestos or items containing asbestos shall not be furnished or installed.
- I. Conformance Labels
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, ETL, 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 CODES AND STANDARDS

- A. The electrical installation shall conform to all requirements of ANSI 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 publications 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. Installations for aeronautical markers, lighting, guidance signs, and other work as shown on the Contract Drawings, shall comply with the standards of the Federal Aviation Administration (FAA), where applicable.
- D. In case of conflict between provisions of codes, laws and ordinances, the more stringent requirement shall apply.

1.05 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.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

1.07 SPECIAL TERMS

Throughout this and other Sections of this Division the term "Authority" is used. In PATH contracts, substitute the term "PATH" is deemed substituted for the term "Authority".

PART 2. PRODUCTS

2.01 MATERIAL AND EQUIPMENT TO BE FURNISHED

Equipment and materials furnished shall be new and unused, prior to this installation, 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 will 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 one-quarter inch. Where letter sizes are not specified, use one-inch high letters for panel boards, switchboards and motor control centers and one quarter 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 one-quarter inch 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 36 inches wide and not less than one quarter inch 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 8 hours, supply temporary services or feeders as required to maintain 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 is installed with working clearances in accordance with NFPA 70. Route conduit to avoid interference with existing installation and with work to be 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 overcurrent 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, will 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, salvaged equipment and materials shall not be reused in the installation.
- D. If existing electrical feeders, wiring, conduit, lighting fixtures or equipment interfere with the installation of new construction of any trade, the existing electrical feeder, wiring and conduit shall be rerouted or the equipment relocated 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 that 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 that 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 so as 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

Secure nameplates on equipment or walls with stainless steel or brass screws.

3.06 RUBBER MATS

- A. Install rubber mats in front of each panelboard, 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 advance 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. Panelboards.
 - 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 (#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. The inspection shall be made with all equipment, motors, lighting fixtures, and miscellaneous loads operating and with all equipment covers removed. 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. 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 the inspections and necessary repairs shall be included in the Contract.
- E. Demonstrate to the Engineer equipment or systems installed or modified in this Contract.
- 1. 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 or interested parties, as designed by the Engineer, so that operational and maintenance personnel are familiarized with the equipment and systems, as follows:
 - a. Switchboards and panelboards.
 - 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.
 - 2. Provide the necessary accessories, test equipment, and personnel, for each demonstration.
 - 3. Complete all arrangements for the demonstrations through the Engineer.
 - 4. 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.

END OF SECTION

SECTION 16000

ELECTRICAL GENERAL REQUIREMENTS

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. Substation and high-voltage transformers.
2. Switchgear.
3. Switchboards.
4. Motor control centers.
5. Emergency lighting battery systems.
6. 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 that will be "pulled-through" without splicing. Calculations shall be certified and sealed by a Professional Engineer licensed in the State in which the Work is to be performed.

B. Catalog Cuts

1. Conduit, and fittings.
2. Wire and cable.
3. Wiring devices.
4. Multi-outlet assemblies.
5. "Standard" outlet and junction boxes.
6. Medium voltage cable, splicing and termination kits.
7. Lightning arresters.
8. Capacitors.
9. Panel boards and cabinets.
10. General purpose transformers.
11. Circuit breakers.
12. Lighting fixtures.
13. Pulling devices and end seals.
14. Special pull and junction boxes.

15. Supporting devices.

C. Certifications

Training, experience and work history for certified splicers and welders.

D. Design Calculations

Calculations where required by the Specifications or the Contract Drawings.

E. Maintenance Manuals

Operation and maintenance manuals, where required by the Specifications or the Contract Drawings.

F. Schedules

Nameplate designations.

G. Record Documents

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.

H. 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 overcurrent devices.
6. 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.
7. Emergency power distribution equipment and system test results.

END OF APPENDIX "A"

DIVISION 16

SECTION 16001

OPERATION AND MAINTENANCE MANUALS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies the requirements for the preparation of operation and maintenance manuals.

1.02 REFERENCES

The following is a list of the publications referenced in this Section:

American National Standards Institute (ANSI)

ANSI Y32.18 Symbols for Mechanical and Acoustical Elements as Used in Schematic Diagrams.

ANSI Y32.9 Graphic Symbols for Electrical Wiring and Layout Diagrams Used in Architecture and Building Construction.

American Society for Mechanical Engineers (ASME)

ASME Y1.1 Abbreviations for Use on Drawings and Text.

Institute of Electrical and Electronics Engineers, Inc. (IEEE)

IEEE 91 Graphic Symbols for Logic Functions.

IEEE 200 Reference Designations for Electrical and Electronic Parts and Equipment.

IEEE 315 Graphic Symbols for Electrical and Electronics Diagrams.

IEEE 315A Supplement to Graphic Symbols for Electrical and Electronics Diagrams.

IEEE 623 Graphic Symbols for Grid and Mapping Diagrams Used in Cable Television Systems.

IEEE 991 Logic Circuit Diagrams.

1.03 QUALITY ASSURANCE

- A. Any entity performing work under this Section shall have had experience on at least two projects involving quantities and complexities at least equal to those required under this Section.
- B. The preparation of the operation and maintenance manuals shall be coordinated by an individual or individuals who are degreed engineers in the field of the subject matter.
- C. Photographs
 1. The individual(s) taking photographs shall be a professional photographer.
 2. All photographs to be included in the operation and maintenance manuals shall be taken with a camera using 2-1/4 inch or 35-millimeter format film.

3. The subject of the photographs shall be in-focus. All out-of-focus photographs will be rejected.
- D. The Engineer reserves the right to periodically visit the offices of the entity responsible for the preparation of the operation and maintenance manuals, upon giving 24 hours' notice, to monitor both the quality and progress of the Work.

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Description

1. The operation and maintenance manual, hereinafter referred to as "the manual," shall be prepared in such a manner to contain the necessary information and to convey the philosophy necessary to enable the reader to understand the procedures and all other requirements for the proper operation, maintenance, and troubleshooting of the system(s) and equipment described therein.
2. The reader of the manual shall be assumed to be technically competent but totally unfamiliar with the systems and equipment described therein.
3. In addition to the description of the operation, maintenance, and troubleshooting instructions, the manual shall contain the following information on the system(s) and equipment described therein:
 - a. All Shop Drawings and As-Built Drawings.
 - b. All Catalog information for the equipment supplied and installed.
 - c. A list of all references utilized to prepare the information contained in the manual.

B. Preliminary Edition, Draft Copies, and Final Review

1. The Preliminary Edition, all Draft copies, and the Final Review shall be 100 percent completed copies of the manual, and they shall be prepared in the same manner as the Final Edition with the exception of the preparation of the binding and cover page.
 - a. After the manual is completed, it shall be submitted for review and designated as "PRELIMINARY EDITION". All comments generated by the Engineer shall be incorporated and resubmitted in the subsequent draft copy.
 - b. The "DRAFT" copy shall include all comments generated in the review process of the Preliminary Edition. At the request of the Engineer, additional sequentially numbered drafts, e.g., DRAFT #2, DRAFT #3, etc., shall be submitted. These submissions shall continue until all errors and omissions are corrected and all comments identified in the Preliminary Edition and Draft copies have been incorporated to the satisfaction of the Engineer.

- c. Once all comments are incorporated and all errors and omissions are corrected, the Engineer will request that another submission be made by the Contractor, and it shall be marked "FINAL REVIEW." After a review by the Authority, the Contractor shall incorporate all comments and correct all errors and omissions as directed by the Engineer.
- 2. The Preliminary Edition, all Draft copies, and the Final Review shall be bound using a black plastic comb binding and a clear, transparent plastic cover. The thickness of the plastic cover shall be 20 gauge, minimum.
- 3. The cover page of the Preliminary Edition, all Draft copies, and the Final Review shall be a copy of the Title Page, designed in accordance with the requirements of 2.02 with the following alterations:
 - a. Instead of "Final Edition," use "PRELIMINARY EDITION" for the first submission and "DRAFT" for the subsequent submission. If additional submissions are required by the Engineer, they shall be designated as "DRAFT #N" where N is a sequential number, e.g., DRAFT #2, DRAFT #3, etc., indicating the number of draft submissions. For the Final Review copy, use "FINAL REVIEW."
 - b. Using an outline font, place "FOR REVIEW ONLY" in black ink going from the bottom left hand to upper right hand corner of the page.
 - c. Cover page shall be printed on light gray, 65 lbs. stock and shall measure 8-1/2 by 11 inches.

C. Organization

The Operation and Maintenance Manual shall be organized logically into the following sections. Layout and content of the chapters and/or subsections shall be prepared in accordance with 2.01.

- 1. **Introduction**
 - a. This section shall include the Introductory Chapter.
 - b. This section shall identify the facility; the systems described in the manual, along with, a brief introduction; and the page location of all the manual's sections and chapters.
- 2. **System Description and Operation**
 - a. This section describes the system and all aspects of its operation including sub-systems and components.
 - b. Chapters shall be organized in a manner to logically describe the system. Examples of logical break points may involve different structures, or buildings and/or locations, sub-systems or major components.
 - c. The manual shall include a detailed description of all procedures for all modes of operation.
- 3. **Recommended Maintenance Procedures**
 - a. Maintenance guidelines shall be included to instruct the reader in the safe, reliable operation of the equipment throughout its service life.

- b. Guidelines shall be based upon manufacturer's recommendations; Port Authority standards, manuals, and maintenance rosters; and all appropriate industry standards.
4. Troubleshooting Guidelines
- a. In-depth troubleshooting procedures shall be included for all systems and equipment.
 - b. The manual shall include written descriptions of typical problems which may occur, possible causes of these conditions, and the step-by-step corrective measures required to correct each possibility.
5. Illustrations
- a. The illustrations used in the manual shall include all drawings and photographs required to properly document the information and visually describe the subject matter presented therein.
 - b. Illustrations that are not photographs shall be considered drawings and prepared accordingly.
6. Abbreviations and Symbols
- a. All abbreviations and symbols utilized shall comply with ANSI Y32.18, ANSI Y32.19, ASME Y1.1, IEEE 91, IEEE 200, IEEE 315, IEEE 315A, IEEE 623, AND IEEE 991.
 - b. All abbreviations and symbols used in the manual shall be unique, and no conflict shall exist between them.
7. As-Built Drawings
- a. As-Built drawings shall be prepared for inclusion in the manual such that they accurately portray the systems after all construction has been completed and the systems are operating to the satisfaction of the Engineer. An index shall be provided that itemizes all of the As-Built drawings.
8. Shop Drawings
- a. All approved shop drawings for all of the equipment supplied and/or installed for the system described in the manual shall be included in the manual. An index shall be included for all shop drawings that tabulate all equipment by type and model number.
 - b. An index shall be included that identifies the different types, including model numbers, of equipment present, listed in alphabetical order. Each entry shall refer to the appropriate shop drawing(s) and the page numbers where they are located.
9. Catalog Information
- a. A sample of the catalog information shall be provided for all equipment furnished and/or installed under this contract.
 - b. An index shall be included that identifies the different types, including model numbers, of equipment present, listed in alphabetical order. Each entry shall refer to the appropriate catalog cut(s) and the page numbers where they are located.

10. References

- a. A list of references shall be included identifying the sources of all the information contained in the manual. The list shall identify the nature of the information and where it was used in the manual.

D. Text and Paper

1. The manual shall be printed in the Courier typeface family using a 12-point font.
2. With the exception of the drawings, diagrams, and photographs, all information shall be printed on 8-1/2 by 11 inches, 24 lb. white bond paper utilizing a portrait format.

E. Photographs

1. Photographs shall show various views of all equipment in the system with all assemblies, subassemblies, and components identified through the use of call-outs.
2. Wherever possible, photographs shall be taken in the vertical, or portrait format, with the subject centered horizontally and vertically. Adequate space shall be provided on all sides between the subjects and the borders of the photograph to facilitate placing call-outs for the respective components.
3. The photographs shall be treated as figures and shall be referred to in the text to assist in conveying the necessary information to the reader. The figures shall be designated using a two-number format separated by a period, for example "Figure 1.2". The first number indicates the Chapter in which the Photograph is first referred to, and the second is a sequential number indicating its position in the total referenced figures in that Chapter.
4. Photographs shall be enlarged and cropped to a finished size of approximately 7 by 9 inches, and shall be placed on a page with margin.
5. A title area shall be provided to accurately describe the subject of the photograph.
 - a. The title area shall be composed of the figure number and a two-line title.
 - b. The first line shall be a description of the photograph's subject. The second shall contain information on the equipment's location and/or details of the photograph's composition, for example, side view, rear view, section, etc. No title shall exceed three lines.
 - c. The title area shall be 6-3/4 by 1/2 inch high.
 - d. Text for title areas shall be 12-point Helvetica Medium, in Bold Face, upper and lower case on white bond paper background.
6. All photographs shall include call-outs identifying the relevant equipment and/or components that are being described in the text which refers to the photograph.
 - a. Each call-out is to be cut straight and squared on all four sides leaving about 1/16-inch white space above top line, below bottom line, to the left of the widest line and to the right of the widest line.
 - b. Text for call-outs shall be in 8-point Helvetica light font, using upper and lower case.
 - c. Equipment that is being called out shall not be covered by a call-out.

- d. Edges of call-outs shall not be closer than 1/8 inch to the borders of the photograph.
 - e. Arrows for call-outs shall be self-stick, black, and with single-sided white trim.
 - f. All call-outs shall identify items by their functional names, regardless of what the manufacturer, drawing, decal, catalog, or personnel indicate (i.e. mode selector switch, motor control switch).
 - g. Specific designations in call-outs shall be continuous. There shall be no space within a designation. If designation involves multiple elements, use dashes between these elements. Ratings or other data shall be separated from the designation by a comma.
7. Completed photographs, or those with call-outs and arrows applied, shall be made into 6-3/4 by 8-1/2 inch screened negatives. The title area shall also be made into a negative and, along with the photograph negative, shall be placed on a mat such that they are separated by 3/8 inch. Alternate methods of reproduction may be used, but only after prior approval by the Engineer.

2.02 FORMAT

A. Binder

1. General

- a. The first six sections of the manual form an integral document and shall be contained in one binder when possible.
- b. If multiple volumes are required, each volume shall include the list of references as the last section. The section number shall be retained, and the Table of Contents shall also include this information.

2. Construction

- a. Binders shall be standard 3-ring booster construction made of 90 gauge Linear Polyethylene. "Microdyne" cover type material is not acceptable.
- b. Binding mechanism shall be secured to the cover by two colored rivets installed one (1) inch from the top and bottom edges of the seam. The color of the rivets shall match the color of the binder.

3. Cover Page

- a. The Engineer shall provide the color of the manual prior to printing the first Draft Copy. Unless otherwise shown on the Contract Drawings, the following color coordination scheme will be utilized:
 - (1) Aviation Department: Red.
 - (2) Economic Development: Beige.
 - (3) Interstate Transportation Department: Light Blue.
 - (4) Ports Department: Green.
 - (5) World Trade Department: Orange.

- b. The cover page shall clearly identify the number of the manual, the facility, and the title of the systems being described. All information shall be presented as described below, and shall be silk-screened to the binder.
- (1) The Port Authority Letter Logo in 3/8 inch high black lettering 1/2 inch from the top of the cover and flush with the right margin.
 - (2) The facility logo shall be placed 3/4 inch below the Port Authority Letter Logo and flush with the right margin.
 - (3) The number of the manual shall be in 75-point Helvetica Bold font, and placed 1 inch below the facility logo and flushed left.
 - (4) The name of the facility shall be placed 3/8 inches to the right of the manual number using a white outline font 1/2 inch high on two separate lines. The complete title shall be balanced between the two lines in a manner that results in approximately equal line lengths. The facility title shall be placed such that the top line is flush with the top of the manual number and the bottom line is flush with the bottom of the number.
 - (5) The words Operation and Maintenance shall appear in Helvetica typeface, and shall be placed 1/2 inch below the manual number and flush with the left margin using 3/16-inch high black letters in lowercase.
 - (6) The title of the manual shall be placed 1/2 inch below the words "Operation and Maintenance" using white 3/4 inch high lowercase letters. The title lines shall be spaced approximately 1 inch apart. The title shall be balanced between as many lines as possible, up to the 1-1/8-inch margin at the bottom of the binder.
- c. Information on Binder Spine
- (1) The title of the manual shall be printed in 3/16 inch white lowercase lettering running vertically on the spine from 1/4 inch from the top rivet running down to a maximum length of 6 inches. If title description requires additional space, balance the title between two lines.
 - (2) The number of the manual shall be shown using white numbers 3/8-inch high and placed 1/4 inch above the bottom rivet.
 - (3) The Authority's standard two- or three-letter abbreviation of the facility shall be in white and shall be centered 3/8 inch above the center of the bottom rivet, with a minimum offset from the rivet of 1/4 inch.
- d. The binder shall be no larger than 2 inches. In the event that the information presented can not fit in a 2-inch binder than multiple volumes shall be utilized.
- (1) Multiple volumes shall be prepared so that the information presented in each volume stands on its own in order to minimize referrals to other volumes.
 - (2) The volume designation shall be located 3/8 inch above the facility letter designation.
 - (3) The breakdown of information for multiple volume manuals shall be submitted to the Engineer for approval.

B. Title Page

The title page shall be the first page of the manual, and shall contain the following information and be formatted in accordance with the requirements of this Section.

1. The facility title shall be in bold 1/4 inch lettering using all capitals and be the first line of text on the page. Text shall be flush with the left margin leaving approximately 1-3/8 inch margin at the top of the page.
2. The wording "Manual No. X" shall be placed approximately 1/4 inch below the facility title. The facility manual number shall be provided by the Engineer.
3. At approximately 1 inch below the manual number line the following wording shall appear "Operation and Maintenance of".
4. The title of the manual shall be placed 7/16 of an inch below item 3 and appear in bold using all lower-case. Title shall occupy as many lines as necessary to be printed within the specified margins.
5. The Port Authority letter logo shall be centered at the bottom of the page leaving a bottom margin of approximately 1-1/4 inches.
6. The following three lines shall appear sequentially such that the last line is approximately 3/4 of an inch above the Port Authority letter logo. The month and year shall indicate the month and year that the Authority received the final edition.
 - a. Final Edition
 - b. Engineering Department
 - c. Publication, Month year
7. Title page shall be 36 lb., 8-1/2 by 11 inch white paper.

C. Foreword

The Foreword shall be prepared as described below.

1. The text shall be justified with 1-3/4 inch left and right margins.
2. The word "F O R E W O R D" shall appear approximately 2-1/2 inches from the top edge of the paper in bold capitals with a space between each letter and flush with the left margin.
3. The first paragraphs shall be below the word Foreword separated by a blank line. Subsequent paragraphs shall be also be separated by a blank line.
4. The page number in lower case roman numbers ("iii") shall be centered, approximately 11/16 of an inch from the bottom of the page.
5. Text for the Foreword shall be restricted to one side only, no printing will be allowed on the back of the page(s).

D. Table of Contents

The Table of Contents shall be prepared as described below.

1. All text shall be in 12-point Helvetica with a left margin of 1-3/4 inches and a right margin of 1-1/4 inches.

2. The word "C O N T E N T S" shall appear in italics using bold capitals, centered over the text approximately 1 inch from the top of the page.
 3. Chapter Identification
 - a. Two lines below item 2, the words "Chapter" and "Page" shall appear in italic, underlined and flush with the left margin and right margins respectively.
 - b. All chapters in the manual shall be itemized using the Chapter number and title on the same line with a 1/2-inch space between the two. A blank line shall separate each chapter entry.
 - c. Chapter titles shall be shown in capitals while the chapter numbers shall be centered under the heading "Chapter".
 - d. All sections of each chapter shall be itemized below their respective chapter after leaving a blank line. Each section title shall appear in upper and lowercase letters along with the page number on which it begins. Section titles shall appear flush with the margin created with the first letter of the chapter title and separated from the page numbers by a series of periods at every 1/8 of an inch until approximately 5/16 of an inch before the page number. The page number shall be centered under the heading "Page".
 - e. All subsections shall be itemized under their respective sections and placed flush with a left margin indented 1/2 inch from the chapter title margin.
 4. All pages for the Table of Contents shall be numbered sequentially in roman numerals starting with "v". The page numbers shall be in italics and centered at approximately 3/4 of an inch from the bottom of the page. A 3/4-inch blank space shall separate the page designation from the last entry on the page.
 5. Printing shall be on both sides of the page.
- E. Chapters
1. Width of text for all paragraphs shall be 5-1/2 inches and justified such that the left and right margins will be 1-1/2 inches.
 2. Line spacing shall be set at 1-1/2 for improved readability.
 3. Page Numbers
 - a. Page Numbers shall be centered 3/4 of an inch from both the bottom of the page and the last line of text on the page.
 - b. Page numbers shall be comprised of two numbers separated by a dash. The first number indicates the number of the respective chapter and the second is the sequential page number within that chapter.
 4. Each chapter shall begin on a new page and contain the chapter number and title.
 - a. Chapter designations shall be in all capitals and be in following format, "CHAPTER X" where X is the chapter number. Chapter designations shall be centered 1 inch from the top edge of the paper.
 - b. Chapter titles shall appear in all capitals centered and two lines below the Chapter designation. If chapter title requires more than one line, the line spacing shall be unity.

- c. Chapter, section and paragraph titles or headings shall be descriptive of the contents of the division they head.
 5. Each chapter shall be broken up into sections that segregate the information being presented into logical units.
 - a. Section titles shall be in all capitals and be centered two lines from the preceding paragraph. The first section title shall be separated vertically by four blank lines from the Chapter title. If the title requires more than one line of text, the line spacing for the title only shall be unity.
 - b. The first two sections shall be designated as "SCOPE" followed by "GENERAL". Additional sections shall be included as needed and labeled to properly convey the information contained therein.
 - c. Subsections shall be utilized to further segregate the information. Subsection titles shall be flush with the left margin in upper and lowercase letters. The title shall be uniformly divided into lines such that no single line contains information that is wider than 2-1/2 inches. Two blank lines shall separate the title from the preceding paragraph. The first successive paragraph shall be separated from the title by one blank line.
 - d. Section Units shall be utilized to further segregate subsections. Unit titles shall be in upper and lowercase, underlined and ended with a period. The title shall be the first item of the paragraph line and be properly indented. The first paragraph shall begin on the same line as the title and shall be separated by two blank lines from the preceding paragraph.
 6. Steps describing a particular procedure
 - a. All procedures described shall be itemized in the numerical sequence (i.e. 1., 2., 3., etc.) that they are to be performed to achieve the desired results.
 - b. Step descriptions shall be indented 1/2 inch from the step number and ended with a period.
 - c. Steps that require multiple lines of text shall be formatted such that all lines of text are left justified to the text on the first line.
 7. Data Tables
 - a. All data shall be tabulated.
 - b. Data tables requiring less than 1/2 a page shall be part of the text. Data tables requiring more than 1/2 a page shall be treated as a figure and prepared along the guidelines specified in 2.02 G.
 - c. Data shall be tabulated under headings that properly describe the information presented in that column.

F. Abbreviations

All abbreviations and designations used in the manual including, drawings, illustrations and catalog cuts shall be in tabulated in alphabetical order.

G. Writing Style

1. The writing used shall be free of vague and ambiguous terms, using the simplest words and phrases to convey the intended meaning and information. Sentences shall be short and concise.
2. All essential information must be included, either by direct statements or by reference.
3. Punctuation shall be used in a manner that aids in reading and prevents misreading. Well-planned word order requires a minimum of punctuation. When extensive punctuation is used for clarity, sentences shall be rewritten.
4. Words that have more than one meaning which will fit the context in which they are applied, shall not be used.
5. The level of writing shall be at a reading grade level correspondent to the target audience of the manual or as directed by the Engineer.
6. Measurements, readings, characteristics and settings shall be provided in their customary format. The appropriate metric or US units shall be provided in parenthesis along with the customary format.
7. References to specific data (i.e. illustrations, schematics, diagrams and data tables) shall be limited to within the same manual or another volume of the same manual.
8. The second person imperative mood shall be used for procedures. Third person indicative mood shall be used for description and discussion.

H. Symbols

1. All symbols used in diagrams, shop drawings, as-built drawings and elsewhere throughout the manual shall be itemized and described in detail. Symbols for electrical and mechanical systems shall be categorized separately under separate headings.
2. Standard symbols shall be utilized as much as possible to minimize the use of special or non-standard symbols.

I. Illustrations

1. All diagrams, all photographs, and data tables requiring more than 1/2 a page shall be treated as illustrations.
2. All illustrations shall have a figure number, a descriptive title and framed on the page with a 7/8-inch margin on the left hand side and a margin of 1/2 inch on the remaining three sides.

J. References

1. The sources of all information provided in this manual shall be included in the appendix.
2. Each source shall be itemized and described completely.

K. As-Built Drawings

1. As-Built Drawings shall be provided for the manual in no larger than the size "C" (11 by 17 inches) Engineering format. The left margin shall be 7/8 inch while the remaining three sides shall have a margin of 1/2 inch.

2. As-Built Drawings shall be updated by showing the permanent construction as actually made and as existing at the time of the preparation of this manual.
3. Prior to incorporation into the manual, the As-Built Drawings shall be submitted to the Engineer for approval.
4. An index shall be provided that itemizes all As-Built Drawings listed by drawing number and title.

L. Shop Drawings

1. All Shop Drawings shall be provided for the manual in no larger than the size "C" (11 by 17 inches) Engineering format. The left margin shall be 3/4 inch and 1/2 inch for the remaining three (3) sides.
2. All Shop Drawings required under the contract(s) responsible for the construction of the system(s) being described in the manual(s) shall be included.
3. An index shall be provided that itemizes all Shop Drawings by equipment type, title and identifies the location and designation of the equipment the drawings pertain to.

M. Catalog Cuts

1. Catalog information shall be included for all types of equipment in the system(s). The information shall include but not be limited to: manufacturer, equipment type, model number, technical specifications and any other information required for the proper technical application of the equipment. In addition the following catalog information shall be included: title, publishing date, serial number, and page numbers for each specific type of equipment.
2. All catalog cuts required under the contract that constructed the system(s) being described in the manual shall be included.
3. Catalog cuts shall be provided on 8-1/2 by 11 inch paper with a minimum of a 3/4-inch margin on the left hand-side suitable for bounding in a standard three-ring binder. A minimum border of 1/2 inch shall be maintained on the remaining three sides.
4. Pages shall be identified by the type of equipment it refers to and by the sequential page number of the manual(s).
5. An index shall be provided at the beginning of the section itemizing all catalog cuts by type of equipment, page number and physical locations where that type of equipment is installed.

2.03 CONTENT

The following sections shall be prepared according the format specified in 2.02 above and shall include, but not be limited to the following information.

A. Foreword

The Foreword shall contain the following information:

1. The purpose of the manual and to what system and facility the information applies.
2. All other Port Authority manual or standards that may apply to the operation and maintenance of the subject system(s).

3. The entities responsible for the preparation of the manual.
 4. Qualifying information presented in the manual.
- B. Introductory Chapter
1. The introduction shall be broken down into a minimum of two subchapters designated as SCOPE, GENERAL, NOTES and APPENDICES.
 2. The SCOPE shall outline the subject matter and function of the manual. All chapters shall be identified and described briefly.
 3. GENERAL shall contain a general description of the system and any background information that may be required to fully understand the information being presented.
 4. Other sections may be required to summarize the interaction of other systems with the systems described in the manual.
 5. NOTES and APPENDICES shall be the last two subchapters in the Introductory Chapter, and shall be identified and described briefly.
- C. Chapters On System Description and Operation
1. General
 - a. The information contained in the manual(s) shall include, but not be limited to, the information presented herein.
 - b. Items to be identified in this section are typical requirements for the systems identified. The information shall be properly located in the respective sections of the manual, and prepared in accordance with the requirements of this Section.
 - c. All chapters shall be divided into subchapters which shall in turn be further divided into sections as described herein in order to convey the information in a modular format that is accurate and clear. The first two subchapters shall be designated as SCOPE and GENERAL respectively. These first subchapters shall not be broken down into sections.
 - d. The SCOPE shall summarize the subject matter contained in each of the respective chapters. GENERAL shall contain a synopsis of the system(s) being described and how the information is presented including a breakdown of the subchapters.
 - e. The quantity and breakdown of the chapters shall be made in a manner such that the information is presented in a modular, logical format for conciseness and clarity. Quantity and breakdown of the chapter shall be submitted to the Engineer for approval prior to the preparation of the manual.
 - f. The information contained in the chapters for a particular type of system shall begin with an overall description followed by an indepth explanation of the theory of operation. Information shall be provided in sufficient quantity and clarity that the reader will be able to understand the principles, proper operation, troubleshooting, and maintenance procedures of the system and all system components. Appropriate references shall be made to the respective illustrations and references.

- g. System and sub-system operation shall be described in sufficient detail and clarity for complete and proper operation of entire system. The operating instructions shall include all the procedures necessary to enable operating personnel to efficiently and effectively use the system(s) and equipment in accomplishing its designated task(s). A numbered step-by-step method shall be utilized to describe proper operational sequences.
 - h. All system components and their proper operation shall be described in complete detail, including its functional name designation, location, and intended function. All major sub-components and sub-assemblies shall be described in detail.
 - i. The physical layout of the system(s) shall be shown on a facility plan that accurately pinpoints their location. Appropriate floor plans and location diagrams shall be included for each of the systems and all equipment. Component references for the same type of equipment shall be consistent throughout the manual.
 - j. All equipment controls and indications shall be identified, located and functions described. All modes and the proper settings shall be identified, itemized and described completely. The use and relative advantage of each mode shall be described including references to the appropriate logic diagrams and schematics.
 - k. All specialized test equipment required for the proper maintenance and troubleshooting of the system(s) shall be described in accordance with the requirements of this Section.
 - l. All manuals or guides required to be submitted to the Engineer by the contract under which the system is constructed shall be included in the appendix.
 - m. Factory and Field (As-Built) Schematics diagrams shall be included for each type of equipment comprising the system(s) being described. Schematics shall be color coded, and identify all interconnections.
2. **Electrical Distribution Systems**
- a. A one-line diagram shall be provided which identifies all sources and load centers connected to the system. Device information shall include pertinent ratings for that type of equipment. Device designations shall conform to IEEE standards.
 - b. Location plans shall be shown for all electrical distribution equipment including conduit runs and duct-banks.
 - c. Systems shall be described beginning with the incoming service or other equipment providing the necessary power. The balance of the equipment shall be addressed in manner that is consistent and correlated with the single line diagram.
 - d. All devices shall have the nameplate information properly documented.
 - e. Point to point wiring for all control wiring and terminal strips shall be included and described in sufficient detail to convey the proper operation of the equipment.
 - f. All terminal strips/cabinets shall have their terminals tabulated. The tabulation shall include terminal numbers, the device controlled or monitored, the function performed, and the indication provided.

- g. All key interlocks shall be shown and documented on a Key-Interlock Diagram. The diagram shall show the key blocks of all devices having key-interlocks along with the key designations superimposed on a single line of the system. The diagram shall indicate, using dashed lines, the sequence for proper key insertions.
 - h. All relays shall have their contacts described in detail and enumerated for function and proper operation.
 - i. All control circuits for each type of equipment shall be described in detail. Schematics shall show all power sources, input and output functions and point-to-point wiring.
 - j. All different types of equipment shall be described in detail. The information should include photographs, diagrams, drawings, schematics and all other information required to convey its proper operation and function, maintenance and troubleshooting requirements.
 - k. The photographs for each type of equipment shall include but not be limited to the following views: overall, interior views showing major mechanisms and components.
3. Control Systems
- a. All control systems shall be depicted using a block diagram. Connections and logic flow shall be indicated along with all interfaces to other external systems.
 - b. All control devices and wiring shall be documented using standard JIC Schematic Ladder diagrams. All lines shall be sequentially enumerated on the left-hand side. On the right-hand side the function of the device or circuit shall be shown along with the line references to where the device contacts are connected. If the contacts are normally closed, they are to be underlined. Each function or device shall be shown on a different line.
 - c. All system equipment shall be shown on plan drawings of the physical plant.
 - d. The system operation shall be described in complete detail including all annunciation and control functions.
 - e. Logic diagrams shall be used to convey the sequence of proper operation and control
 - f. JIC standard schematic ladder diagrams shall be utilized to document all control circuits and associated functions.
 - g. All components and sensors shall be described in detail in terms of function, proper operation, physical and electrical characteristics.
 - h. System components shall be described in detail including information on the signals as well as the physical media used for transmission.
4. Heating, Ventilation, Air Conditioning (HVAC)
- a. The system shall be described in complete detail along with the theory of operation. System capabilities and characteristics shall be covered in detail.
 - b. A block diagram and a schematic control and flow diagram of the entire system shall be prepared to assist in describing the system as well as to convey the interrelation between the different subsystems.

- c. The refrigeration system shall be described in detail. Control and flow diagrams shall show all system components such as the compressor, expander, heat exchanger and the distribution system connecting these items. Diagram connections shall indicate the normal flow between the subsystems. Photographs shall document all equipment including all necessary internal views. Schematics shall be included to document all power and control circuits.
 - d. The air movement system shall be described in detail. Control and flow diagrams and schematics shall show all system components including motors, fans and the resulting ductwork to the utilization space. Schematic connections shall indicate the normal flow between all subsystem components. Photographs shall be utilized to document the different types of equipment including overall and appropriate internal views.
5. Security Systems
- a. All security systems shall be depicted using schematic block diagrams. The diagrams shall comprise the entire system and indicate all sub-system components. Connections and interfaces to other external systems shall also be shown.
 - b. All system equipment shall be shown on plan drawings of the physical plant. Tables shall be included that itemize all system equipment broken down by physical location (building, room, etc.) and type of equipment. Tables shall show the quantity and designation of each type of equipment at that respective location.
 - c. The system operation shall be described in complete detail including all annunciation and control functions. Descriptions of all system inputs and the resultant outputs generated by the system shall be included. Tables shall be utilized as much as possible in order to present the information in a clear and concise manner.
 - d. Logic flow diagrams shall be used to describe the sequence of proper operation. Flow diagrams include system inputs, control functions and all associated annunciations and outputs.
 - e. The means and types of identification used shall be identified and described in detail in terms of theory and actual operational requirements.
 - f. All levels of access shall be described in detail in terms of philosophy, theory of operation (including interfaces with the system) and actual operational restrictions (access areas, etc.).
 - g. All manual access functions, (manual locks and keys, etc.) shall be described and how they interface with the balance of the system.
 - h. All types of system functions and capabilities shall be categorized and described in detail. The description shall include how the function is accomplished and reference the system components that are involved in providing these functions including interfaces with computer hardware and software. Block diagrams shall be included to show typical inputs and outputs of the system for each type of function identified.

- i. All categories of data used to characterize all individuals shall be identified and described. Description shall include reference to how this data is used by the system to accomplish the intended functions (i.e., identification, access, control, etc.).
 - j. All software required for the proper operation of the system shall be described in detail. A User's Guide shall be included in the appendix for the Host Software Application. A complete programming manual from the original software publisher shall be included in the appendix. The programming manual shall include complete instructions and sample programming for the functions required by the contract documents.
6. **Communication Systems**
- a. All communication systems shall be depicted using block diagrams and schematics. The diagrams shall comprise the entire system and convey all sub-systems. Connections and logic flow shall be indicated along with all interfaces to other external systems.
 - b. As-Built wiring diagrams and schematics showing point to point (pin to pin) wiring shall be included for all electronic interconnect, audio, video, and control system wiring.
 - c. As-Built Run sheets or field wiring drawings shall be included to document all system communication lines and interconnections and included in the Appendix.
 - d. The manual shall include descriptions, photographs and drawings of: patch panel assignments, custom equipment modifications, front panel layouts of equipment racks and mill work details.
 - e. Field installation wiring and cabling diagrams shall be included. All cable and wiring terminations shall be shown on the drawings along with all terminal markings, cable connector markings and cable lengths.
 - f. All equipment shall be described in detail. All appropriate illustrations shall be included to properly convey to the reader the proper operation, maintenance and troubleshooting of the device accurately and concisely. All internal wiring and schematic diagrams, parts list, gain charts, impedance charts shall be included for each device. Electrical characteristics shall be tabulated. All associated controls shall be explained in detail including the nature and limits of these controls on the output signal.
 - g. Interfaces and interconnections between the system and external communication systems shall be described in detail. Interconnection wiring and schematic diagrams shall be included.
 - h. All software required for the proper operation of the system shall be described in detail, in terms of operational and programming procedures. A User's Guide shall be included in the appendix for the Host Software Application. Source code if supplied, shall be listed in the appendix and described by subroutine and line-by-line. A complete programming manual from the original software publisher shall be included in the appendix. The programming manual shall include complete instructions and sample programming for the functions required by the contract documents.
 - i. A copy of the FCC license, FCC regulations and all FCC required information shall be included and properly indexed.

7. Fire Detection and Alarm Systems

- a. All fire detection and alarm protection systems shall be described completely using block diagrams and schematics. Block diagrams and schematics shall be prepared and referenced as illustrations. The diagrams shall describe the entire system and convey all sub-systems. Connections and logic flow shall be indicated along with all interfaces to other external systems.
- b. One-line riser diagrams shall be included for all systems described in the manual. The riser diagram shall include all signaling devices and alarm indicating devices, central fire command stations, auxiliary fire command stations, local control panels, portable programmers, power supplies, video display units, printers, power supply, security hardware, and all other relays, detectors, and interface modules necessary for total system operation.
- c. The system shall be described in sufficient detail to accurately and concisely convey to the reader the proper operation, maintenance and troubleshooting requirements of the entire system.
- d. All software required for the proper operation of the system shall be described in detail, in terms of operational and programming procedures. Source code if supplied, shall be listed in the appendix and described by subroutine and line-by-line. A complete programming manual from the original software publisher shall be included in the appendix. The programming manual shall include complete instructions and sample programming for the functions required by the contract documents.
- e. Field wiring, routing and types shall be described in detail.
- f. The stand-by power system shall be described in detail in terms of its proper operation, maintenance and troubleshooting requirements.

D. Maintenance Schedules and Instructions

1. Maintenance schedules and instructions shall be provided for the system(s) and for each type of equipment comprising the system(s). These procedures in their entirety shall convey all the necessary information required to maintain the system(s) and equipment operating under the same reliability as when the equipment was purchased.
2. The maintenance procedures shall incorporate information from, but not necessarily be limited to, the following sources.
 - a. Original manufacturer's maintenance recommendations.
 - b. All applicable industry standards (NFPA-70B, etc.).
 - c. Existing Port Authority Operation and Maintenance Manuals on similar systems and equipment.
 - d. Existing Port Authority Maintenance standards and rosters.
 - e. Existing procedures being performed by maintenance staff.
3. If any procedure conflicts with the original manufacturer's recommended maintenance procedures in a manner that its implementation would result in either the equipment operating under decreased reliability or violate the equipment's warranty, the manufacturer's recommendations shall prevail.

4. Maintenance instructions shall include inspections, testing, and overhaul of equipment, all procedures, instructions or both for the performance of scheduled maintenance along with the requirements for number of personnel, tools, consumable materials, replacement parts and time required to perform each maintenance routine. If applicable, references shall be made to the appropriate illustrations (photographs and drawings) to insure that the reader fully understands the proper steps to be taken to properly perform the recommended maintenance.
5. In addition to the scheduled maintenance, repair procedures for potentially frequent problems and for the repairs identified in 2.03 shall be included and prepared in accordance with the requirements of this Section. These procedures shall be presented in the same format as the maintenance procedures and provide as a minimum all the information required to properly perform the repair.
6. All maintenance and repairs shall be strictly limited to de-energized equipment that has been taken off-line. The proper procedures and safety precautions required to isolate and de-energize the equipment shall be identified, enumerated and described in complete detail.
7. Maintenance for electrical distribution system equipment operating at voltages greater than 600V shall be described in such a manner that its performance will be in strict adherence to the Port Authority's High Tension Administrative and Safety Rules, a copy of which is available for inspection at the Engineering Department Design Division, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397.
8. An index shall be provided at the beginning of the chapter identifying the recommended maintenance or repair procedures by title, type of equipment (including model number), and the page(s) where it is located. The index shall be organized in alphabetical order first by type of equipment and then by title of maintenance/repair routine.
9. Prior to writing the maintenance instructions for the system(s) and equipment described in the manual, a sample maintenance/repair routine shall be submitted to the Engineer for his review and approval.

E. Troubleshooting Guidelines

1. If at all possible, troubleshooting procedures shall be performed only on de-energized equipment that has been taken off-line. In the event that this condition is not possible, the proper safety precautions required to safely operate, test and troubleshoot the system(s) and equipment shall be identified, enumerated and described in complete detail.
2. The troubleshooting guidelines shall be presented in a three-column format. The first column shall identify the symptoms of typical problems enumerated by decreasing probability of occurrence. The second column shall identify all possible causes for that condition and each shall be identified with a letter designation. The corrective measures required to rectify each of these probable causes shall be listed in the third column using the same letter designation followed by a sequential number.
3. Troubleshooting procedures for electrical distribution system equipment operating at voltages greater than 600V shall be described in a manner that their performance will be in strict adherence to the Port Authority's High Tension Administrative and Safety Rules available as stated in 2.03 D.3.7 herein.

4. An index shall be provided at the beginning of the chapter identifying the troubleshooting procedure by title, type of equipment, including model number, and the page(s) where it is located. The index shall be organized in alphabetical order first by type of equipment and then by title of symptom or problems observed.
5. Prior to writing the troubleshooting procedures for the system(s) and equipment described in the manual, a sample procedure shall be submitted to the Engineer for his review and approval.

F. Abbreviations

1. All abbreviations utilized in the manual, including illustrations, shop and as-built drawings shall be itemized and described completely in alphabetical order.
2. Abbreviations shall be minimized as much as possible.
3. All abbreviations used in the text and illustrations shall be in accordance to ASME Y1.1.

G. Symbols

1. All symbols utilized in the manual, including illustrations, shop and as-built drawings shall be itemized and described completely. Symbols shall be itemized logically and grouped by similar types and function.
2. Electrical and electronic symbols shall be in accordance with IEEE 315.
3. Mechanical symbols shall be in accordance with ANSI Y32.18.

END OF SECTION

SECTION 16001

OPERATION AND MAINTENANCE MANUALS

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

Prior to beginning any photographic work, submit details of camera(s) and type of film to be used.

B. Samples

1. Sample photographs of the subject matter.
2. Prior to preparation of the operation and maintenance manual, submit for approval samples of the following items:
 - a. Binder.
 - b. Binder Cover Page.
 - c. All fonts for text.
 - d. All drawings and diagrams that are to be prepared by the Contractor.
 - e. Structure and format of the operation and maintenance manual, including a preliminary Table of Contents.
 - f. Samples of maintenance and troubleshooting routines.

C. Operation and Maintenance Manuals

1. Prepare the following in accordance with the requirements of this Section, and submit to the Engineer for review:
 - a. Thirty (30) copies of the Preliminary Edition.
 - b. Five (5) copies of each Draft copy requested by the Engineer.
 - c. Fifteen (15) copies for Final Review.
 - d. One hundred (100) copies of the Final Edition.

END OF APPENDIX "A"

DIVISION 16
SECTION 16110
RACEWAYS

PART 1. GENERAL**1.01 SUMMARY**

This Section specifies requirements for raceways.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American National Standards Institute (ANSI)

ANSI C 80.1	Rigid Steel Conduit - Zinc Coated
ANSI C 80.3	Electrical Metallic Tubing - Zinc Coated
ANSI C 80.5	Rigid Aluminum Conduit
ANSI C 80.6	Intermediate Metal Conduit - Zinc Coated

National Electrical Manufacturers Association (NEMA)

ANSI/NEMA FB 1	Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
NEMA RN 1	Polyvinyl - Chloride (PVC) externally coated galvanized rigid steel conduit and intermediate metal conduit
NEMA TC-3	PVC Fittings for use with rigid PVC Conduit and Tubing
NEMA TC-6	PVC and ABS plastic utilities duct for underground installation
NEMA TC-8	Extra-strength PVC plastic utilities duct for underground installation
NEMA TC-14	Filament - Wound Reinforced Thermosetting Resin Conduit and Fittings

National Fire Protection Association (NFPA)

NFPA 70	National Electric Code
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Underwriters Laboratories Inc. (UL)

ANSI/UL 1	Flexible Metal Conduit
ANSI/UL 5	Surface Metal Raceways and Fittings
ANSI/UL 6	Rigid Metal Conduit
ANSI/UL 209	Cellular Metal Floor Raceways and Fittings
ANSI/UL 360	Electrical Liquid-tight Flexible Steel Conduit

ANSI/UL 514B	Fittings for Conduit and Outlet Boxes
ANSI/UL 651	Schedule 40 and 80 Rigid PVC Conduit
ANSI/UL 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit
ANSI/UL 797	Electrical Metallic Tubing
ANSI/UL 870	Wireways, Auxiliary Gutters, and Associated Fittings
ANSI/UL 884	Underfloor Raceways and Fittings
ANSI/UL 1242	Intermediate Metal Conduit
ANSI/UL 1479	Fire Tests of Through-Penetration Firestops

1.03 DELIVERY, STORAGE, AND HANDLING

- 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.

1.04 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 6.
- 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. RGS/PVC - PVC coated, rigid galvanized steel conduit (Heavy-wall) hot dipped galvanized inside and out with hot dipped galvanized threads. The interior of the conduit shall have a thermoplastic or thermosetting coating of a nominal thickness of .007 (7 mils) and shall conform to NEMA TC-14. All PVC coated conduit shall conform to NEMA RN-1.
 - 3. IMC - Intermediate metal conduit, galvanized steel (medium-wall) conduit, threads shall be galvanized and shall conform to ANSI/UL 1242 and ANSI C80.6.
 - 4. ALC - Aluminum conduit shall conform to UL 6 and ANSI C 80.5.

5. 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.
 6. All fittings shall be threaded and shall conform to NEMA FB-1.
 7. 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 and conform to NEMA RN-1.
- C. Electrical Metallic Tubing
1. EMT - Electrical metallic tubing (thin-wall) shall be galvanized steel and shall conform to ANSI/UL 797 and ANSI C 80.3.
 2. All fittings shall be indenter or compression type made of malleable or pressed steel and shall conform to ANSI/NEMA FB 1.
- D. Cellular Metal Floor Raceway
- Cellular Metal Floor Raceway and Fittings shall conform to NFPA 70 and ANSI/UL 209.
- E. 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.
- F. 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.
- G. 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.
- H. 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 ANSI/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.
 7. FRE - Fiberglass Reinforced Epoxy (FRE) conduit shall conform to ANSI/NEMA TC-14.
- I. 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.
- J. 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.
- K. Fastening Devices
- Provide inserts, clamps, bolts and washers, or any other type of fastening devices conforming to the requirements of the Section entitled "SUPPORTING DEVICES", 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 entitled "SUPPORTING DEVICES".
 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 mono-filament 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 345 fully applies.
- C. Electrical Metallic Tubing**
- 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. Cellular Metal Floor Raceway**
- Installation limits shall be defined by NFPA 70.
- E. 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;
 - b. Condensating, moist, wet or humid conditions;
 - c. Corrosive atmospheres;
 - d. Water spray;
 - e. Dripping oil, grease or water.
 3. Install FSC and LSC with a separate, insulated copper, code-sized, equipment-grounding conductor, installed inside the flexible conduit.

F. Surface Metal Raceways

1. Only metallic surface metal raceways will 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.

G. Underfloor Raceways

Install underfloor raceways in accordance with the Contract Drawings NFPA 70, ANSI/UL 884 and the recommendations and requirements of the manufacturer.

H. 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.

I. 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.

J. 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. Elbows and fittings shall be manufactured from the same resin/hardener/glass system as the conduit.

K. 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 will 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 3.02 A.2 above.
 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 will 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 him to make his decision.

END OF SECTION

SECTION 16110

RACEWAYS

APPENDIX A

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:
1. Shop Drawings
Raceway systems - only when shop drawings are required by the Contract Drawings
 2. Catalog Cuts
 - a. Conduit and Tubing
 - b. Surface Metal Raceway and Accessories
 - c. Underfloor Raceway and Accessories
 - d. Wireways and Auxiliary Gutters

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:

	<u>American National Standards Institute (ANSI)</u>
ANSI C 2	National Electrical Safety Code
ANSI C 80.1	Rigid Steel Conduit - Zinc Coated
	<u>American Society for Testing and Materials (ASTM)</u>
ASTM A 185	Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
	<u>Institute of Electrical and Electronics Engineers, Inc. (IEEE)</u>
IEEE 837	Standard for Qualifying Permanent Connections Used in Substation Grounding
	<u>National Electrical Manufacturers Association (NEMA)</u>
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
	<u>National Fire Protection Association (NFPA)</u>
NFPA 70	National Electrical Code
OSHA	Occupation Safety and Health Administration
	<u>Underwriters Laboratories Inc. (UL)</u>
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 the Section entitled "CONCRETE" of these Specifications.
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-protected 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 the Section entitled "CONCRETE" of these Specifications.
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

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. Handholes
 - 2. Vaults
 - 3. Frames and covers
 - 4. 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.

- B. Catalog Cuts
 - 1. Conduit
 - 2. Racking assemblies
 - 3. Grounding assemblies
 - 4. 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 factory-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 consistently 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:

<u>Conductor</u>	<u>System Voltage</u>	
	<u>208Y/120V</u>	<u>480Y/277V</u>
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, ASTM B8, 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 chlorosulphanated 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 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-retardant, cold and weather-resistant, 3/4 inch or 1 1/2 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; 3/4 inch 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

WIRE, CABLES, SPLICES, TERMINATIONS

(600 VOLTS OR LESS)

APPENDIX A

SUBMITTAL REQUIREMENTS

- A. Submit Catalog Cuts for the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:
1. Wires and cables for each type and size;
 2. Splice kit materials and installation procedures.
- B. Submit certified shop test reports for wires and cables.
- C. 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
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Federal Specifications (FS)

HH-I-553	Insulation Tape, Electrical (Rubber, Natural and Synthetic)
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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, 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 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, helically 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 mils thick, 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 applicable).
 - 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'

SUBMITTAL REQUIREMENTS

- A. Submit the following in accordance with the requirements of "Shop Drawings", Catalog Cuts, and Samples", of Division 1 - General Provisions:
 - 1. Shop Drawings
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.
 - 2. Catalog Cuts
 - a. Medium Voltage Cable(s)
 - b. Ground Wire(s)
 - c. Terminators
 - d. Splices
 - e. Pulling Devices and End Seals
- B. Submit certified shop test reports for wires and cables.
- C. Submit field test results for wires and cables, including all test data and methodology.
- D. Submit nitrogen purge procedure for moisture laden wires and cables.

END OF APPENDIX "A"

DIVISION 16
SECTION 16125
TRAFFIC SIGNAL CABLES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for traffic signal cables.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	<u>American Society for Testing and Materials (ASTM)</u>
ASTM B 3	Standard Specification for Soft or Annealed Copper Wire.
ASTM B 8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
ASTM B 33	Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
	<u>Electrical Testing Laboratories, Inc. (ETL)</u>
	<u>International Municipal Signal Association (IMSA)</u>
IMSA	Official Wire And Cable Specifications (Series 19/20-600 Volts).
	<u>National Electrical Manufacturers Association (NEMA)</u>
NEMA TS 2	Traffic Controller Assemblies with NTCIP requirements.
	<u>National Fire Protection Association (NFPA)</u>
NFPA 70	National Electrical Code (NEC).
	<u>Underwriters Laboratories, Inc. (UL)</u>

1.03 QUALITY ASSURANCE

Wires and cables that have been manufactured more than two years prior to installation shall not be used in the Work of this Section.

1.04 DELIVERY, STORAGE, AND HANDLING

Store material in a clean, dry space and protect from weather.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

- A. Traffic signal cable wires shall be soft annealed copper wire in accordance with ASTM B 33 for tinned coated conductors or ASTM B 3 for bare copper conductors and shall be stranded copper conductors with concentric stranding conforming to ASTM B 8.
- B. Color-Coding for Conductors
 - 1. Insulation or covering of wires and cables shall be factory color-coded by the use of colored compounds or coatings. Consistently follow the color-code throughout the performance of the Work.
 - 2. Color-code for conductors shall meet the IMSA standards.
- C. All wires, cables, splice and terminations for which there are established UL standards shall bear the UL label.
- D. Traffic Signal Cable
 - 1. Shall meet the requirements specified herein, shall be Underwriters Laboratories (UL) and Electrical Testing Laboratories (ETL) approved and shall bear such approval labels.
 - 2. Conductors shall be stranded copper of the gauge and number shown on the Contract Drawings. Standard conductor size for traffic signal cable applications shall be #14 AWG. Where voltage drop exceeds 5 percent, the conductor size for the traffic signal cable shall be #12 AWG.
 - 3. Each conductor shall be factory tested for insulation resistance and for continuity of conductors.
 - 4. Cables shall have a 600-volt rating, shall be factory tested for each conductor insulation resistance and for continuity of conductors and shall conform to the following International Municipal Signal Association (IMSA) Specifications:
 - a. Cable in conduit and raceways: IMSA Specification 19-1 for polyethylene insulated polyvinyl chloride jacketed signal cable, with individual color-coded conductors and black outer jacket.
 - b. Aerial Cable: IMSA Specification 19-3 for polyethylene insulated polyvinyl chloride jacketed signal cable with integral messenger, with individual color-coded conductors and black outer jacket.

2.02 CONSTRUCTION FEATURES

- A. Cable Tags
 - 1. Dry and Wet Locations
 - a. Polyethylene tags, 0.025-inches thick and 1-1/2-inches wide, with letters and numbers 7/8-inch wide, with 2-14 AWG nylon, weather-resistant cable ties.
 - b. PVC tags, 0.025-inches thick and 9/16-inch wide, with letters and numbers 5/16-inch wide, with 2-14 AWG nylon, weather-resistant cable ties.
- B. Splicing and Terminating
 - 1. All splicing and terminating 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. All cable terminations shall meet the requirements of NEMA TS 2.

PART 3. EXECUTION

3.01 PREPARATION

- A. Prior to pulling wires and cables, clean raceway systems of 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. Locations, types, sizes and numbers of wires and cables are shown on the Contract Drawings. Where not indicated, provide traffic signal cable selection to comply with this Section and NFPA 70 standards.
- B. Keep wires and cables dry at all times.
- C. 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.
- D. Pull wires and cables through conduits in such a manner as not to overstress or stretch any wire. Do not score out, twist or damage the protective covering or insulation. In the pulling of wire or cable into conduits, where the strain on the wire or cable may prove excessive, use wire lubricant. Without exception, provide all cables and wires in junction or pull boxes with an adequate amount of slack formed around the interior of the box.
- E. After cables have been installed and pending permanent splicing, make a thorough inspection to determine that water has not entered the wires and cables and that the wires and cables have not been damaged. Carefully seal the end of each section of cable in hand holes and service panels or cabinets, using rubber tape, and paint with a sealing type of waterproof compound. All cables in hand holes shall be placed on cable racks while waiting to be permanently spliced.
- F. Cables and wires installed in a conduit system shall be properly trained through the hand holes to permit racking and connection to traffic signal poles and controller cabinets.
- G. For wiring trained through existing hand holes, if any, which are not equipped with cable racks, furnish and install a cable rack assembly. Provide ground bushing and bonding wire on all metallic conduit ends within such hand holes. Cable rack assemblies for installation in existing hand holes, if any, shall consist of four cable racks, including inserts and fasteners.
- H. Install cable terminations and terminate cables with insulated spade terminals conforming to NEMA TS 2.
- I. Provide one coil of slack wire, three feet minimum, in all pole bases and six feet minimum in rectangular hand holes to allow for proper connection of all wiring. The allowable slack specified shall be the minimum amount of slack required. At certain locations or under certain conditions additional slack may be necessary, as shown on the Contract Drawings.

- J. Secure conductors to the cable racks using nylon cable ties. In circular hand holes, provide one coil of slack wire, eight feet minimum, secured in a loop with nylon cable ties and placed in the bottom.
- K. Cable/Wiring Joints and Splices
 - 1. Cable shall be run between units of equipment without splices except in pole bases or unless otherwise shown on the Contract Drawings.
 - 2. Where joints or splices are specified:
 - a. Make them with compression solderless connector and secured mechanically and electrically. Thoroughly clean conductors with a minimum of insulation removed.
 - b. Insulate joints and splices with insulating tape and provide one and one half times the insulation equivalent to that of the original conductor. Insulate the taped joints and splices with resin splicing kits.
- L. Identification of Wires and Cables
 - 1. Identify each wire and cable by its signal number in all cabinets, boxes, manholes, hand holes, wire ways and other enclosures and access locations, and at all terminal points.
 - 2. The signal number designations shall be as shown on the Contract Drawings. Attach tags to wires and cables in such a manner as to be readily visible.
 - 3. Wrap tag ties around all conductors comprising the signal number to be identified.

3.03 FIELD TESTS

- A. Test all wires and cables up to equipment installed under the Contract with a 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 codes that would apply if the Authority were a private corporation, promptly replace the materials involved, at the Contractor's expense, and retest.
- B. When each wiring system is completed and before any connection is made to operating equipment, perform the following tests on each circuit in the presence of the Engineer to determine whether the installations are in acceptable working order:
 - 1. Tests for continuity.
 - 2. Tests for ground.
 - 3. Tests for insulation resistance performed between circuit wires and from circuit wires to ground. Upon completion of the electrical system with fuses removed, or devices removed from the circuit, and before energizing, the insulation resistance shall not be less than 150 megohms between conductors or between conductor and ground on those circuits with a total single conductor length of 1,500 feet and over, and no less than 175 megohms for those circuits with a single conductor length of less than 1,500 feet.
- C. Perform tests on the system as a whole. Circuits shall be complete, including all splicing from the control cabinet to all the devices it services.

END OF SECTION

SECTION 16125
TRAFFIC SIGNAL CABLES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

- A. Wires and cables for each type and size.
- B. Termination and splice kit materials and installation procedures.
- C. Furnish four copies of wire and wiring test results identifying the observed readings with their respective circuits. Identify test results with the Contract title, the date of the test and the atmospheric conditions. The Contractor is responsible for recording data and preparing the report with test results.
 - 1. Submit certified shop test reports for wires and cables.
 - 2. Submit field test results for wires and cables, including "Megger" readings with the test method used.

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
	<u>Naval Engineering Standards</u>
NES 713	Determination of Toxicity Index of Products of Combustion From Small Specimens of Materials
	<u>Underwriters Laboratories Inc.</u>
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 clad, 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"

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 control/ signal transmission media.
- B. 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".
- C. One (1) foot sample of each type of control/signal transmission media for approval.
- D. Sample splice kit materials and installation procedures.
- E. Certified shop test reports for control/signal transmission media.
- F. Field test reports indicating and interpreting test results.
- G. 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.
- H. Maintenance requirements for cables.

END OF APPENDIX "A"

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

	<u>American Society for Testing and Materials (ASTM)</u>
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
	<u>Underwriters Laboratories (UL)</u>
UL 94V 0	Tests for Flammability of Plastic Materials for Part in Devices and Appliances

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

Arcproofing 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.

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.
- B. 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

SUBMITTAL REQUIREMENTS

A. Catalog Cuts

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:

	<u>American National Standards Institute (ANSI)</u>
ANSI Z 55.1	Gray Finishes for Industrial Apparatus and Equipment
	<u>National Electrical Manufacturers Association (NEMA)</u>
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
	<u>National Fire Protection Association (NFPA)</u>
NFPA 70	National Electric Code
	<u>Underwriters Laboratories Inc. (UL)</u>
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/JL 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, Poweright 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 AND CABINETS

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

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.

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:

	<u>National Electrical Manufacturers Association (NEMA)</u>
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)
	<u>National Fire Protection Association (NFPA)</u>
NFPA 70	National Electrical Code
	<u>Underwriters Laboratories Inc. (UL)</u>
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:

<u>Conduit Size</u>	<u>Distance Between Entry and Cover</u>
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

SUBMITTAL REQUIREMENTS

Submit the following, for approval in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Catalog Cuts

1. All boxes and fittings.

B. Shop Drawings

1. Special boxes.
2. Boxes larger than 12 inches.
3. Ancillary equipment if shown on Contract Drawings.

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 (\pm 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

SUBMITTAL REQUIREMENTS

Submit for approval the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

- A. Shop drawings
 - 1. Installation details for surface mounted receptacles and switches
 - 2. Installation details for "poke-through" assemblies
 - 3. Installation details for floor service receptacles
- B. Catalog cuts
 - 1. Receptacles
 - 2. Switches
 - 3. Wallplates
 - 4. Ground fault circuit interrupter receptacles
 - 5. 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:

	<u>National Electrical Manufacturers Association (NEMA)</u>
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
	<u>National Fire Protection Association (NFPA)</u>
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

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

Shop drawings shall include:

1. Job name
 2. Item number
 3. Specification for electrical parts, and assemblies.
 4. Wiring interconnection and schematic diagrams as follows:
 - a. 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
 - b. 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.
 - c. External connection diagram between the equipment and devices connected to it.
- B. 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.

- C. Catalog cuts
 - 1. Protection and control devices
 - 2. Terminal blocks
 - 3. All factory or field mounted devices and equipment shown on Equipment drawings
- D. Schedules
 - 1. Terminal block designations
- E. 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:

	<u>American Institute of Steel Construction Inc. (AISC)</u>
AISC	Manual of Steel Construction
	<u>American Iron and Steel Institute (AISI)</u>
AISI	Specifications for the Design of Cold-Formed Steel Structural Members
	<u>American Society for Testing and Materials (ASTM)</u>
ASTM A 36	Structural Steel
	<u>American Welding Society (AWS)</u>
AWS D1.1	Structural Welding Code, Steel
	<u>National Electrical Contractors Association (NECA)</u>
NECA 5055	Standard of Installation
	<u>National Fire Protection Association (NFPA)</u>
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 threaded 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.

<u>Raceway Diameter (inches)</u>	<u>Sleeve Inside Diameter (inches)</u>
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

SUBMITTAL REQUIREMENTS

Submit for approval the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

- A. **Shop Drawings**
Submit layout drawings for dimensioned locations of inserts, sleeves and anchors when required by the Contract Drawings.
- B. **Catalog Cuts**
 - 1. **Hangers and supports**
 - 2. **Sleeves**
 - 3. **Fasteners**
- C. **Submit calculations for the following:**
 - 1. **Supporting steel sections and channels, properly reflecting installed and future loading, including:**
 - a. **Safety factors of not less than 4 to 1;**
 - b. **Deflection ratio of not greater than 1/240.**
 - 2. **Special hangers and supports shown on the Contract Drawings**
 - 3. **Hangers, supports and fasteners when required by but not specifically shown on the Contract Drawings.**

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:

- I. 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:

<u>Transformer Size</u>	<u>Maximum Sound Level</u>
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:

- A. Shop Drawings
 - 1. Physical dimensions of each transformer.
 - 2. Nameplate drawing for each transformer.
 - 3. Drawings showing location of all specified accessories.
 - 4. Technical specification for proposed transformer.
 - 5. Wiring diagram of fan cooling provisions.
 - 6. Details of current transformers.
- B. Catalog Cuts
 - 1. Temperature gauges.
 - 2. Lightning arrestors.
- C. Test Reports

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 primed 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.

I. 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

I. 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"

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. Legend, Abbreviations, General Notes, and Drawing List
2. Outline drawings indicating overall dimensions, shipping sections, weights, and aisle space requirement for removable equipment
3. Switchgear rigging and installation drawings including anchoring details, locations of sills, and anchor bolts
4. Elementary diagrams (terminal configuration) for removable circuit breakers, relays, control switches, and meters
5. Structural drawings showing available space for busway, conduit, and cable connections
6. Bus arrangement including dimensions and ampere rating of all bus bars
7. Bill of materials for all equipment including item description, rating, and location
8. One line diagram showing all ratings, main connections, and location of all instruments including relays, transformers, and meters
9. Three line diagrams showing all instrument connections including relays transformers and meters
10. Kirk key interlock diagram with functional description
11. Removable circuit breaker's elementary diagrams
12. Front view of each vertical section showing all panel mounted equipment
13. Front view of all internal panels of each cubicle showing all control devices such as relays
14. Complete point to point wiring diagrams or schedules indicating the internal wiring of each component and the interconnections between components
15. Nameplate schedule and details
16. List special tools required for operation and maintenance of all equipment

B. Catalog Cuts

1. Relays
2. Control switches
3. Indicating lamps

4. Control wiring
 5. Wire markers
 6. Terminal blocks
 7. Switchgear space heaters
 8. Thermostats
 9. Bus insulation materials
 10. All types of lugs
 11. All types of fuses and circuit breakers
 12. Family of time-current characteristics curves for all types of fuses, relays, and trip devices
 13. Instrument transformer characteristic curves and burden
 14. Conventional metering system (CMS) devices
 15. Digital Metering System (DMS) hardware and software
- C. Test Reports
1. Submit factory tests and field tests forms for approval prior to implementation of the tests.
 2. Submit certified test reports for tests specified in 2.05 and 3.03 of this section.
 3. Submit Seismic Certification.
 4. Submit certified test report for paint qualification test performed per ANSI C 37.20.1.
- D. Operation and Maintenance Manuals
1. 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.
 2. Each manual, in addition to the information described above, shall contain the following:
 - a. Calibration data, curves, wiring diagrams, and other pertinent information for all components provided
 - b. Operational procedure, both manual and automatic
 - c. Recommended preventive maintenance schedules
- E. 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 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 Recommended Practice for Grounding of Industrial and Commercial
142-1991 Power Systems

IEEE Std Recommended Practice for Powering and Grounding Sensitive Electronic
1100-1992 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 REFERENCESAmerican 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:

<u>Material</u>	<u>Percent</u>
Hydrated Gypsum	50
Bentonite	50

- a. 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

ELECTRICAL BONDING

APPENDIX A

SUBMITTAL REQUIREMENTS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples", Division 1 - GENERAL PROVISIONS:

- A. 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.
- B. Shop Drawings
 - 1. Details of bonding of structural steel and reinforcing bars encased in concrete below grade.
 - 2. Steel and concrete shop drawings, including all required welds, bonding connections and recoating or patching of protective coatings.
 - 3. Layout drawings of test electrodes, cabling and test junction boxes.
- C. Submit 12 copies of all test data, and the final report.
- D. Submit qualifications of the Corrosion Specialist and a copy of NACE certificate.

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
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Underwriters Laboratories Inc. (UL)

ANSI/UL 67	Panelboards
ANSI/UL 50	Cabinets and Boxes
UL 1059	Electrical Terminal Blocks
ANSI/UL 55	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 branch 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 testResults 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 greater.
- 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

SUBMITTAL REQUIREMENTS

Submit for approval the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

Shop drawings for each enclosure/cabinet shall include:

1. Data sheet for each panelboard with the following information
 - a. Job name
 - b. Item number
 - c. Panelboard nameplate(s) in accordance with the design drawings
 - d. Quantity of this panelboard configuration
 - e. Phase, wire and voltage
 - f. Main and neutral Bus material, continuous current, current density, and momentary capacity.
 - g. Short-circuit rating
 - h. 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)
 - i. Thru feed lugs, subfeed
 - j. Ground bar with main lug on frame
 - k. Branch connection information:
 - (1) Circuit breakers rating, number of poles, type, manufacturer, and catalog number
 - (2) Lugs and cables per phase, Cable size range
 - l. Panelboard circuits breaker's arrangement for left and right side-top to bottom.
 - m. Panelboard overall dimensions H x W x D
 - n. Panelboard NEMA rating
2. Panelboard dimensional drawing. Indicate conduit entrance space at the top and bottom, knockout diagram and mounting details
3. Panelboard directory

- B. **Catalog cuts**
 - 1. **Panelboards and Cabinets**
 - 2. **Circuit breakers**
 - 3. **Family of time current characteristic curves for all types and sizes of circuit breakers**
- C. **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

APPENDIX "A"

SUBMITTAL REQUIREMENTS

Submit for approval the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - General Provisions:

- A. Shop Drawings
 - 1. Fuses; time-current and current-limiting curves for both melting and clearing.
 - 2. Circuit breakers; time-current curves.
 - 3. Fused circuit breakers - time current curves.
- B. Catalog Cuts
 - 1. Low Voltage Power Air Circuit Breakers
 - 2. Molded case circuit breakers
 - 3. Safety Switches
 - 4. 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.

- | | |
|--------------|--|
| | <u>American National Standards Institute (ANSI)</u> |
| ANSI C 37.91 | Protective Relay Applications of Power Transformers
<u>Institute of Electrical and Electronics Engineers Inc. (IEEE)</u> |
| IEEE 242 | Protection and Coordination of Industrial and Commercial Power Systems
<u>National Fire Protection Association (NFPA)</u> |
| 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 and 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

- 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 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 inbedded, 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/m² (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 its 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 Panels
 - (1) The remote power switching lighting panels 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 panels shall consist of a microprocessor-based control module, interface module, control busses, remote-controlled breakers, and Class 2 barriers.
 - (3) The remote power switching panels 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.
 - (f) Expansion port to connect additional inputs via expansion cabinet.
 - (k) RS-232 port for connection to personal computer.
 - (l) Non-volatile EEPROM memory.
- (4) All electronic modules and circuit breakers in the panels shall be mounted in the positions and control the loads as indicated on the panel wiring schedules indicated on the Contract Drawings.
- (5) Emergency panels 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

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

This Section specifies requirements for Roadway Lighting.

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 LTS-2 | Structural Support for Highway Signs, Luminaires, and Traffic Signals |
| | <u>American Society for Testing and Materials (ASTM)</u> |
| ASTM A 153 | Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM B 108 | Aluminum - Alloy Permanent Mold Casting |
| ASTM B 117 | Method of Salt Spray (Fog) Testing |
| ASTM B 136 | Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum |
| ASTM B 137 | Method for Measurement of Weight of Coating on Anodically Coated Aluminum |
| ASTM B 221 | Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes |
| ASTM B 244 | Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basic Metals with Eddy-Current Instruments |
| | <u>Underwriters Laboratories (UL)</u> |
| UL 57 | Electric Lighting Fixtures |
| UL 1029 | High-Intensity-Discharge Lamp Ballasts |
| UL 1572 | High Intensity Discharge Lighting Fixtures |
| | <u>The Energy Policy Act of 1992</u> |
| | Lamp Efficiency Labeling and Standards |
| | <u>Illuminating Engineering Society of North America (IESNA)</u> |
| ANSI/IES
RP8-1983 | American National Standard Practice for Roadway Lighting |

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

- A. The roadway lighting system shall provide safe and uniform illumination levels on roadway and parking lot pavements. The lighting levels shall be as specified or as produced by the lighting systems shown on the Contract Drawings. In no case the lighting levels shall be lower than recommended by the ANSI/IES RP8-1983 or its latest editions.
- B. The complete roadway lighting standard including shafts, luminaires, appurtenances and accessories shown on the Contract Drawings, including but not limited to: mast arms, traffic signals, pedestrian signals, fixed signs, arms, bases and anchor bolts shall be designed to support the weight of the equipment and withstand a maximum wind force of 90 mph (unless otherwise shown on the Contract Drawings) without sustaining permanent deformation, rupture or structural failure.
- C. The roadway light standards and accessories shall be designed in accordance with AASHTO LTS-2. Maximum deflection shall be limited to 5 percent of shaft length under static load test.
- D. Design calculations shall be certified by a Professional Engineer licensed in the State where the installation will take place.
- E. Where a manufacturer's model number is shown on the Contract Drawings, it shall establish the standards of quality and performance, accessories, including the construction features, lighting and electrical performance, finish and other physical and technical properties of the equipment.
- F. Roadway lighting fixtures shall be furnished with an optical assembly which complies with IESNA light distribution classification and as specified on the Contract Drawings.
- G. Install and adjust roadway lighting as specified in this Section and on the Contract Drawings.

1.04 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.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened, protective packaging.
- B. Materials shall be wrapped for protection during delivery, storage, and handling. Wet or damp wrapping shall be removed, and disposed of, to prevent staining shaft finish.
- 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 coverings until installation is complete and remove such coverings as part of final cleanup.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

Unless otherwise noted on the Contract Drawings, materials for roadway lighting standards and assemblies shall be as specified below, or approved equal:

- A. Shafts, Mast Arms, Pole Caps - ASTM B 221, Aluminum alloy 6063 heat-treated to produce a T6 temper.
- B. Anchor Bases (including Bolt Covers) and Transformer Bases - ASTM B 108, Aluminum alloy 356 heat-treated to produce a T6 temper.
- C. Anchor Studs, Lockwashers, Flatwashers, Screws, Nuts, Bolts, and Hardware -Stainless Steel
- D. Anchor Rods - Hot-rolled steel; galvanized in accordance with ASTM A 153 for thread exposure, plus 3 inches minimum toward "hook" end.
- E. Anchor Couplings - Hot-rolled steel; galvanized in accordance with ASTM A 153.
- F. Luminaire Housings - Low copper content (less than 0.4%) aluminum alloy 360.4 heat-treated to produce a T6 temper.

2.02 CONSTRUCTION FEATURES

- A. General
 - 1. Components and sizes (lengths and diameters) of roadway lighting standards and assemblies shall be as shown on the Contract Drawings.
 - 2. Electrical 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 electrical equipment are listed as suitable for the purpose specified and shown on the Contract Drawings.
- B. Luminaires
 - 1. General
 - a. Roadway luminaires described in this specifications are of three general types:
 - (1) Highway luminaires-pole mounted luminaires for open roadways.
 - (2) Underpass luminaires-ceiling or wall mounted luminaires for covered portions of roadways.
 - (3) Sign luminaires-sign mounted luminaires for traffic signs.

- b. Supply and install roadway luminaires in accordance with Section 16510, this Section of specifications and lighting fixture descriptions and manufacturer's model number as shown on the Contract Drawings.
 - c. Unless otherwise noted on the Contract Drawings, roadway luminaires shall be constructed of a metal housing, optical assembly, and a lens door. All mounting hardware shall be constructed of corrosion resistant material.
 - d. Optical assembly shall consist of specular aluminum reflector and borosilicate glass refractor or flat lens. Polycarbonate, Acrylic or other plastic refractors and lenses are not permitted. Optical assembly shall be self-leveling and sealed with a breathing and filtering gasket to prevent entrance of airborne contaminants. Gasket shall be cemented full perimeter with no metallic clips or fasteners.
 - e. The hinge mounted lens door shall be fully gasketed and accessible for tool-less or single tool relamping.
 - f. Ballast shall be mounted on a removable tray and shall have quick disconnect electrical terminals for easy maintenance.
 - g. Unless otherwise noted on the Contract Drawings, roadway luminaires shall have an electrostatically deposited, thermally set, grey polyester powder coat finish.
 - h. There shall be optional factory prewired no-tool photoelectric control receptacle. Photocontrol receptacles shall be provided with a stop to prevent rotation beyond 350°.
 - i. The photometric light distribution of the roadway luminaires shall be classified by IESNA as a one of the following Types:
 - (1) Type I
 - (2) Type II (Type II four-way)
 - (3) Type III
 - (4) Type IV
 - (5) Type V
2. Highway luminaires:
- a. Unless otherwise noted on the Contract Drawings, highway luminaires shall be a high-pressure Sodium (HPS) type with Type I, Type II or Type III photometric distribution.
 - b. Highway luminaires shall be furnished with cutoff, semi-cutoff or non-cutoff optics as specified on the Contract Drawings.
 - c. The highway luminaires shall be equipped with a latched and hinged power door for easy luminaire access.
 - d. The internal slipfitter shall be furnished with one-piece pipe clamp capable of adapting 1-1/4 through 2-inch pipe without rearrangement of clamp or bolts, and shall be adjustable at least $\pm 5^\circ$ from horizontal.

3. Underpass luminaires:

- a. Underpass luminaires shall be supplied for direct ceiling mounting, direct wall mounting, or for use with surface conduits and boxes. Mounting boxes shall comply with the requirements specified in Section 16135 of this specification.
- b. Unless otherwise noted on the Contract Drawings ceiling mounted underpass luminaires shall be a HPS type with Type I or Type V photometric distribution.

4. Sign Lighting luminaires:

- a. Unless otherwise noted on the Contract Drawings ceiling sign luminaires shall be a Metal Halide (MH) type with wide photometric distribution.
- b. Sign luminaires shall be furnished with integral light shields to minimize back and side glare.

C. Lamps

1. A lamp shall be furnished for each lamp holder of each luminaire. Luminaires and lamps shall be of the type and wattage as shown on the Contract Drawings and as specified in this Section and in Section 16510 of these specifications.
2. Mercury Vapor lamps are not permitted for roadway lighting.

D. Ballasts

1. Unless otherwise noted on the Contract Documents ballasts shall be a Constant Wattage Auto transformer (CWA) type and shall comply with requirements of Section 16510 of these specifications.
2. HPS ballasts, which are not used in a 24-hour operation, 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. Fuse Assemblies

Fuse assemblies shall be complete with 5 amperes, 600-volt fuses, with 18-inch long leads of No.10 Standard type XHHW or USE wire.

F. Shafts

1. Unless otherwise noted on the Contract Drawings, shaft shall be spun tapered, or octagonal tapered, seamless tubing. Shaft may be drilled to manufacturer's specification for mounting luminaires. Removable aluminum pole cap shall be provided for the top of each shaft.
2. Each shaft shall be furnished with a cable support hook mounted inside the top of the shaft.
3. Welding shall be performed on the shaft only at the anchor base. Field welding shall not be permitted.
4. Where design parameters will result in excessive vibration, shafts shall be provided with factory installed vibration dampeners. Vibration dampener size, location and mounting shall be in accordance with the manufacturer's recommendations, and as approved by the Engineer.

G. Mast Arms

The types and sizes of mast arms shall be as shown on the Contract Drawings.

H. Anchor Bases

Anchor bases shall be free from cracks, pits, and blow holes, and shall be provided with a grounding lug. The base shall be supplied with bolt covers and mounting hardware and shall have provision for anchoring to the transformer base.

I. Transformer Bases

1. Transformer bases shall be frangible type and shall be free from cracks, pits and blow holes. Transformer bases shall be breakaway approved and fatigue tested.
2. Each transformer base shall be sized in accordance with the manufacturer's specifications and by pole height, total weight and bolt circle.
3. All transformer bases shall be provided with internal lugs for mounting on anchorage and a tapped hole inside the base for mounting a ground stud.
4. The base shall be furnished with a suitably sized, lockable, hinged door.

J. Pole Foundations

Pole foundation details and concrete for the pole foundations shall be as shown on the Contract Drawings.

K. Finish

Unless otherwise shown on the Contract Drawings, shafts, mast arms and transformer bases shall be satin finished clear anodized. Anodic coatings shall comply with ASTM B 117, 0 136, 0 137, and 0 244.

L. Accessories

Hardware accessories: slip fitters, mounting plates, screws, nuts, washers, bolts and other hardware necessary for assembling the roadway lighting standards shall be provided. The exposed portion of studs, washers, hex nuts and other hardware shall be well greased.

M. Anchor Bolts

Anchor bolts, including anchor rods, anchor couplings, anchor studs, nuts, installation template and flatwashers and lockwashers, shall be furnished for each lighting standard.

PART 3. EXECUTION

3.01 INSTALLATION

- A.** Install concrete foundations, including conduits and anchor bolts, as shown on the Contract Drawings and in accordance with the manufacturer's anchor bolt template.

- B. Install underground conduits as shown on the Contract Drawings and as specified in Section 16115 of this specification.
- C. Install conduit bodies and mounting boxes for underpass luminaires as shown on the Contract Drawings and as specified in Section 16135 of this specifications.
- D. Install roadway lighting standards, fixtures and appurtenances in accordance with the Contract Drawings, manufacturers' installation procedures and as specified herein.
- E. Connect all equipment as required for proper operation and as shown on the Contract Drawings.
- F. Set lighting standards plumb with variation off-true-vertical not to exceed 1/8-inch in ten feet. Vertical alignment shall be achieved by shimming, grouting or other approved means. Grout all bases after final alignment has been completed.
- G. Set underpass and sign luminaires plumb with variations off-true-horizontal between two adjacent fixtures not to exceed 1/8-inch. Fixture mounting variations from a straight line between the first and the last fixture in a row shall not exceed 1/8-inch.
- H. Requirements for mounting heights shall be as shown on the Contract Drawings.

3.02 FINISH REPAIR

All abraded or damaged anodized surfaces of roadway lighting standards, fixtures and appurtenances shall be repaired in a manner satisfactory to the Engineer.

END OF SECTION

SECTION 16550
LIGHTING SYSTEMS

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. Manufacturer's established installation procedure manuals for each type of specified roadway lighting standard and fixture.
 2. For each roadway lighting standard and fixture type: Clearly illustrate assembly methods, detailed dimensions, anchor bolt templates, mounting details, materials, finishes, electrical components, and light sources.
 3. For each lighting fixture type: Submit independent testing laboratory photometric report, and performance data in IESNA format
 - a. Luminaire, ballast and lamp and optical assembly description and manufacturer's complete catalog number
 - b. Luminaire schematic drawing with basic dimensions
 - c. Isolux (isofootcandle) Curves for street and house sides
 - d. Lumen Utilization Curves for street and house sides
 - e. Zonal Lumen Summary Table
 - f. Input Watts
 - g. Luminaire Efficiency
 4. For each ballast type: Submit manufacturer's data with ballast description, catalog number, lamp type, input voltage, input wattage, ballast factor, power factor, minimum starting temperature, operating temperature and wiring diagram.
 5. Photoelectric Control Devices: Submit manufacturer's data for ambient light sensors and contactors.
- B. Calculations**
1. For each roadway lighting standard type specified on the Contract Documents submit calculations verifying that total weight and Effective Projected Area (EPA) of the selected lighting standard with accessories and appurtenances do not exceed manufacturers Maximum Recommended Total Load.
- C. 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.

D. 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 roadway lighting 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 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:

Lightning 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

For Submittal Requirements see Appendix "A".

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 be 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"

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. 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.
- B. Catalog Cuts
 - 1. Wire and cable
 - 2. Air terminals and other equipment
 - 3. Supports, fasteners and hardware
- C. Certifications
 - 1. LPI system Certification
 - 2. UL Master Label
 - 3. LPI Forms
 - a. 175A
 - b. 175B
 - c. 175C
 - 4. 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 16720

FIRE ALARM SYSTEMS

PART 1. GENERAL

1.01 SUMMARY

This Section provides requirements for Fire Alarm Systems.

1.02 REFERENCES

The following is a listing of publications referenced in this Section:

	<u>Building Officials and Code Administrators, Inc. (BOCA)</u>
	<u>National Electrical Manufacturers Association Standards (NEMA)</u>
	<u>National Fire Protection Association (NFPA)</u>
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
	<u>Underwriters Laboratories, Inc. (UL)</u>
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
	<u>American National Standards Institute (ANSI)</u>
ANSI 117.1	Elevator Operation
	<u>Americans with Disabilities Act, PL 101-336 (ADA)</u>
	New York City Building Code NYCBC
	New York City Electrical Code NYCEC
	New York City Fire Prevention Code and Directives

1.03 Quality Assurance

A. QUALIFICATIONS

1. The entity performing the Work of this Section 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. Said 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. The entity shall be licensed to perform this type of Work in the jurisdiction of said Work. Licensure shall be evidenced by a submission from the entity of the following: a copy of the entity's current license, business permit and certifications. The entity performing the Work of this Section 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.
2. **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.
System Manufacturer
3. **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 must 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 will 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.

4. **System Maintainer:** For the maintenance of Fire Alarm System required in 3.05 herein, 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 must 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.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in Manufacturer's original unopened protective packaging.
- B. Store materials in a clean, dry space and protect same from damage.
- C. Handle in a manner to prevent damage. Damaged equipment shall be replaced.
- 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.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, including but not limited to 1.03A, provide fire alarm systems of manufacturers as shown on the Contract Drawings.

2.02 GENERAL

- A. The System shall consist of those components as shown on the Contract Drawings, including but not limited to Fire Alarm Control Panel(s), Annunciator(s), Initiating Devices, Notification Appliances, Auxiliary and Accessory Devices, Test and Programming software, firmware and hardware, and all wiring and wiring methods as shown on the Contract Drawings and as specified in this Section.
- B. Provide a fully operational Code compliant system. Only current equipment manufactured within six (6) months of the installation date shall be utilized.

2.03 MATERIALS

- A. Addressable Fire Alarm Systems.
 - 1. Addressable Fire Alarm Systems, where required on the Contract Drawings, shall provide discreet identification and status information of system modules and devices via an alphanumeric visual display and hardcopy printer. The system shall be microprocessor based and user software programmable.
 - 2. Fire Alarm Control Panel (s).
 - a. Fire Alarm Control Panel (s) shall be of the type shown on the Contract Drawings.
 - b. Panel (s) shall have active zones/loops/circuits as required. The spare capacity for zones/loops/circuits shall be at least 20%, or as otherwise shown on the Contract Drawings. Initiating and notification circuit loading shall be limited to 80% of the maximum specified by the Manufacturer for the design configuration, with the maximum to comply with code requirements or as specified in the Contract Documents, whichever is more stringent. In no case shall the circuits be loaded as to impede proper system operation.
 - c. Panel(s) shall be of modular construction using only solid state components and modules. Panels(s) shall contain all of the necessary components and modules to provide a complete operational code and specification compliant system, including spare capacity, as called for in the Contract Drawings.
 - d. All Panel Door(s) shall be painted except those as specified otherwise. All System controls shall reside behind a key locked steel door provided with viewing windows made of any material other than glass accepted as part of the product listings.
 - e. The System shall be programmable via an IBM compatible laptop computer and Manufacturer-supplied software. The System shall be fully field programmable utilizing the laptop computer via an onboard system programming port with the System fully powered and in operation. Shutdown of the System, loss of System operation, or removal of the System memory chips shall not be acceptable as part of the normal programming method. The System program shall be stored onboard utilizing non-volatile memory IC(s). Upon power up from complete shutdown, the System shall automatically reboot using the last stored program. Operator intervention or reprogramming shall not be required.

- f. The System shall provide a text area for each addressable module or device, designated as a "Custom Message Field" which shall be reserved for the Authority's use. The "Custom Message Field" shall be capable of displaying any character of the English alphabet in both upper and lower case and any Arabic numeric digit. The character capacity of the "Custom Message Field" shall be as specified in the Contract Drawings.
- g. The System shall incorporate an automatic "watchdog" feature that will reboot the System in any event where the operating system or processor halts. Operation of the watchdog feature shall be both visually displayed and printed at the time of occurrence.
- h. The System power supply shall be provided with two (2) sources of energy. The primary supply shall be 120 VAC single phase commercial power. The secondary supply shall be either an emergency standby generator(s) qualified as an emergency power supply for fire alarm systems of the type specified in this Contract or emergency standby batteries of the size and capacity required to meet the standby requirements of the System specified in this Contract. The system power supply shall automatically transfer between the primary and secondary power and vice versa. The power supply shall be monitored for integrity as required by applicable codes, standards and listings for the intended use.
- i. The Panel(s) shall be UL listed as a test instrument for the measurement of the sensitivity of connected intelligent ionization and photoelectric smoke detectors to comply with the testing requirements of NFPA 72.

The fire alarm control panel shall provide a display and a printed list of these sensitivity measurements as a permanent record of the required sensitivity testing.

The fire alarm control panel shall be programmed and the connected ionization and photoelectric light refracting smoke detectors shall be capable of self adjustment to compensate for the accumulation of contaminants that would change the detector sensitivity in either a more or less sensitive direction. The adjustment shall keep the relationship between the sensing chamber and the programmed alarm threshold voltage constant to prevent false indications of the failure to alarm in the presence of smoke.

The fire alarm control panel shall annunciate a trouble condition when any smoke detector approaches 80% of its alarm threshold due to gradual contamination, signaling the need for service and eliminating unwanted alarms. The trouble report shall annunciate the specific location of the smoke detector requiring service.

3. Initiating Devices - Pull Stations

Provide manual fire pull stations where indicated on the Contract Drawings. Stations shall be painted red. Where specified on the Contract Drawings the station shall also include either an integral white stripe or an accessory backing plate with white stripe. The white stripe shall be (1) one-inch wide and placed diagonally from top left to bottom right of the station. The stripe shall not obscure the stations operating instructions. The station shall be operable without the use of a special key or other device not part of the station, except in the case of resetting. The station shall be constructed of materials specified in the Contract Drawings. All stations shall be single action unless otherwise specified. The device shall be field programmable.

4. Initiating Devices - Open Area Detectors

Provide automatic detection devices where indicated on the Contract Drawings. All automatic detection devices shall be resettable from the control panel. Detectors shall include the use of a separate base assembly. The base assembly shall not include detection electronics which shall be housed in the detector. The detector shall be removable from the base assembly without the use of tools and without disturbing wiring connections. The device shall be field programmable.

5. Initiating Devices - Duct Detectors

- a. Provide automatic detection devices where indicated on the Contract Drawings. All automatic detection devices shall be resettable from the control panel. Detectors shall include the use of a separate housing assembly. The housing assembly shall not include detection electronics that shall be housed in the detector. The housing assembly may contain an auxiliary local relay. The detector shall be removable from the housing assembly without the use of special tools and without disturbing wiring connections. The device shall be field programmable.
- b. Detectors used in air duct applications shall be listed for this use. The air velocity ratings of the housing, sampling tubes or detector shall not be less than the air velocities expected to occur in the air handling system duct at the point of insertion. Duct Housings shall be installed to avoid undesirable flow restrictions and turbulence according to the Manufacturers installation instructions.
- c. Duct detection devices shall have provisions for the use of a remote location indicator.

6. Initiating Devices - System Interfaces

- a. Provide System interface modules where indicated on the Contract Drawings. System interfaces shall allow for the monitoring of conventional dry contact inputs to the System. The Interface shall supervise the dry contact inputs through use of an end of line device (EOL). EOL devices shall be placed across the contacts being monitored and not at the interface. The device shall be field programmable.
- b. The System Interface Modules shall be available in the following versions:
 - Dual Input
 - Single input
 - Single Input and Single Form C Contact Output

7. Notification Appliances

- a. Provide system notification appliances where indicated on the Contract Drawings. System notification appliances shall provide either audible, visual or combination audible and visual indication as indicated on the Contract Drawings. Notification appliance field wiring connection shall be accomplished using an integral terminal strip with screw & binding plate fasteners. Each appliance terminal position shall permit (2) single conductor # 14 stranded or solid wires to be attached without the use of wire loops, wire nuts, wire terminals or other methods other than a straight in connection. Appliances employing "pigtail" or "flying lead" field connections shall not be used.

Appliance source voltages shall be 24VDC for visuals, 24 VDC for coded and non-coded bells, and horns, and either 25VAC or 70.7VAC, based on system platform, for voice/tone speaker appliances. All appliances shall be UL Listed and UL Cross-listed for the Base System utilized. Appliances shall be red in color unless otherwise specified on the Contract Drawings.

- b. The system Notification Appliances shall be available in the following versions:

- (1) 4", 6", 10", 12" Motor or ElectroMechanically Operated Bells
- (2) 4", 6", 10", 12" Motor or ElectroMechanically Operated Bells with 15, 30, 15/75, 75, 110 Candela Strobe Lights.
- (3) Single and Multitone Electronic Horns
- (4) Single and Multitone Electronic Horns with 15, 30, 15/75, 75, 110 Candela Strobes.
- (5) Electronic Strobes, 15, 30, 15/75, 75, 110 Candela Outputs.
- (6) Speakers, 25VAC or 70.7VAC MultiTap Wall and Ceiling-Mounted.
- (7) Speakers, 25VAC or 70.7VAC MultiTap Wall-Mounted with 15, 30, 15/75, 75, 110 Candela Strobes.
- (8) Accessory mounting plates, boxes, trim rings and guards.

B. Conventional Fire Alarm Systems.

1. Conventional (Non-Addressable) Fire Alarm Systems, where required on the Contract Drawings, shall provide area or zone type identification of system devices. The visual display may consist of either an LED lamp display, an LED segmented display or a combination of both.
2. Fire Alarm Control Cabinet(s).
 - a. Fire Alarm Control Panel (s) shall be of the type shown on the Contract Drawings.
 - b. Panel(s) shall have active zones/loops/circuits as required. The spare capacity for zones/loops/circuits shall be at least 20%, or as otherwise shown on the Contract Drawings. Initiating and Notification Circuit loading shall be limited to 80% of the maximum specified by the manufacturer for the design configuration, with the maximum to comply with code requirements or as specified on the Contract Drawings whichever is more stringent. In no case, shall the circuits be loaded as to impede proper system operation.

- c. Panel(s) shall be of modular construction of only solid state components and modules. Panels(s) shall contain all of the necessary components and modules to provide a complete operational code and specification compliant system, including spare capacity as called for in the Contract Drawings.
- d. All panel door(s) shall be painted red, except those as specified otherwise. All System controls shall reside behind a key locked steel door provided with viewing windows made of any material other than glass accepted as part of the product listings.
- e. The system power supply shall be provided with two (2) sources of energy. The primary supply shall be 110 VAC single-phase commercial power. The secondary shall be either an emergency standby generator(s) qualified as an emergency power supply for fire alarm systems of the type specified in this contract or emergency standby batteries of the size and capacity required to meet the standby requirements of the System specified in this Contract. The System power supply shall automatically transfer between the primary and secondary power and vice versa. The power supply shall be monitored for integrity as required by applicable codes, standards and listings for the intended use.

3. **Initiating Devices - Pull Stations**

Provide manual fire pull stations where indicated on the Contract Drawings. Stations shall be painted red. Where specified on the Contract Drawings the station shall also include either an integral white stripe or an accessory backing plate with white stripe. The white stripe shall be (1) one inch wide and placed diagonally from top left to bottom right of the station. The stripe shall not obscure the stations operating instructions. The station shall be operable without the use of a special key or other device not part of the station, except in the case of resetting. The station shall be constructed of materials specified in the Contract Documents. All stations shall be single action unless otherwise specified.

4. **Initiating Devices - Open Area Detectors**

Provide automatic detection devices where indicated on the Contract Drawings. All automatic detection devices shall be resettable from the control panel. Detectors shall include the use of a separate base assembly. The base assembly shall not include detection electronics that shall be housed in the detector. The detector shall be removable from the base assembly without the use of tools and without disturbing wiring connections.

5. **Initiating Devices - Duct Detectors**

- a. Provide automatic detection devices where indicated on the Contract Drawings. All automatic detection devices shall be resettable from the control panel. Detectors shall include the use of a separate housing assembly. The housing assembly shall not include detection electronics that shall be housed in the detector. The housing assembly may contain an auxiliary local relay. The detector shall be removable from the housing assembly without the use of special tools and without disturbing wiring connections.

- b. Detectors used in Air Duct Applications shall be listed for this use. The air velocity ratings of the housing, sampling tubes or detector shall not be less than the air velocities expected to occur in the air handling system duct at the point of insertion. Duct housings shall be installed to avoid undesirable flow restrictions and turbulence according to the manufacturer's installation instructions.
 - c. Duct detection devices shall have provisions for the use of a remote location indicator.
6. Notification Appliances
- a. Provide system notification appliances where indicated on the Contract Drawings. System notification appliances shall provide either audible, visual or combination audible and visual indication as indicated on the Contract Drawings. Notification appliance field wiring connection shall be accomplished using an integral terminal strip with screw & binding plate fasteners. Each appliance terminal position shall permit (2) single conductor # 14 stranded or solid wires to be attached without the use of wire loops, wire nuts, wire terminals or other methods other than a straight in connection. Appliances employing "pigtail" or "flying lead" field connections shall not be used.
- Appliance source voltages shall be 24VDC for visuals, 24 VDC for coded and non-coded bells, and horns, and either 25VAC or 70.7VAC, based on system platform, for Voice/Tone Speaker appliances. All appliances shall be UL listed and UL cross-listed for the base System utilized. Appliances shall be red in color unless otherwise specified on the Contract Drawings.
- b. The system Notification Appliances shall be available in the following versions:
 - (1) 4", 6", 10", 12" Motor or ElectroMechanically Operated Bells
 - (2) 4", 6", 10", 12" Motor or ElectroMechanically Operated Bells with 15, 30, 15/75, 75, 110 Candela Strobe Lights.
 - (3) Single and Multitone Electronic Horns
 - (4) Single and Multitone Electronic Horns with 15, 30, 15/75, 75, 110 Candela Strobes.
 - (5) Electronic Strobes, 15, 30, 15/75, 75, 110 Candela Outputs.
 - (6) Speakers, 25VAC or 70.7VAC MultiTap Wall and Ceiling Mounted.
 - (7) Speakers, 25VAC or 70.7VAC MultiTap Wall-Mounted with 15, 30, 15/75, 75, 110 Candela Strobes.
 - (8) Accessory mounting plates, boxes, trim rings and guards.

PART 3. EXECUTION

3.01 EXAMINATION

Inspect all system equipment and accessories prior to installation. Replace any damaged items.

3.02 PREPARATION

Field verify dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing the equipment.

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.

After the System 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 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 1.02 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. Install grounding bushings on all conduits penetrating fire alarm enclosures. 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.

3.04 TRAINING

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.

3.05 MAINTENANCE

Furnish full preventive and remedial maintenance service for the fire alarm system, including all labor, parts, materials, and supplies until the issuance of the certificate of final completion. The Contractor shall respond to service calls by responding at the site within four (4) hours of the call 24 hours a day, 7 days a week, including holidays.

3.06 FIELD TESTING

- A. No system devices, modules, or other system electronics shall be connected to any circuit, prior to or during testing. Any equipment damaged due to testing shall be replaced by the Contractor at no additional cost to the Authority.
- B. All wiring not supplied as part of the manufactured control panel shall be tested by the Contractor in accordance with the test criteria listed on the test reports provided in the section entitled "Field Testing of Wiring". Prior to testing, field wiring shall not be connected to any equipment except external terminal blocks.
- C. All testing prescribed by, and within, the test reports shall be accomplished in the presence of the Engineer only after all wiring work is completed. Conduit, conduit, pull box, and junction box terminations shall be completed prior to testing. Once testing has been completed, the tested wiring shall not be disturbed. Any connection or wire that must be reworked shall be re-tested. Any conduit that has its contents modified in any way, shall have all of its circuit conductors re-tested.
- D. Test instruments (Meggers, Volt/Ohm Meters, etc.) used for testing as part of this Contract shall have been tested and calibrated within the last twelve (12) months and shall be evidenced by a certificate. A copy of the calibration certificate for each instrument used shall be submitted.
- E. Field Wiring Test Reports shall be submitted, in duplicate, to the Engineer for approval. One copy shall be the original and one copy a photocopy. The reports shall be legibly handwritten. Typewritten reports will not be acceptable.

- F. Field wiring will only be connected to the fire alarm equipment and devices once the test reports have been approved by the Engineer. Field wiring shall only be connected to the fire alarm panel(s) in the presence of a factory-trained technician acceptable to the System Manufacturer and the Engineer, unless otherwise indicated on the Contract Drawings.
- G. All fire alarm equipment, panels, detectors, signals etc. shall be fully pre-tested and shall have passed a 30 day operational test prior to presentation for final acceptance test. All Punch List items, defective or damaged equipment or backordered items shall be replaced, installed and or completed prior to the pre-test and final acceptance test. Upon satisfactory completion of the pre-test, the Engineer shall be notified in writing that the pre-test has been completed and that the system is in full conformance with the Contract Documents and ready for the final acceptance test.
- H. The final acceptance test of the fire alarm system shall be performed by the System Manufacturer's authorized technicians in the presence of the Engineer and shall consist of but shall not be limited to: all fire alarm System panels, notification appliances, initiating devices, interface modules, off premise monitoring, and auxiliary functions. The Engineer will also witness the test. It shall be the sole responsibility of the System Vendor to supply, and prepare any and all resources necessary to conduct and document the final acceptance test as prescribed by these Specifications, the Contract Drawings, and NFPA 72.

END OF SECTION

SECTION 16720

FIRE ALARM SYSTEM

APPENDIX "A"

SUBMITTAL REQUIREMENTS

Submit complete sets of the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - General Provisions:

- A. Shop Drawings:
 - 1. Layout drawings with dimensioned locations and quantities of each device
 - 2. System riser drawings detailing system equipment location and type, and reference notation to each drawing.
 - 3. Wiring and conduit details indicating numbered wires and terminals, and size and routing of each conduit and wire.
 - 4. System calculations detailing system power requirements, battery standby calculations, voltage drops, resistance, and capacitance limits as set by the manufacturer and wiring size as set by the manufacturer.

- B. Catalog Cuts and Installation Sheets:
 - 1. Manufacturer's current catalog cut and installation sheet for each product utilized in the System specified including:
 - a. Fire Alarm wires
 - b. Speakers
 - c. Horns
 - d. Strobes
 - e. Strobe/horn units
 - f. Pull station
 - g. Power wiring
 - h. Warden telephones
 - i. Standpipe phone jacks
 - j. Air duct detectors
 - k. Heat smoke detectors
 - l. Supervisory switches
 - m. Conduits, fittings, boxes, terminal strip cabinets
 - n. Cutout switch
 - o. Relays
 - p. Interface modules

- q. Fire alarm command station
 - r. Fire alarm control panel
 - s. Computers and components
 - t. Fire alarm accessory equipment
 - u. Wire labeling system
2. Copies of all UL listing documents, as provided by the Manufacturer, for each product utilized in the System.
 3. Copies of all NYC/MEA listing documents and resolutions (report of Material and Acceptance Test Division), as provided by the Manufacturer, for each product utilized in the System.
 - a. System circuit test results
 - b. Factory test reports.
 - c. 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.

4. Test Plans

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:

- 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. A 30-day operational test commencing with the successful completion of the on-site inspection and test.

5. Training

Prior to the on-site inspection and test of the system, prepare and submit to the Engineer for approval a fire alarm system curricula, in accordance with the requirements of this section.

6. Operation and Maintenance Manuals

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 Section 16001, entitled "OPERATION AND MAINTENANCE MANUALS."

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

SUBMITTAL REQUIREMENTS

A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples", Division 1 - GENERAL PROVISIONS:

1. Shop drawings.
 - a. Layout drawings layout, type and locations of electrical heaters.
 - b. Electrical and control wiring diagram.
2. Catalog 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.

B. Calculations

Submit calculations for the room heating requirements

C. Shop test data

Submit 12 copies of shop test data and manufacturer's certification.

Submit 12 copies of operation and maintenance manuals including replacement and spare parts list.

END OF APPENDIX "A"

DIVISION 16**SECTION 16861****ELECTRIC BASEBOARD HEATERS****PART 1. GENERAL****1.01 SUMMARY**

This Section specifies requirements for electric baseboard heaters.

1.02 REFERENCES

- A. American National Standard Institute (ANSI).
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
- C. National Electric Code (NEC).
- D. National Fire Protection Agency (NFPA).
- E. Occupational Safety and Health Association (OSHA).
- F. Underwriters Laboratories Inc. (UL).

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

Design and performance of components and methods specified herein shall comply with the applicable provisions of the codes and standards, and shall be as shown on the Contract Drawings.

1.04 QUALITY ASSURANCE

Electric baseboard heaters of the manufacture, type, and size required shall have been installed in similar applications to those intended herein for not less than three years.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Handle heaters carefully to prevent damage to finished surfaces.
- B. Store heaters in accordance with the manufacturer's instructions in clean, dry spaces and protect them from weather.
- C. Comply with the manufacturer's instructions for unloading and moving heaters to their final location for 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, provide electric baseboard heaters as manufactured by one of the following companies, or approved equal.

Q Mark Electric Heating Products; Division of Malley Electric Heating
Brasch Manufacturing Co. Inc.
Vulcan Radiator Corp.

2.02 MATERIALS

- A. Electric Heating Elements**
 - 1. Elements: Aluminum.
 - 2. Bushings: Nylon.
- B. Enclosures**
 - 1. Front and Side Panel: Aluminum.
 - 2. Back Panel: Steel.
 - 3. Pedestal Legs: Extruded aluminum.
 - 4. Grille: Extruded aluminum.
 - 5. Screen: Aluminum.

2.03 CONSTRUCTION FEATURES

- A. General**

Electric baseboard heaters shall consist of electric heating elements, control equipment, power and control wiring, enclosures, pedestal legs, discharge grille, blank section and accessories as specified herein and as shown on the "Electric Heater Schedule" shown on the Contract Drawings.
- B. 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 a 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.
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 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.

2.04 SHOP TESTS

Manufacturer shall test each electric heater and certify its rating and its completeness.

PART 3. EXECUTION

3.01 INSTALLATION

- A. Install units in accordance with the manufacturer's installation instructions.
- B. Coordinate all trades to ensure that the installation of the units is not in conflict with work performed by other trades.
- C. Verify that the electrical wiring installation is in accordance with the manufacturer's submittal and the installation requirements of this Section.

3.02 FIELD TEST

Start up, test and adjust units in presence and to the satisfaction of the Engineer.

END OF SECTION

SECTION 16861

ELECTRIC BASEBOARD HEATERS

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

Electrical and control wiring diagrams.

B. Product Data

1. Performance operating data for heating capacity, power and electrical characteristics.
2. Unit construction components materials.
3. Electrical operation heating element data.
4. Control equipment data.
5. Installation procedures.

C. Schedules

Electric heater schedules.

D. Maintenance Manuals

Submit 12 copies of operation and maintenance manuals including replacement and spare parts list.

END OF APPENDIX "A"

SECTION 16910

FIRE ALARM SPEAKER, STROBE AND ALD LOOP

FIELD TESTING OF WIRING

PART 1 - GENERAL

1.01 SUMMARY

This section specifies requirements for field testing of wiring for connection to the Fire Alarm (F.A.) System.

1.02 REFERENCES

A. The following is a list of references in this section:

1. National Electrical Code

1.03 SCOPE OF WORK

A. After installation, perform the tests as outlined in Part 3 of this Specification, in the presence of the Engineer.

1.04 QUALITY ASSURANCE

A. Record all test result reports on the attached form shown in Appendix "A".

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01

A. Should any of the following test results reveal defects, promptly correct such defects and rerun the test until the entire installation is satisfactory to the engineer.

3.02 SPEAKER WIRING

A. General

1. Speaker Wiring Circuits - See DWG E-302 for cable specification.
 - a. Speaker Circuit "A": 1 pair.
 - b. Speaker Circuit "B": 1 pair.

B. Sequential Test Procedures

1. After installing all field wiring, including heat shrinking and labeling, but before making final connections, strip cable jacket and conductor insulation for testing.
2. Visually inspect cables for physical damage and proper connection in accordance with the Contract Drawings.
3. "Ring out" all circuits to verify continuity, proper markings and location.
4. Splice through all open connections (except the home run to terminal strip cabinet, and last device cable end) using a temporary "wire-nut" as approved by the Engineer.
5. Perform insulation resistance and stray voltage tests.
6. Apply a short between the red and the black conductors at the last device cable end using a temporary "wire-nut" approved by the Engineer and perform resistance test.
7. After satisfactory completion of all testing, remove temporary "wire-nuts" and make final connections of speakers and end-of-line resistors (E.O.L.).

C. Tests

1. General

- a. Check and test all wiring installed under this Contract in accordance with the following procedure to ensure that the system is free of shorts, open and ground faults.

2. Test Performance

- a. Insulation Resistance: Test all wires and cables (as outlined below) with a 1000 Volt Megohmmeter (megger). Applied potential to be 1000 Volts DC for 1 minute.

Red Conductor to Black Conductor: _____ MΩ.

Red Conductor to Ground: _____ MΩ

Black Conductor to Ground: _____ MΩ

- b. Stray Voltage: Test all wires and cables (as outlined below), with the Fluke 87 Multimeter.

Red Conductor to Black Conductor: _____ AC Volts

Red Conductor to Black Conductor: _____ DC Volts

- c. Resistance: Test all wires and cables (as outlined below) with the Fluke 87 Multimeter.

Red Conductor to Black Conductor: _____ Ohms

- d. After all test result reports have been approved by the Engineer, remove temporary test connections and connect all wiring as shown on the Contract Drawings.

3.03 STROBE WIRING

A. Sequential Test Procedures

1. After installing all field wiring, including heat shrinking and labeling, but before making final connections, strip cable jacket and conductor insulation for testing.
2. Visually inspect cables for physical damage and proper connection in accordance with the Contract Drawings.
3. "Ring out" all circuits to verify continuity, proper markings and location.
4. Splice through all open connections (except the home run to terminal strip cabinet, and last device cable end), using a temporary "wire-nut" as approved by the Engineer.
5. Perform insulation resistance and stray voltage tests.
6. Apply a short between the red and the black conductors at the last device cable end using a temporary "wire-nut" approved by the Engineer and perform resistance test.

7. After satisfactory completion of all testing, remove temporary "wire-nuts" and make final connections of strobes and end-of-line resistors (E.O.L.).

B. Tests

1. General

- a. Check and test all wiring installed under this Contract in accordance with the following procedure to ensure that the system is free of shorts, open and ground faults.

2. Test Performance

- a. Insulation Resistance: Test all wires and cables (as outlined below) with a 1000 Volt Megohmmeter (megger). Applied potential to be 1000 Volts DC for 1 minute.

Red Conductor to Black Conductor: _____ MΩ
Red Conductor to Ground: _____ MΩ
Black Conductor to Ground: _____ MΩ
Red Conductor to Shield: _____ MΩ
Black Conductor to Shield: _____ MΩ
Shield Conductor to Ground: _____ MΩ

- b. Stray Voltage: Test all wires and cables (as outlined below) with the Fluke 87 Multimeter.

Red Conductor to Black Conductor: _____ AC Volts
Red Conductor to Black Conductor: _____ DC Volts

- c. Resistance: Test all wires and cables (as outlined below) with the Fluke 87 Multimeter.

Red Conductor to Black Conductor: _____ Ohms

- d. After all test result reports have been approved by the Engineer, remove temporary test connections and connect all wiring as shown on the Contract Drawings.

3.04 ALD LOOP

A. Sequential Test Procedures

1. After installing all field wiring, including heat shrinking and labeling, but before making final connections, strip cable jacket and conductor insulation for testing.

2. Visually inspect cables for physical damage and proper connection in accordance with the Contract Drawings.
3. "Ring out" all circuits to verify continuity, proper markings and location.
4. Splice through all open connections (except the home run to terminal strip cabinet, and last device cable end), using a temporary "wire-nut" as approved by the Engineer.
5. Perform insulation resistance and stray voltage tests.
6. Apply a short between the red and the black conductors at the last device cable end using a temporary "wire-nut" approved by the Engineer and perform resistance test.
7. After satisfactory completion of all testing, remove temporary "wire-nuts" and make final connections of ALD devices.

B. Tests

1. General

- a. Check and test all wiring installed under this Contract accordance with the following procedure to ensure that the system is free of shorts, open and ground faults.

2. Test Performance

- a. Insulation Resistance: Test all wires and cables (as outlined below) with a 1000 Volt Megohmmeter (megger). Applied potential to be 1000 Volts DC for 1 minute.

Red Conductor to Black Conductor: _____ MΩ
 Red Conductor to Ground: _____ MΩ
 Black Conductor to Ground: _____ MΩ
 Red Conductor to Shield: _____ MΩ
 Black Conductor to Shield: _____ MΩ
 Shield Conductor to Ground: _____ MΩ

- b. Stray Voltage: Test all wires and cables (as outlined below) with the Fluke 87 Multimeter.

Red Conductor to Black Conductor: _____ AC Volts
 Red Conductor to Black Conductor: _____ DC Volts

-
- c. Capacitance: Test all wires and cables (as outlined below) with the Fluke 86 Multimeter.

Red Conductor to Black Conductor: _____ μF

Red Conductor to Shield: _____ μF

Black Conductor to Shield: _____ μF

- d. Resistance: Test all wires and cables (as outlined below) with the Fluke 87 Multimeter.

Red Conductor to Black Conductor: _____ Ohms

- e. After all test result reports have been approved by the Engineer, remove temporary test connections and connect all wiring as shown on the Contract Drawings.

END OF SECTION

SECTION 16910

**FIRE ALARM ALD LOOP
FIELD TESTING OF WIRING**

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 an outline of the test method to be used to the Engineer for approval.
- B. Submit all test results on the following Speaker Test Result Report, Strobe Test Result Report and ALD Loop Test Results Report forms.

END OF SECTION

DIVISION 16**SECTION 16998****MEDIUM VOLTAGE SYSTEM COMMISSIONING TESTS****PART 1. GENERAL****1.01 SUMMARY**

This Section specifies the tests required for commissioning the medium voltage equipment shown on the Contract Drawings. These tests are to be performed in addition to the specified tests outlined in other sections of these Specifications.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

National Electrical Manufacturers Association (NEMA) Standard
National Electrical Testing Association (NETA) "Acceptance Testing Specifications for
Electrical power Distribution Equipment and Systems", also Called - NETA ATS.

American National Standards Institute (ANSI)

Occupational Safety and Hazard Administration (OSHA) Safety Rules

Port Authority High Tension Safety Rules

American Society of Testing and Materials (ASTM)

- | | |
|-----------|--|
| ASTM D877 | Test method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes. |
| ASTM D923 | Method for Sampling Electrical Insulating Liquids |
| ASTM D924 | Test Method for AC Loss Characteristics and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids |

1.03 QUALITY ASSURANCE

- A. The Contractor shall secure the services of qualified personnel to perform inspection and testing. The required qualifications include, but are not limited to a minimum of five years experience in testing of this type.
- B. The Authority reserves the right to interview the actual personnel who will be assigned to perform the tests. The test personnel will be questioned to ascertain the level of experience attained. Only those personnel interviewed and authorized by the Authority may perform the testing.

If the finding of the panel selected by the Authority's Chief Electrical Engineer conducting the interview is that the personnel interviewed are not qualified, this shall be the cause for rejection.

1.04 SUBMITTALS

For Submittal Requirements, see Attachment "A".

PART 2. PRODUCTS

2.01 TESTING FIRMS

Subject to compliance with the requirements of this Section, provide the services of a Testing Firm selected from the list shown on the Contract Drawings or approved equal.

PART 3. EXECUTION (TESTS)

3.01 GENERAL

- A. In addition to the tests outlined in Section 3.02 hereunder, perform all tests recommended by the manufacturer in manufacturer's instructions, shop drawings, as described in various sections of these Specifications and as outlined on the Contract Drawings.
- B. All tests must be witnessed by the Engineer. A written notice, at least fourteen days prior to the tests shall be given to the Engineer.
- C. Test values shall be considered acceptable as specified by the manufacturer and approved by the Engineer.

3.02 ELECTRICAL TESTS

A. General

- 1. Prior to the energization of any medium voltage equipment, all tests outlined in 3.01 above, and those outlined below in accordance with NETA ATS, shall have been performed by the Contractor and approved by the Engineer.
- 2. No voltage other than Megger output shall be applied to control voltage transformers during the performance of any tests, so that no high voltage can be induced on the primary of these transformers or into the high voltage system.
- 3. All safety precautions shall be exercised per OSHA and Port Authority High Tension Safety Rules to avoid personal injury and damage to equipment under test.

B. Medium Voltage Switchgear

- 1. Perform the following tests on all the Current Transformers including those located within the ground and test device. Readings are to be taken at each protective relay to confirm wiring connections.
 - a. Ratio test at all the taps with full primary current injection
 - b. Polarity test with inductive kick method
 - c. Measure secondary winding resistance
 - d. Megger secondary winding at 1000VDC
 - e. Perform magnetization curve test to the saturation voltage. Plot the curve and verify with the Accuracy Class claimed by the manufacturer.

2. Perform the following tests on all the Voltage Transformers:
 - a. Ratio test.
 - b. Polarity test
 - c. Megger secondary winding at 500VDC.
 - d. Over Potential test at voltage recommended by the manufacturer.
3. Perform the following tests on all the switchgear bus sections:
 - a. All bus connections shall be inspected. Check for loose connections, missing or damaged components. Torque all connections and terminations to the manufacturer's specifications.
 - b. The switchgear bus shall be given a phase-to-phase and phase-to-ground Megger test at 1000VDC, with all the breakers open and all potential transformer fuses removed.
 - c. Perform phasing check to ensure proper bus phasing from each source.
 - d. Perform an overpotential test on each bus section in accordance with manufacturer's instructions.
4. Perform insulation resistance test on control wiring. (Do not perform this test on wiring connected to solid state components).
5. 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 and tripping function.
6. Perform current injection tests on the entire current circuit in each section of switchgear, including the ground and test device, to check in-zone and through-zone fault operation for differential protection.
7. Verify operation of the Directional Overcurrent relays to make sure that the relays trip only in the direction specified in the contract drawings.
8. Verify the proper output level and polarity at each transducer.
9. Confirm phasing receptacle connections by the battery pulse method from the primary of the voltage transformer.
10. Check all meters at mid-scale for accuracy. Verify multipliers.
11. All protective relays shall be tripped (either manually or electrically) to determine whether the proper breaker has functioned as intended and any device or devices (including alarm, horns) have also operated correctly.
12. Clean, calibrate and test all protective relays. All relay settings shall be in accordance with the values furnished and/or approved by the Engineer and/or the Authority.
13. Voltmeters shall be checked against potential transformer ratios. Pointers shall be set on zero scale. With no voltage, voltmeter reading shall be checked with test-voltmeter after energizing.
14. Watt meters and watt-hour meters shall be checked for proper current and potential transformer ratios. Pointers shall be set on zero scale with no load and energized to check for proper rotation of meter.

15. All test results shall be in accordance with the requirements of all applicable test standards.
16. All switchgear shall be given operational tests. This shall include mechanical operation as well as operation by control circuit relays and tripping devices. Operating voltage at closing and tripping coils shall be checked to determine that voltage is of proper value.
17. The Contractor shall adjust and set all overcurrent trip devices, shunt trip devices and alarm devices in accordance with values furnished by Engineer.

C. Medium Voltage Circuit Breakers And Ground & Test Devices

The following tests shall be performed on the Medium Voltage Circuit Breakers and Ground & Test Devices. The term "Breaker" in the following tests represents Medium Voltage Circuit Breakers and Ground & Test Devices.

1. Measure contact resistance by a Digital Low Resistance Ohmmeter (DLRO). Any contact resistance over 100 micro-ohms should be investigated and remedial action shall be performed.
2. Perform minimum pick-up voltage tests on the trip and close coils.
3. Each Breaker shall be given a Megger test in the racked-out and closed position. A 1000-Volt, motor-driven Megger shall be used. Megger tests shall be applied between each phase to ground, between phases and between Line and Load sides. All test readings shall be recorded.
4. Perform an Overpotential Test, at a voltage recommended by the Breaker manufacturer, in the closed position. Test each phase to ground with all other phases grounded and across open contacts of each phase.
5. Perform insulation resistance test at 1000 volts DC on the Breaker control wiring. (Do not perform the test on wiring connected to solid state components).
6. With the Breaker in the test position, perform the following tests:
 - a. Trip and Close the Breaker with the control switch at least ten (10) times. All indication lights, annunciations, alarms and targets shall be observed to determine correct operation. The Breaker mechanism shall be observed for correct alignment, freedom of binding and good contact.
 - b. Trip each Breaker by manually operating each of its protective relays.
 - c. Test the Breaker antipump circuit as recommended by the manufacturer.
7. All Breakers shall be operated through at least three (3) Open-Close cycles in the Racked-in position by manual operation and via control circuits, from each control point. All indication lights, annunciations, alarms and targets shall be observed to determine correct operation. The Breaker mechanism shall be observed for correct alignment, freedom of binding and good contact.

D. Medium Voltage Liquid Filled Transformers

1. Perform insulation power factor test and excitation current test using the test procedures outlined by Doble Engineering or approved equal. Furnish values of the Power Factor, Capacitance, Excitation Current and Watt Loss.

2. Perform overpotential test in accordance with the applicable ANSI and NEMA standards.
 3. Insulating liquid shall be sampled in accordance with ASTM D-923. Sample shall be laboratory tested for:
 - a. Dielectric breakdown voltage
 - b. Acid neutralization number
 - c. Specific gravity
 - d. Interfacial tension
 - e. Color
 - f. Visual condition
 - g. Water content in PPM
 - h. PCB content
 4. Perform ratio, polarity, insulation resistance and magnetization curve tests on the bushing current transformers.
 5. Perform ratio, polarity and insulation resistance on any voltage transformers installed on the transformer.
 6. Check all the gauges and protective devices on the transformer for their intended functions.
 7. Record Nitrogen pressure and verify with the manufacturer's recommended pressure.
 8. Perform Turn-to-Turn ratio test on all the taps of the transformer.
 9. Check the operation of the automatic tap changer.
 10. Verify the terminal markings with the nameplate and the applicable ANSI standard.
- E. Medium Voltage Disconnect Switches
1. Measure contact resistance with a Digital Low Resistance Ohmmeter. If the contact resistance is above 100 micro ohms, repeat the test after cleaning and re-adjusting the contacts.
 2. Apply overpotential between each phase and ground with the switch in the closed position. The remaining two phases should be connected to ground while testing the third phase. Test across open contacts of each phase.
 3. Apply overpotential between phases and between line and load sides of the switch with the switch in the OPEN position.
 4. Operate the switch at least ten (10) times to check its mechanical operation.
 5. Check the mechanical, electrical and key interlocking features between the subject disconnect switch, grounding switch and any upstream and downstream circuit breakers or disconnect switches.
 6. Verify the fuse size and rating as per specifications and Contract Drawings.
 7. Check the operation and intended purpose of the Blown Fuse Indicator.
 8. Check the fuse for continuity and damage and check the fuse holder for adequate mechanical support for each fuse.

9. Check blade alignment and arc interrupter operation

F. Medium Voltage Dry Type Transformers

1. Perform insulation power factor test, following the procedures outlined by the Doble Engineering or approved equal. Furnish readings of the Insulation Power Factor, Capacitance, Excitation Current and Watt Loss.
2. Perform over potential test as approved by the manufacturer. Measure insulation resistance at intervals of 30 seconds, 1 minute and 10 minutes. Calculate Dielectric Absorption Ratio and Polarization Index.
3. Perform turn ratio test between windings at each available tap.
4. Verify the terminal markings with the nameplate and applicable ANSI standards.
5. Test the lightning arrestors
6. Measure core to ground resistance
7. Check the operation of the cooling fans.
8. Check the temperature control unit and set the unit for the operation of fans, initiation of alarms and trip functions. Verify each control function.
9. Check the ratio, polarity, insulation resistance and magnetization curves any current transformers installed inside or outside the transformer enclosure.
10. Check the ratio, polarity and insulation resistance of any voltage transformers installed inside or outside the transformer enclosure.
11. Perform winding resistance test for each winding at as found tap position.

G. Medium Voltage Insulated Power Cables

1. All medium voltage cables should be Hi-Potential tested by the following the method outlined herein at a voltage recommended by the manufacturer. It should be noted that these tests shall be performed with all safety precautions and proper preparation of the cable ends.

"Each phase conductor of the cable shall be subjected to the Hi-Potential test to ground with the other two phases grounded together with the ground shields. Applied potential shall be increased in steps of 5KV by holding the voltage for one minute at each step. At the end of each minute, leakage current shall be recorded.

After reaching the intended voltage level, the voltage shall be held for at least ten minutes and the leakage current shall be recorded at the end of each minute." If the test indicates excessive leakage current, discontinue the test and notify the Engineer. Discharge each cable of the capacitive charge by grounding the cable till the cable is completely discharged and remains discharged.

2. Check continuity of the cable shield and measure its resistance for the entire length of the cable.

END OF SECTION

SECTION 16998

MEDIUM VOLTAGE SYSTEMS COMMISSIONING TESTS

APPENDIX "A"

SUBMITTAL REQUIREMENTS

- A. Submit the name of the NETA Certified proposed testing firm with the following information accompanied:
1. Company resume.
 2. List of references.
 3. List of testing work completed of similar magnitude.
 4. Number of permanent employees with their employment duration.
 5. List of test equipment owned or leased with their valid calibration certificates.
- B. Submit a list of the proposed personnel with their resumes who shall perform the testing prior to the interview.
- C. Submit a sample of test forms to be used for the testing for Engineer's approval. If not approved by the Engineer, the testing firm shall resubmit the forms, with the changes, for the Engineer's approval.
- D. Submit test procedures, with sketches to illustrate how the test equipment will be connected to the equipment to be tested, for Engineer's approval. If not approved by the Engineer, the testing firm shall resubmit the test procedures, with the changes, for the Engineer's approval.
- E. Once all of the above items A-D have been satisfied, the testing firm shall submit a schedule indicating when the tests shall be performed.
- F. After the testing has been completed, submit three (3) copies of the test report for each unit within 15 calendar days of the completed testing to the Engineer for review. All test results and values shall be recorded on the forms approved by the Engineer.

The test sheet shall have all technical characteristics of the unit and all identification data including feeder name, building, substation, location, nameplate information, test date and name of tester. "As found" and "As left" relay settings shall be documented. All discrepancies encountered shall be itemized and clearly described on the test sheet. All tabulations of the test data shall be in the Microsoft Excel format and shall be supplied on a disk as well as two bound hard copies.

A report for each substation shall be provided indicating number of units tested, number of units not available to be tested, discrepancies found and cross references for more information to the specific test sheet. A summary of all reports along with the testing firm's recommendation shall be submitted.

END OF APPENDIX "A"

PERMITS

State of New Jersey

Department of Environmental Protection

Air Quality Permitting

General Permit

Site Remediation Activities for Gasoline Contamination at Vehicle Fueling Stations

This General Permit allows for the construction, installation, reconstruction, modification and operation of one or more of the following types of remediation systems at the specified location:

1. Soil Vapor Extraction without Air Sparging;
 2. Air Sparging with simultaneous Soil Vapor Extraction;
 3. Groundwater Air Stripping.
- This General Permit will allow the remediation of subsurface gasoline contamination at:
 - vehicle fueling stations, including current or former retail gasoline stations,
 - vehicle fueling activities located at municipal, county and state garages, fire and police departments, and
 - similar vehicle fueling activities located at commercial and industrial sites.
 - An adjacent property, provided the remediation activities are related to and conducted concurrent with remediation activities at an approved site.

The control apparatus that may be used under this General Permit to reduce air emissions of offgases during site remediation activities are limited to a:

- Thermal Oxidizer,
- Catalytic Oxidizer, or
- Carbon adsorption system consisting of a minimum of two carbon beds connected in series, or
- Stationary Internal Combustion Engine (SICE) controlled utilizing a three way catalyst.

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PAGE
NOT USED

This General Permit allows the replacement of one type of remediation system and/or control apparatus with another system throughout the duration of the project as long as the equipment complies with the applicable requirements of this General Permit. This General Permit can also be used to conduct a pilot test at vehicle fueling station sites in accordance with N.J.A.C. 7:27-8.9 provided an approved control apparatus is used.

I. DEFINITIONS

The terms used in this General Permit shall have the meanings given to them in N.J.A.C. 7:27-8 and/or N.J.A.C. 7:27-22, except as listed below:

- **Air Sparging** means a site remediation system where air or oxygen is injected into the soil or groundwater to enhance mass transfer of the contaminants from the soil or groundwater into the injected air or oxygen.
- **Off-gas Control Apparatus** means a pollution control device used to reduce emissions of VOCs before discharge to the atmosphere by treatment of the off-gases produced as a result of site remediation activity.
- **Soil Vapor Extraction** means a site remediation activity where soil gases (and contaminants) are removed from the unsaturated soil zone using a vacuum system.
- **Groundwater Air Stripping** means a site remediation activity, where VOC contaminated groundwater is pumped to a vessel where the VOC contaminants are removed by contact with an air stream and the off-gases discharged to the atmosphere.
- **Vehicle Fueling Station** means current or former retail gasoline stations, vehicle fueling operations at municipal, county and state garages, fire and police departments, and similar vehicle fueling activities located at commercial and industrial sites. The site remediation activities covered under this General Permit are solely for contamination due to gasoline discharges. It does not include site remediation activities being conducted at bulk fuel terminals, petroleum refineries, or chemical manufacturing sites (SIC codes 5171, 2911, or 2800 - 2899, or equivalent industry classification codes).
- **Stationary Internal Combustion Engine (SICE)** means an internal combustion engine that is not self propelled.

II. AUTHORITY

This General Permit is issued under the authority N.J.S.A 26:2C-9.2. This General Permit shall allow for inspection and evaluation to assure conformance with all provisions of N.J.A.C. 7:27 et seq. An opportunity for public comment on this General Permit was provided on April 1, 2002.

III. APPLICABILITY:

This General Permit allows for the construction, installation, reconstruction, modification and operation of one or more of the following types of remediation systems at the specified location:

1. Soil Vapor Extraction Equipment operating without Air Sparging Equipment;
2. Soil Vapor Extraction Equipment operating simultaneously with Air Sparging Equipment;
3. Groundwater Air Stripping.

This General Permit will allow the remediation of subsurface gasoline contamination at vehicle fueling stations, including current or former retail gasoline stations, vehicle fueling activities located at municipal, county and state garages, fire and police departments, and similar vehicle fueling activities located at commercial and industrial sites. Remediation activities conducted at an adjacent property may be included under this General Permit as long as the activities are related to, and are conducted concurrent with, remediation activities at a vehicle fueling station covered by this General Permit and utilize an approved off-gas control apparatus.

The site remediation activities covered under this General Permit are solely for contamination due to gasoline discharges. It does not include site remediation activities being conducted at bulk fuel terminals, petroleum refineries, or chemical manufacturing sites.

This General Permit can also be used to conduct a pilot test at vehicle fueling station sites in accordance with N.J.A.C. 7:27-8.9 as long as an approved off-gas control apparatus is used.

The off-gas control apparatus that may be used under this General Permit to reduce air emissions of off-gases during site remediation activities are limited to a thermal oxidizer, catalytic oxidizer, carbon adsorption system consisting of a minimum of two carbon beds connected in series or a stationary internal combustion engine (SICE) controlled utilizing a three way catalyst.

This General Permit allows the replacement of one type of remediation system and/or control apparatus with another system throughout the duration of the project as long as each complies with the applicable requirements of this General Permit. This provision permits the Permit Applicant to use the remediation systems and/or control devices that are the most suitable for the kind and amounts of air contaminants being emitted during the cleanup activity.

IV. EXCLUSIONS

This General Permit cannot be used for:

1. Site remediation activities at sites other than Vehicle Fueling Stations, as defined above.
2. Site remediation activities at a bulk terminal, petroleum refinery, or chemical manufacturing site (SIC codes 5171, 2911, or 2800 - 2899, or equivalent).
3. Site remediation activities at a major facility which has an approved Subchapter 22 Operating Permit.
4. Site remediation activities for contaminants other than those resulting from a gasoline discharge. For example, cleanups involving chlorinated organic compounds, such as 1,1,1, trichloroethane (TCA), trichloroethylene (TCE), perchloroethylene, and other chlorinated degreasing solvents would not be covered by this General Permit.
5. Site remediation activities that do not utilize an off-gas control apparatus,
6. Site remediation activities (including pilot tests) that use an off-gas control apparatus other than a thermal oxidizer, catalytic oxidizer, carbon adsorption system (a minimum of two beds in series) or a stationary internal combustion engine (SICE) controlled utilizing a three way catalyst.
7. Site Remediation activities involving Air Sparging Equipment without the simultaneous operation of Soil Vapor Extraction Equipment consistent with the attached compliance plan.

V. COMPLIANCE PLAN:

Each piece of site remediation equipment, and associated control device, covered by this General Permit is subject to the following applicable requirements.

(Note: This General Permit does not include requirements of the Bureau of Underground Storage Tanks (BUST) or any other site remediation requirements. The Permittee should contact the BUST [609 292-8761] for information regarding other NJDEP requirements)

COMPLIANCE PLAN: Site Remediation Activities at Vehicle Fueling Stations

No.	Applicable Requirement (State & Federal Requirement unless otherwise indicated)	Monitoring Requirement	Recordkeeping Requirement	Submittal / Action
1.	The owner/operator (Permittee) shall notify the appropriate Air Regional Field Office (RFO) in writing at least seven days prior to starting remediation activities. The Permittee shall notify the RFO within thirty days of completion of the project. [N.J.A.C. 7:27-8.13(a)]	None	The Permittee shall maintain copies of notifications available for NJDEP inspection upon request for five years. [N.J.A.C 7:27-8.13(d)3]	The Permittee shall notify the Air Regional Field Office in writing at least seven days prior to starting remediation and within thirty days of completion of the project. [N.J.A.C 7:27-8.13(d)4]
2.	The owner/operator shall post the name of the contact person and responsible person, together with address and phone number, on a permanent, legible sign in a conspicuous location on the work site, prior to beginning the work (not including pilot tests) to be performed in accordance with the permit. [N.J.A.C. 7:27-8.13(a)]	None	None	The Permittee shall report any non-compliance within three working days after the event in writing to the Air Regional Enforcement Office. [N.J.A.C 7:27-8.13(d)4]
3.	No person shall cause, suffer, allow or permit particles to be emitted from any stack or chimney into the outdoor air the shade or appearance of which is greater than or equal to 20 percent opacity, exclusive of condensed water vapor, except for a period of not longer than three minutes in any consecutive 30-minute period. [N.J.A.C. 7:27-6.2(d)] & [N.J.A.C. 7:27-6.2(e)]	Monitored by visual determination monthly based on an instantaneous determination. For compliance with the opacity standard, the Permittee shall conduct visual opacity inspections during daylight hours. Visual inspections shall consist of a visual survey to identify if the stack has visible emissions. If visible emissions are observed, the Permittee shall perform a check via a certified opacity reader, in accordance with N.J.A.C. 7:27B-2. If visible emissions greater than the prescribed standard are observed, the Permittee shall perform a check via a certified opacity reader, in accordance with N.J.A.C. 7:27B-2 each day until	Recordkeeping by manually logging parameter monthly and retain the following records: (1) Date and time of inspection; (2) Emission Point number; (3) Operational status of equipment; (4) N.J.A.C. 7:27B-2 observed results and conclusions; (5) Description of corrective action taken if needed; 1. Date and time opacity problem was solved, if applicable; 2. Name of person(s) conducting inspection.	Notify by phone: Upon occurrence of visible emissions, the Permittee shall notify the Department immediately of the event. Such notification shall be made by calling the Environmental Action Hotline at (877) 927-6337 [N.J.A.C. 7:27-8.13(d)]

No.	Applicable Requirement (State & Federal Requirement unless otherwise indicated)	Monitoring Requirement	Recordkeeping Requirement	Submittal / Action
		corrective actions taken result in opacity readings below the prescribed standard. [N.J.A.C. 7:27-8.13(d)]	[N.J.A.C. 7:27-8.13(d)]	
4.	This equipment shall not cause any air contaminant, including an air contaminant detectable by the sense of smell, to be present in the outdoor atmosphere in such quantity and duration which is, or tends to be, injurious to human health or welfare, animal or plant life or property, or would unreasonably interfere with the enjoyment of life or property, except in areas over which the owner or operator has exclusive use or occupancy. [N.J.A.C 7:27-5]	None	The Permittee shall record in either a permanent bound log book or in readily accessible computer memory, instances (date and time) when the operation of equipment has the potential to cause off-property effects. All records must be available for NJDEP inspection upon request for the duration of the site remediation project, plus 5 years. <i>(Note: This General Permit does not include requirements of the Bureau of Underground Storage Tanks (BUST) or other site remediation requirements. The Permittee should contact BUST at (609) 292-8761 for information regarding their requirements.)</i> [N.J.A.C 7:27-8.13(d)3]	Any operation of the equipment which may cause a release of air contaminants in a quantity or concentration which poses a potential threat to public health, welfare, or the environment or which might reasonably result in citizen complaints shall be reported by the Permittee as required by the Air Pollution Control Act. The Permittee shall immediately notify the Department of any non-compliance by calling the Environmental Action Hotline at 1-877-927-6337 [N.J.S.A 26:2C-19(e)]
5.	Stack Height above ground greater than or equal to 20 ft. [N.J.A.C. 7:27-8.13(d) 2ii]	None	None	None
6.	All components connected or attached to, or serving the equipment or control apparatus must be functioning properly and must be used in accordance with all conditions and provisions of this permit. [N.J.A.C. 7:27-8.3(e)]	None	None	None
7.	The Permittee will be allowed to switch the control apparatus throughout the duration of	None	The Permittee shall maintain records of all equipment and control	None

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No.	Applicable Requirement (State & Federal Requirement unless otherwise indicated)	Monitoring Requirement	Recordkeeping Requirement	Submittal / Action
	the project as long as they meet the requirements of this General Permit. [N.J.A.C. 7:27-8.13(a)]		apparatus used and make these available for NJDEP inspection upon request. The Permittee shall record the date and time when the equipment or control apparatus is changed. Records shall be kept for the duration of the site remediation project, plus 5 years. [N.J.A.C. 7:27-8.13(d)3]	
1235	8. Sources Using Air Sparging are Subject to Items 8 through 11 The ratio of the Soil Vapor Extraction rate to the Air Sparging rate shall be at least three to one (3:1) at all times during operation. [N.J.A.C. 7:27-8.13(a)]	The Permittee shall monitor the ratio of the SVE rate to the AS rate, by using the flow rates as measured in accordance with Facility Specific Requirements References Numbers 10 and 11 at the following frequency: once within the first seven operating days after implementation of air sparging and quarterly thereafter. [N.J.A.C. 7:27-8.13(d)2]	The Permittee shall record the Soil Vapor Extraction and Air Sparging flow-rates at the time of the measurements. The SVE/AS ratio shall then be calculated and recorded in a permanent bound logbook or in readily accessible computer memory. The records shall be available for NJDEP inspection upon request for the duration of the site remediation project, plus 5 years. [N.J.A.C. 7:27-8.13(d)3]	The Permittee shall report any non-compliance within three working days after the event in writing to the Air Regional Enforcement Office. [N.J.A.C. 7:27-8.13(d)4]
9.	The Permittee shall air sparge at a minimum depth of 10 feet below the ground surface. [N.J.A.C. 7:27-8.13(a)]	The Permittee shall monitor the depth of the air sparging wells upon request of the Department. This may be monitored with the use of well permits and well logs. [N.J.A.C. 7:27-8.13(d)2]	The Permittee shall maintain documentation of construction records for each air sparging well and make them available for NJDEP inspection for the duration of the site remediation project, plus 5 years. [N.J.A.C. 7:27-8.13(d)3]	
10.	The maximum Soil Vapor Extraction rate shall be 500 Actual Cubic Feet per Minute (ACFM). [N.J.A.C. 7:27-8.13(a)]	The Permittee shall monitor the Soil Vapor Extraction rate using flow meters or equipment settings. The Permittee shall install, calibrate and maintain the monitors in accordance with the	The Permittee shall record the Soil Vapor Extraction rate at the time of the measurements in a permanent bound logbook or in readily accessible computer memory. The	The Permittee shall report any non-compliance within three working days after the event in writing to the Air Regional Enforcement Office. [N.J.A.C. 7:27-8.13(d)4]

No.	Applicable Requirement (State & Federal Requirement unless otherwise indicated)	Monitoring Requirement	Recordkeeping Requirement	Submission / Action
		<p>manufacturer's specifications. The monitoring frequency shall be as follows: once within the first seven operating days after implementation of air sparging and quarterly thereafter.</p> <p>[N.J.A.C. 7:27-8.13(d)2]</p>	<p>records shall be available for NJDEP inspection upon request for the duration of the site remediation project, plus 5 years.</p> <p>[N.J.A.C. 7:27-8.13(d)3]</p>	
1236	<p>11. The maximum Air Sparging rate shall be 166 Actual Cubic Feet per Minute (ACFM)</p> <p>[N.J.A.C. 7:27-8.13(a)]</p>	<p>The Permittee shall monitor the Air Sparging rate using flow meters or equipment settings. The Permittee shall install, calibrate and maintain the monitors in accordance with the manufacturer's specifications. The monitoring frequency shall be as follows: once within the first seven operating days after implementation of air sparging and quarterly thereafter.</p> <p>[N.J.A.C. 7:27-8.13(d)2]</p>	<p>The Permittee shall record the Air Sparging rate at the time of the measurements in a permanent bound logbook or in readily accessible computer memory. The records shall be available for NJDEP inspection upon request for the duration of the site remediation project, plus 5 years.</p> <p>[N.J.A.C. 7:27-8.13(d)3]</p>	<p>The Permittee shall report any non-compliance within three working days after the event in writing to the Air Regional Enforcement Office.</p> <p>[N.J.A.C. 7:27-8.13(d)4]</p>
	<p>12. <u>Sources using Thermal Oxidizers are Subject to Items 12 through 14.</u></p> <p>The Equipment shall operate at either a minimum temperature of:</p> <ul style="list-style-type: none"> ➤ 1500°F with a minimum residence time of 0.5 seconds, or ➤ 1400°F with a minimum residence time of 1.0 seconds. <p>The minimum operating temperature shall be attained prior to start-up of the source equipment, with an automatic shutoff system designed to inactivate the source equipment when an outlet temperature less than the minimum permitted value is detected at any time.</p>	<p>A temperature sensor shall be installed and operated to measure continuously monitor the temperature at the outlet of the Thermal Oxidizer. This sensor shall be operated in accordance with the manufacturer's specifications and shall be located in such manner that allows easy access and visibility. The sensor shall be properly shielded from direct contact with and radiation by the flame. Flame must not be visible from the point of view of the thermocouple.</p> <p>[N.J.A.C. 7:27-8.13(d)2]</p>	<p>The Permittee shall record operating temperature measurements at the exit of the combustion chamber on a continuous basis by installing and operating a continuous temperature recorder.</p> <p>Records shall be kept for the duration of the site remediation project, plus 5 years.</p> <p>[N.J.A.C. 7:27-8.13(d)3]</p>	<p>The Permittee shall report any non-compliance within three working days after the event in writing to the Air Regional Enforcement Office.</p> <p>[N.J.A.C. 7:27-8.13(d)4]</p>

No.	Applicable Requirement (State & Federal Requirement unless otherwise indicated)	Monitoring Requirement	Recordkeeping Requirement	Submittal / Action
	[N.J.A.C. 7:27-8.13(a)]			
13.	<p>The Thermal Oxidizers shall be designed to operate at a minimum destruction and removal efficiency of 99% VOCs.</p> <p>[N.J.A.C. 7:27-8.13(a)]</p>	None	<p>The Permittee shall retain on-site the manufacturer's specifications for the control apparatus and make these available for NJDEP inspection upon request. Records shall be kept for the duration of the site remediation project, plus 5 years.</p> <p>[N.J.A.C. 7:27-8.13(d)3]</p>	None
4. 1037	<p>The Permittee shall maintain the Thermal Oxidizer per the manufacturer's recommendations.</p> <p>[N.J.A.C. 7:27-8.13(a)]</p>	None	<p>The Permittee shall retain the manufacturer's specifications for the control apparatus and make these available for NJDEP inspection upon request. Records shall be kept for the duration of the site remediation project, plus 5 years.</p> <p>[N.J.A.C. 7:27-8.13(d)3]</p>	None
15.	<p><u>Sources using Catalytic Oxidizers are Subject to Items 15 through 17.</u></p> <p>The equipment shall attain the minimum operating temperature as set by the manufacturer or 500 °F, whichever is greater.</p> <p>The minimum operating temperature shall be attained prior to start-up of the source equipment, with an automatic shutoff system designed to inactivate the source equipment when the inlet temperature is less than the minimum operating temperature.</p> <p>[N.J.A.C. 7:27-8.13(a)]</p>	<p>A temperature sensor shall be installed and operated to continuously monitor temperature at the inlet of the Catalyst. This sensor shall be operated in accordance with the manufacturer's specifications.</p> <p>[N.J.A.C. 7:27-8.13(d)2]</p>	<p>The Permittee shall record operating temperature measurements prior to the catalyst in the combustion chamber on a continuous basis by installing and operating a continuous temperature recorder. Records shall be kept for a period of five years.</p> <p>[N.J.A.C. 7:27-8.13(d)3]</p>	<p>The Permittee shall report any non-compliance within three working days after the event in writing to the <u>Air</u> Regional Enforcement Office.</p> <p>[N.J.A.C 7:27-8.13(d)4]</p>

No.	Applicable Requirement (State & Federal Requirement unless otherwise indicated)	Monitoring Requirement	Recordkeeping Requirement	Submittal / Action
16.	<p>The Catalytic Oxidizers shall be designed to operate at a minimum destruction and removal efficiency of 99% VOCs.</p> <p>[N.J.A.C. 7:27-8.13(a)]</p>	None	<p>The Permittee shall retain the manufacturer's specifications for the control apparatus and make these available for NJDEP inspection upon request. Records shall be kept for the life of the duration of the site remediation project apparatus, plus 5 years.</p> <p>[N.J.A.C. 7:27-8.13(d)3]</p>	None
17.	<p>The Permittee shall maintain the Catalytic Oxidizer per the manufacturer's directions.</p> <p>[N.J.A.C. 7:27-8.13(a)]</p>	None	<p>The Permittee shall retain the manufacturer's specifications for the control apparatus and make these available for NJDEP inspection upon request. Records shall be kept for the duration of the site remediation project, plus 5 years.</p> <p>[N.J.A.C. 7:27-8.13(d)3]</p>	None
18.	<p><u>Sources using Carbon Adsorption are Subject to Items 18 through 20.</u></p> <p>The adsorption unit shall consist of a minimum of at least two or more carbon canisters in series.</p> <p>When breakthrough is determined based on the weight of the primary canister(s) or the concentration of the vapor stream leaving the primary carbon canister(s), the following action must be taken.</p> <p>The primary carbon canister(s) (closest to the equipment off-gas) shall be replaced with the</p>	<p>The Permittee shall monitor the carbon adsorption system at a frequency that is less than the estimated time for breakthrough or at least quarterly. Either one of the following methods shall be used for breakthrough monitoring.</p> <p>1. Monitor the weight of the primary carbon canister(s) using a weight scale. When the weight of the primary canister(s) is equal to 80% or greater of the weight at saturation as provided by the manufacturer, the primary</p>	<p>The Permittee must maintain records of the estimated breakthrough time, the dates of testing and measurements obtained and make these available for NJDEP inspection upon request until project completion, plus 5 years.</p> <p><u>For sources using a weight scale:</u></p> <p>Record the date, time and weight of the carbon canister(s) ,when the primary adsorption unit is changed and make these available for NJDEP inspection upon request until project</p>	<p>The Permittee shall report any non-compliance within three working days after the event in writing to the Air Regional Enforcement Office.</p> <p>[N.J.A.C 7:27-8.13(d)4]</p>

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No.	Applicable Requirement (State & Federal Requirement unless otherwise indicated)	Monitoring Requirement	Recordkeeping Requirement	Submittal / Action
1239	<p>secondary unit and the secondary unit replaced with fresh or newly regenerated carbon canister.</p> <p>The estimated time for breakthrough shall be calculated based on the amount of carbon in the primary canister(s), the maximum VOC concentration of off-gases measured at the inlet to the carbon adsorption beds, and the specifications of the manufacturer.</p> <p>[N.J.A.C. 7:27-8.13(a)]</p>	<p>canister(s) is replaced by the secondary canister and a fresh or newly regenerated carbon canister is installed as the secondary, or</p> <p>2. Monitor the concentration of VOCs in the off-gases at the inlet to the carbon adsorption system, exiting the primary carbon canister(s) using a properly calibrated portable field instrument (OVA or PID) with a range of 0 to 1000 parts per million by volume (ppmv) with an accuracy of $\pm 10\%$ as detailed on pages 213 – 227 of the Department's <u>Field Sampling Procedures Manual</u> dated May 1992.</p> <p>The breakthrough point is reached when the concentration of the gases exiting the primary carbon canister(s) exceeds 10 % of the inlet concentration of carbon adsorption system or 10 ppmv, whichever is greater.</p> <p>[N.J.A.C. 7:27-8.13(d)1]</p>	<p>completion, plus 5 years.</p> <p><u>For sources using a portable field instrument:</u></p> <p>Record the VOC concentration measured at the inlet and outlet of the primary carbon canister(s), and in the discharge stack using a calibrated portable field instrument and make these available for NJDEP inspection upon request until project completion, plus 5 years.</p> <p>Record calibration results in accordance with manufacturer's procedures and make these available for NJDEP inspection upon request until project completion, plus 5 years.</p> <p>[N.J.A.C. 7:27-8.13(d)3]</p>	
19.	<p>The Carbon Adsorption system shall be designed to operate at a minimum destruction and removal efficiency of 99% VOCs.</p> <p>[N.J.A.C. 7:27-8.13(a)]</p>	None	<p>The Permittee shall retain the manufacturer's directions for the control apparatus and make these available for NJDEP inspection upon request. Records shall be kept for the duration of the site remediation project, plus 5 years.</p> <p>[N.J.A.C. 7:27-8.13(d)3]</p>	None
20.	<p>The Permittee shall maintain the Carbon Adsorption system per the manufacturer's recommendations.</p> <p>[N.J.A.C. 7:27-8.13(a)]</p>	None	<p>The Permittee shall retain the manufacturer's specifications for the control apparatus and make these available for NJDEP inspection upon request.</p>	None

No.	Applicable Requirement (State & Federal Requirement unless otherwise indicated)	Monitoring Requirement	Recordkeeping Requirement	Submittal / Action
			Records shall be kept for the duration of the site remediation project, plus 5 years, in a permanent bound logbook. [N.J.A.C. 7:27-8.13(d)3]	
21.	Sources using a SICE are Subject to Items 21 through 27. The SICE shall be equipped with a 3-way catalyst capable of achieving a minimum control efficiency of 90 % for Total Hydrocarbons and Carbon Monoxide and 75 % for Nitrogen Oxides. [N.J.A.C. 7:27-8.13(a)]	None	The Permittee shall retain the manufacturer's specifications for the control apparatus and make these available for NJDEP inspection upon request. Records shall be kept for the duration of the site remediation project, plus 5 years, in a permanent bound logbook. [N.J.A.C. 7:27-8.13(d)3]	None
22.	The Permittee shall maintain the SICE and maintain and replace the 3-way catalyst as per the manufacturer's specifications or after a minimum of 4,000 hours of operation, whichever comes first. [N.J.A.C. 7:27-8.13(a)]	An hour meter shall be installed and operated to monitor the daily hours of operation. This sensors shall be installed and shall be located in such manner that allows easy access and visibility. [N.J.A.C. 7:27-8.13(d)2]	The Permittee shall retain the manufacturer's maintenance schedules for the SICE and the 3-way catalyst. Also, the hours of operation shall be recorded for the 3-way catalyst. All records shall be made available for NJDEP inspection upon request for the duration of the site remediation project, plus 5 years. [N.J.A.C. 7:27-8.13(d)3]	None
23.	The distance from the SICE to the property line shall be greater than or equal to 20 ft. [N.J.A.C. 7:27-8.13(d) 2ii]	None	None	None
24.	The maximum vapor intake rate shall be 180 Standard Cubic Feet per Minute (SCFM). [N.J.A.C. 7:27-8.13(a)]	The Permittee shall continuously monitor the vapor intake rate using a flow meter. The Permittee shall install, calibrate and maintain the monitors in	The Permittee shall record the vapor intake in a readily accessible computer memory. The recordkeeping frequency shall be as	The Permittee shall report any non-compliance within three working days after the event in writing to the Air Regional Enforcement Office.

No.	Applicable Requirement (State & Federal Requirement unless otherwise indicated)	Monitoring Requirement	Recordkeeping Requirement	Submittal / Action
		<p>accordance with the manufacturer's specifications.</p> <p>[N.J.A.C. 7:27-8.13(d)2]</p>	<p>follows: Every 30 Minutes during operation. The records shall be available for NJDEP inspection upon request for the duration of the site remediation project, plus 5 years.</p> <p>[N.J.A.C. 7:27-8.13(d)3]</p>	[N.J.A.C 7:27-8.13(d)4]
25.	<p>The SICE shall only combust propane as an auxiliary fuel. No other gaseous or liquid commercial or non-commercial fuels shall be combusted as an auxiliary fuel.</p> <p>[N.J.A.C. 7:27-8.13(a)]</p>	None	None	None
26.	<p>The Permittee shall maintain a minimum temperature of 600 degrees Fahrenheit at the inlet of the 3-way catalyst and a minimum temperature increase across the 3-way catalyst of 25 degrees Fahrenheit, measured at the outlet of the 3-way catalyst.</p> <p>[N.J.A.C. 7:27-8.13(a)]</p>	<p>Temperature sensors shall be installed and operated to continuously monitor the temperature at the inlet and the outlet of the 3-way catalyst. These sensors shall be installed and operated in accordance with the manufacturer's specifications and shall be located in such manner that allows easy access and visibility.</p> <p>[N.J.A.C. 7:27-8.13(d)2]</p>	<p>The Permittee shall record the exhaust temperature measured at the outlet of the 3-way catalyst in a readily accessible computer memory. The recordkeeping frequency shall be as follows: Every 30 Minutes during operation. The records shall be available for NJDEP inspection upon request for the duration of the site remediation project, plus 5 years.</p> <p>[N.J.A.C. 7:27-8.13(d)3]</p>	None
27.	<p>The Permittee shall maintain the percent oxygen (O₂) level within a range of 0.2 to 1.0 % by volume, as measured at the outlet of the SICE.</p> <p>[N.J.A.C. 7:27-8.13(a)]</p>	<p>An oxygen sensor shall be installed and operated to continuously monitor the percent oxygen (O₂) at the outlet of the SICE. This sensor shall be installed and operated in accordance with the manufacturer's specifications and shall be located in such manner that allows easy access and visibility.</p> <p>[N.J.A.C. 7:27-8.13(d)2]</p>	<p>The Permittee shall record the percent oxygen measured at the outlet of the SICE in a readily accessible computer memory. The recordkeeping frequency shall be as follows: Every 30 Minutes during operation. The records shall be available for NJDEP inspection upon request for the duration of the site remediation project, plus 5 years.</p>	None

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No.	Applicable Requirement (State & Federal Requirement unless otherwise indicated)	Monitoring Requirement	Recordkeeping Requirement	Submittal / Action
			[N.J.A.C. 7:27-8.13(d)3]	

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HUDSON-ESSEX-PASSAIC SOIL CONSERVATION DISTRICT

15 BLOOMFIELD AVENUE
NORTH CALDWELL NJ 07006
Telephone: (973) 364-0785
Fax: (973) 364-0784

June 28, 2007

Mr. Matthew Masters
Port Authority of NY & NJ
2 Gateway Center, 14 Fl. SW
Newark, NJ 07102

SAMPLE

Re: Newark Airport Taxiways W & S Rehab.
Newark Liberty International Airport
Block 5094, Lot 1
HEP File#207-E-2987, Plan dated: 6/1/07

Dear Sir/Madam:

The District has completed the review of the soil erosion and sediment control plan for the above referenced project and hereby reports that the plan meets the Standards for Soil Erosion and Sediment Control in New Jersey (N.J.A.C.290-1.1 et seq., promulgated pursuant to the New Jersey Soil Erosion and Sediment Control Act, J.I.S.A.4-24-39 et seq.). Accordingly, the plan has been certified by the Hudson-Essex-Passaic Soil Conservation District subject to the following conditions:

- The District must be notified by mail 48 hours prior to the commencement of any of construction activity.
- A copy of the certified plan must be kept on the job site at all times.
- The applicant or contractor must request a final inspection (once landscaping and final soil stabilization is complete) prior to seeking a temporary or permanent Certificate of Occupancy.
- The District must be provided with written notification of any conveyance of this project, subject property, or portions thereof, including individual residential lots if applicable. Said notice must provide the names, addresses, and telephone numbers of subsequent owners.
- The District must be informed of address and or telephone number changes of owners, agents responsible for site construction, and job supervisors.

Please be advised that the Soil Erosion and Sediment Control Act authorizes the issuance of stop construction orders and penalties of up to \$3000 per day for violations of the certified plan or for failure to comply with the aforementioned requirements. Please be further advised that any conveyance of this project or portions thereof will transfer full responsibility for compliance with the certified plan to subsequent owners. Please contact the District if you require assistance implementing the certified soil erosion and sediment control plan. This certification is valid for 3-1/2 years and is limited to the controls specified in this plan. It is not authorized to engage in proposed land use unless such use has been previously approved by the municipality or other controlling agency.

Yours truly,

A handwritten signature in black ink, appearing to read "Carl Quazza".

Carl Quazza
Chairman

SAMPLE

AUTHORIZATION TO DISCHARGE STORMWATER



N.J. Department of Environmental Protection
Bureau of Nonpoint Pollution Control
in cooperation with the
N.J. Department of Agriculture
State Soil Conservation Committee
and Soil Conservation Districts



NJPDES General Permit No. NJG0088323
Stormwater Discharge Associated with Construction Activity

Ch. 251 App. No. 06-B8706 SCD RFA # 02-62-06-146

1. Project or Facility Name and Address (add State Plane Coordinates if available):
Construction of Taxiways N & C
Teterboro Airport
Teterboro, NJ

2. Permittee Name and Address:
Port Authority of NY & NJ
2 Gateway Center, 14th Fl. SW
Newark, NJ 07102

3. Owner Name and Address:
Port Authority of NY & NJ
2 Gateway Center, 14th Fl. SW
Newark, NJ 07102

4. Proposed Land Use (check the appropriate category(ies)):
(A) Residential Dwelling: Single Family Multi-Family
(B) Commercial Facility (C) Industrial Facility (D) Mining or Quarry
(E) Public School, Religious or Charitable Institution (F) Other (Specify) Airport

Effective Date 7/28/06 Expiration Date 1/28/10

Your Request for Authorization under NJPDES General Permit No. NJG0088323 has been certified in accordance with the provisions of N.J.A.C. 7:14A and the New Jersey Stormwater Permitting Program in coordination with the New Jersey Department of Agriculture, the State Soil Conservation Committee and the Soil Conservation District.

Barry Chalofsky
Barry Chalofsky, P.P., Chief
Bureau of Nonpoint Pollution Control
New Jersey Department of Environmental Protection

CERTIFIED BY:
Signature Date

Supervisor
Title

Bergen County
Soil Conservation District

FOR DISTRICT USE ONLY
NJ Natural Resources Conservation Program
Expiration of Authorization to Discharge Stormwater
Reason for Expiration:
Project Completed (Final Report of Compliance Issued)
Application Withdrawn by Applicant
Application Denied by District or SSCC
Project SESC Plan Certification Expired
Date of Expiration
Authorized by
District Official

SAMPLE



Passaic Valley
Sewerage Commissioners

IRENE G. ALMEIDA
CHAIRMAN

JAMES KRONE
VICE CHAIRMAN

FRANK J. CALANDRIELLO
DOMINIC W. CUCCINELLO
CARL S. CZAPLICKI, JR.
ANGELINA M. PASERCHIA
THOMAS J. POWELL
DONALD TUCKER
COMMISSIONERS

600 WILSON AVENUE
NEWARK, N.J. 07105
(973) 344-1800
FAX: (973) 344-2951
www.pvsc.com

ROBERT J. DAVENPORT
EXECUTIVE DIRECTOR

PETER G. SHERIDAN
CHIEF COUNSEL

LOUIS LANZILLO
CLERK

June 26, 2002

Mr. Francis J. Lombardi
The Port Authority of New York & New Jersey
2 Gateway Center, 14th Fl., SW
Newark, New Jersey 07102

**RE: Consent for Sewer Connection Project
The Port Authority of NY & NJ: A-2 Cooling Tower
Newark, New Jersey**

Dear Mr. Lombardi,

Enclosed is the endorsed SCC-97 form. If you have any questions, please call me at (973) 817-5922.

Very truly yours,

PASSAIC VALLEY SEWERAGE COMMISSIONERS

A handwritten signature in black ink, appearing to read "Angela Dees", written over a horizontal line.

Angela Dees
Senior Industrial Technician

Enclosure

SAMPLE

Form SCC-97 Rev. 5/97

PASSAIC VALLEY SEWERAGE COMMISSIONERS

CONSENT FOR SEWER CONNECTION PROJECT

1) Applicant:

Name: Port Authority of NY & NJ

Address: 2 Gateway Center, 14th Fl., SW Newark, NJ 07102

Contact: Francis J. Lombardi

Phone # 973-565-7522

2) Owner:

Name: Port Authority of NY & NJ

Address: 2 Gateway Center, 14th Fl., SW Newark, NJ 07102

Contact: Francis J. Lombardi

Phone# 973-565-7552

3) Description of Project:

Name: Port Authority of NY & NJ: A-2 Cooling Tower

Description: The project involves a 4-inch sanitary sewer line connecting to an existing on-site 6-inch sewer line to discharge cooling tower blow-down water.

Address: Newark International Airport (EWR)

Municipality: Newark

4) Projected Flow: 14,005 gallons per day.

5) Fee paid:

Administrative Fee:

\$250.00

Connected Flow Fee:

\$20,307.25

Total Paid:

\$20,558.25

6) PVSC Consent for Project:


Robert J. Davenport
Executive Director

6/34/02
Date



State of New Jersey

Department of Environmental Protection

James E. McGreevey
Governor

Bradley M. Campbell
Commissioner

Division of Remediation Management & Response
Northern Bureau of Field Operations
2 Babcock Place
West Orange, New Jersey 07052

The Port Authority of New York & New Jersey
Engineering Department
Two Gateway Center
Newark, New Jersey 07102
Attn: Marvin Kirshner, P.E.

SAMPLE

RE: On-Scene Coordinator Discharge Authorization
Liberty Newark International Airport
South Fuel Farm - Groundwater Remediation Project
Elizabeth, Union County
DRMR PI#159640

December 4, 2003

Dear Mr. Kirshner:

This authorization is to grant permission for an emergency discharge of treated ground water to the Newark Bay via the Peripheral Ditch at the referenced site. This authorization is granted pursuant to the authorities provided under the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq., On-Scene Coordinator (OSC) authorities pursuant to 40 CFR part 300, the National Oil and Hazardous Substance Pollution Contingency Plan and the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11 et seq.

As set forth in N.J.A.C. 7:14A-3.1(b)3, a surface water discharge in compliance with the instructions of an On-Scene Coordinator pursuant to 40 CFR part 300, the National Oil and Hazardous Substance Pollution Contingency Plan and the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11 et seq., is exempted from the requirement of obtaining a NJPDES discharge to surface water permit while under the direction of the OSC during the term of the emergency.

1. The On-Scene coordinator for this case is:
Gary Greulich, Case Manager
New Jersey Department of Environmental Protection,
Northern Bureau of Field Operations
2 Babcock Place
West Orange, New Jersey 07052
Tel. (973) 669-3960
2. This authorization allows you to construct and operate a ground water recovery and treatment system, comprised of: settling tanks and two granular activated carbon vessels, providing the following conditions are met:
 - a) The system is required to be winterized if the treatment is to last greater than 6 months.
 - b) Information such as the volume of treated ground water discharged and maintenance requirements for

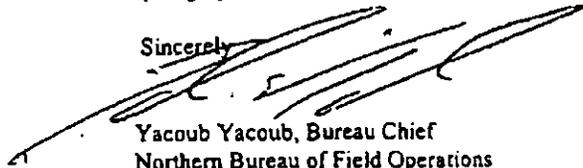
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Recycled Paper

the system shall be submitted upon request.

3. Influent samples must be taken immediately upon startup. These samples must be analyzed for the compounds listed in table 1 (attached).
4. Treatment system effluent samples must be taken immediately, analyzed, and results reported for those compounds outlined in accordance with table 1 (attached).
5. Two (2) copies of all sample results must be submitted to the address listed in paragraph 1.
6. This OSC authorization letter shall end no later than one hundred and eighty (180) days from the receipt of this letter. If an extension is needed, a request must be made to this office thirty (30) days prior to the expiration of this authorization.
7. The system may not be altered, taken off-line, or changed in any way without review and approval by the On-Scene Coordinator identified in paragraph 1.
8. If at any time, the Department determines there are any adverse impacts to public health, or the environment, or this system is being improperly operated or maintained, the system must be immediately shut down and re-evaluated. The OSC shall be notified immediately of the situation and the corrective actions taken to correct the situation.

If you have any questions, please contact the On-Scene Coordinator identified in paragraph 1.

Sincerely,


Yacoub Yacoub, Bureau Chief
Northern Bureau of Field Operations

c: Elizabeth Health Department
Howard Tompkins, Point Source Permitting – Region I
Gloria Grant, BNFO
File

ATTACHMENT I

Parameters (in ug/l unless Otherwise noted)	Monitoring Frequency *	EPA Test Method	PQL
pb (standard parameters)	monthly	Field Tested	na
Petroleum Hydrocarbons (mg/l)	monthly	418.1	2
Total Base Neutrals	semi-annual *	52	N/A
Total Suspended Solids (mg/l)	quarterly	16.2	10
Total Organic Carbon (mg/l)	quarterly	415.1	N/A
Benzene ***	monthly	624 or 602	5
Ethylenebenzene ***	quarterly	624 or 602	N/S
Lead, Total Recoverable	quarterly	239.2	10
Naphthalene ***	monthly	610	8
Toluene ***	quarterly	624 or 602	N/S
Xylenes, Total ***	quarterly	624 or 602	N/S

PQL - Practical Quantitation Level

N/A - Not Applicable N/S - Not Specified

*--Monitoring for all parameters in this table shall be performed initially during the startup of the discharge to surface water; specified monthly or quarterly monitoring for a parameter shall then continue on every month or third month thereafter. All of the monitoring shall be performed using grab samples. Monitoring for any parameter shall not decreased, but can be increased by the On-Scene Coordinator if it is necessary to ensure that proper treatment is being achieved for the protection of any sensitive areas.

**-- Monitoring for these parameters shall be performed again during the first month of any authorized extension for discharge to surface water under On-Scene Coordinator past the initial six (6) month authorization period.

***--The choice of method should be made on a site specific basis. Only the specified compounds need to be analyzed for. Total Xylenes must be requested from the laboratory.

NOTE: In addition to the copies provided to the OSC, copies of all monitoring data collected at the above site, properly identified, shall be sent to: Bureau of Standard Permitting, PO Box 029, Trenton, New Jersey 07625-0029.

GENERAL DECISION: NJ20080003 01/02/2009 NJ3

Date: January 2, 2009

General Decision Number: NJ20080003 01/02/2009

Superseded General Decision Number: NJ20070003

State: New Jersey

Construction Types: Building, Heavy and Highway

Counties: Bergen, Essex, Hudson, Hunterdon, Middlesex,
Morris, Passaic, Somerset, Sussex, Union and Warren Counties in
New Jersey.

Does not include building construction in Hunterdon and
Somerset Counties

BUILDING CONSTRUCTION PROJECTS (does not include single family
homes and apartments up to and including 4 stories) (does not
include building construction in Hunterdon or Somerset Counties)

HEAVY AND HIGHWAY CONSTRUCTION PROJECTS

Modification Number	Publication Date
0	02/08/2008
1	02/15/2008
2	02/29/2008
3	03/21/2008
4	04/11/2008
5	04/18/2008
6	04/25/2008
7	05/09/2008
8	05/16/2008
9	05/23/2008
10	05/30/2008
11	06/06/2008
12	06/20/2008
13	07/04/2008
14	07/11/2008
15	07/18/2008
16	08/01/2008
17	08/08/2008
18	08/22/2008
19	08/29/2008
20	09/05/2008
21	09/19/2008
22	09/26/2008
23	10/24/2008
24	10/31/2008
25	11/07/2008
26	11/28/2008
27	12/05/2008
28	12/19/2008
29	01/02/2009

ASBE0032-001 09/19/2008

BERGEN, ESSEX AND HUDSON COUNTIES; HUNTERDON COUNTY (Borough of

Califon; Township of Tewksbury); MIDDLESEX COUNTY (Boroughs of Carteret and Dunellen; Township of Edison; Boroughs of Highland Park, Metuchen and Middlesex; City of New Brunswick; Township of Old Bridge; City of Perth Amboy; Township of Piscataway; Borough of Sayreville; City of South Amboy; Boroughs of South Plainfield and South River; Township of Woodbridge); MORRIS AND PASSAIC COUNTIES: SOMERSET COUNTY (Boroughs of Bernardsville and Bound Brook; Township of Bridgewater; Borough of Far Hills; Township of Green Brook; Boroughs of North Plainfield, Peapack-Gladstone, Raritan, Somerville, South Bound Brook and Watchung; Township of Warren); SUSSEX AND UNION COUNTIES; WARREN COUNTY (Townships of Allamuchy, Blairstown and Frelinghuysen; Town of Hackettstown; Townships of Hope, Independence, Knowlton, Liberty and Mansfield):

Rates Fringes

<p>Insulator/asbestos worker (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).....\$ 41.99</p>	<p>26.84</p>
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ASBE0032-004 09/19/2008

BERGEN, ESSEX AND HUDSON COUNTIES; HUNTERDON COUNTY (Borough of Califon; Township of Tewksbury); MIDDLESEX COUNTY (Boroughs of Carteret and Dunellen; Township of Edison; Boroughs of Highland Park, Metuchen and Middlesex; City of New Brunswick; Township of Old Bridge; City of Perth Amboy; Township of Piscataway; Borough of Sayreville; City of South Amboy; Boroughs of South Plainfield and South River; Township of Woodbridge); MORRIS AND PASSAIC COUNTIES: SOMERSET COUNTY (Boroughs of Bernardsville and Bound Brook; Township of Bridgewater; Borough of Far Hills; Township of Green Brook; Boroughs of North Plainfield, Peapack-Gladstone, Raritan, Somerville, South Bound Brook and Watchung; Township of Warren); SUSSEX AND UNION COUNTIES; WARREN COUNTY (Townships of Allamuchy, Blairstown and Frelinghuysen; Town of Hackettstown; Townships of Hope, Independence, Knowlton, Liberty and Mansfield):

Rates Fringes

<p>Hazardous material handler/asbestos removal worker.....\$ 23.94</p>	<p>7.00</p>
--	-------------

ASBE0089-001 07/01/2008

HUNTERDON COUNTY (does not include the Borough of Califon; Township of Tewksbury); MIDDLESEX COUNTY (does not include the Boroughs of Carteret and Dunellen; Township of Edison; Boroughs

of Highland Park; Metuchen and Middlesex; City of New Brunswick; Township of Old Bridge; City of Perth Amboy; Township of Piscataway; Borough of Sayreville; City of South Amboy; Boroughs of South Plainfield and South River; Township of Woodbridge); SOMERSET COUNTY (Townships of Branchburg, Franklin, Hillsborough and Montgomery); WARREN COUNTY (Townships of Franklin, Greenwich, Harmony, Lopatcong, Oxford, Pohatcong, Washington and White):

	Rates	Fringes
Asbestos worker/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).....	\$ 38.02	24.98

PAID HOLIDAYS:

The last day prior to the Christmas and New Year's Day observed holiday: 4 hrs. pay.

 * BOIL0028-001 01/01/2009

	Rates	Fringes
Boilermaker.....	\$ 39.90	21.60

 BRNJ0002-005 11/01/2008

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.....	\$ 36.70	20.97

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 11/01/2008

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.....	\$ 36.70	20.97

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 11/01/2008

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 and plasterer.....	\$ 36.70	20.97

Cement mason and plasterer:
 Work on high stacks: 22% per hour additional.

Cement mason only:
 Epoxy, acid and latex work: \$.50 per hour additional.

 BRNJ0002-009 11/01/2008

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 and plasterer.....	\$ 36.70	20.97

Cement mason and plasterer:
Work on high stacks: 22% per hour additional.

Cement mason only:
Epoxy, acid and latex work: \$.50 per hour additional.

* BRNJ0007-003 01/01/2009

	Rates	Fringes
Marble setter.....	\$ 50.53	24.00

* BRNJ0007-004 01/01/2009

	Rates	Fringes
Marble finisher.....	\$ 41.30	23.83

BRNJ0007-005 07/01/2005

	Rates	Fringes
Terrazzo finisher.....	\$ 38.37	23.25
Terrazzo setter.....	\$ 39.68	23.25

BRNJ0007-009 12/01/2005

BERGEN, ESSEX, HUDSON AND HUNTERDON COUNTIES; MIDDLESEX COUNTY (north of Route 33); MORRIS, PASSAIC, SOMERSET, SUSSEX, UNION AND WARREN COUNTIES:

	Rates	Fringes
Tile finisher.....	\$ 33.40	17.15
Tile setter.....	\$ 40.17	21.08

Tile finisher:
Work grouting all epoxy: \$10.00 additional per day.

BRNJ0007-010 12/01/2007

MIDDLESEX COUNTY (south of Route 33):

	Rates	Fringes
Tile finisher.....	\$ 33.51	16.36
Tile setter.....	\$ 37.08	19.23

Tile finisher:
Work grouting all epoxy: \$10.00 additional per day.

CARP0006-008 06/01/2006

	Rates	Fringes
Carpenter, drywall hanger.....	\$ 35.72	46%

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.

CARP0029-003 05/01/2006

	Rates	Fringes
Soft floor layer.....	\$ 33.76	42.25% + .04

CARP0715-001 05/01/2006

	Rates	Fringes
Millwright.....	\$ 36.55	46% + .04

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.

CARP1456-001 05/01/2008

	Rates	Fringes
Divers:		
Diver tender.....	\$ 35.03	32.90
Diver.....	\$ 45.24	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.

CARP1456-002 05/01/2008

	Rates	Fringes
Dockbuilder and piledriver operator		
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.

 ELEC0102-001 06/02/2008

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.....	\$ 50.15	50.75%
Ground person.....	\$ 26.496	51%
Groundman.....	\$ 27.36	50.75%
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..	\$ 44.16	51%
Line technician-welder.....	\$ 47.87	50.75%
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..	\$ 45.59	50.75%
All other work:		
Cable splicer.....	\$ 50.15	50.75%
Ground person.....	\$ 26.496	51%
Groundman.....	\$ 27.36	50.75%
Line technician; equipment operator.....	\$ 44.16	51%
Line technician-welder.....	\$ 47.87	50.75%
Lineman; equipment operator.....	\$ 45.59	50.75%

Work with, or the removal of, asbestos materials: 114% times the journeyman rate.

ELEC0102-002 06/02/2008

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.....	\$ 50.07	51%
Electrician.....	\$ 45.52	51%

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.

ELEC0102-020 06/02/2008

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:		
Work on gas stations; free-standing fast-food restaurants and convenience stores; commercial work involving a free-standing building not exceeding 13,000 sq. ft.....	\$ 26.28	40%

 ELEC0164-002 06/02/2008

BERGEN, ESSEX AND HUDSON COUNTIES:

	Rates	Fringes
Electricians:		
All other work:		
Cable splicer.....	\$ 51.87	54%
Electrician on radio tower work.....	\$ 55.54	54%
Electrician.....	\$ 45.90	54%

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.

 ELEC0164-009 06/01/2008

BERGEN, ESSEX AND HUDSON COUNTIES:

	Rates	Fringes
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Electricians:

Work on gas stations; free-standing fast-food restaurants and convenience stores; commercial work involving a free-standing building not exceeding 13,000 sq. ft.....\$ 28.07 28% + 1.00

ELEC0164-010 06/02/2008

BERGEN, ESSEX AND HUDSON COUNTIES:

	Rates	Fringes
Line construction:		
Cable splicer.....	\$ 51.87	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 10/01/2006

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
Electrician.....	\$ 44.48	51.3% + .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%

 ELEG0456-001 06/02/2008

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.....	\$ 48.84	60.25%
Electrician.....	\$ 43.22	60.25%

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 06/01/2006

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; crane operator.....	\$ 48.85	54.75%
Ground person (when installing conduit on public roadways).....	\$ 25.94	54.75%
Ground person; winch operator.....	\$ 42.44	54.75%
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.....	\$ 43.23	54.75%
All other work:		
Cable splicer; crane operator.....	\$ 48.85	54.75%
Ground person (when installing conduit on public roadways).....	\$ 25.94	54.75%
Ground person; winch operator.....	\$ 42.44	54.75%
Line technician.....	\$ 43.23	54.75%

ELEV0001-001 03/17/2008

BERGEN, ESSEX, HUDSON, MIDDLESEX, MORRIS, PASSAIC, SOMERSET,
SUSSEX AND UNION COUNTIES:

	Rates	Fringes
Elevator mechanic Work on the addition, replacement, refurbishing or relocation of control, drive, generating equipment, hoistway or pit equipment, including work involving a structural rise in the elevator shafts in an existing building and other elevator work in the machine room, hoistway or pit; Also, changes in design and appearance of basic escalator equipment....	\$ 38.46	21.565
All other work.....	\$ 48.19	21.715

PAID HOLIDAYS:

New Year's Day, President's Day, Good Friday, Memorial Day,
Fourth of July, Labor Day, Columbus Day, Veteran's Day,
Thanksgiving Day, the Friday after Thanksgiving Day, and
Christmas Day.

PAID VACATION:

A worker who has worked less than 5 years: 4% of his or her hourly rate for all hours worked.

A worker who has worked 5 to 10 years: 6% of his or her hourly rate for all hours worked.

A worker who has worked 15 or more years: 8% of his or her hourly rate for all hours worked.

ELEV0084-005 01/01/2007

HUNTERDON AND WARREN COUNTIES:

	Rates	Fringes
Elevator mechanic.....	\$ 36.295	14.885

PAID HOLIDAYS:

New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, the Friday after Thanksgiving Day, and Christmas Day.

VACATION PAY CREDIT:

A worker with 6 months but less than 5 years of service receives two weeks vacation; a worker with 5 years or more of service receives three weeks vacation.

ENGI0825-003 07/01/2008

	Rates	Fringes
Power equipment operators:		
Tank erection:		
GROUP 1.....	\$ 41.61	21.00
GROUP 2.....	\$ 40.67	21.00
GROUP 3.....	\$ 41.15	21.00
GROUP 4.....	\$ 38.58	21.00
GROUP 5.....	\$ 36.12	21.00
GROUP 6.....	\$ 34.87	21.00
GROUP 7.....	\$ 33.37	21.00

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:

Operating engineer - on all equipment, including cranes and derricks with boom including jib, 140 ft. or more above the ground

GROUP 2:

Operating engineer - on all equipment, including cranes and derricks with boom including jib, less than 140 ft. above the ground

GROUP 3:

Helicopter pilot

GROUP 4:

Air compressor; welding machine and generator (gas, diesel, or electrical-driven equipment and sources of power from a permanent plant (steam, compressed air, hydraulic or other power), for the operation of any machine or automatic tool used in the erection, alteration, repair and dismantling of tanks and any and all "dual-purpose" trucks used on the construction job site)

GROUP 5:

Concrete cleaning/decontamination machine operator, decontamination and remediation work only; directional boring machine; heavy equipment robotic operator/technician, decontamination and remediation work only; master environmental maintenance technician, decontamination and remediation work only; 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

GROUP 6:

Off-road back dump

GROUP 7:

Oiler

ENGI0825-004 07/01/2008

	Rates	Fringes
Power equipment operators:		
Steel erection:		
GROUP 1.....	\$ 41.79	21.00
GROUP 2.....	\$ 40.88	21.00
GROUP 3.....	\$ 42.65	21.00
GROUP 4.....	\$ 38.59	21.00
GROUP 5.....	\$ 35.93	21.00
GROUP 6.....	\$ 34.40	21.00
GROUP 7.....	\$ 32.64	21.00

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

ENGI0825-005 07/01/2008

	Rates	Fringes
Power equipment operators:		
OILSTATIC MAINLINE & TRANSPORTATION PIPELINE:		
GROUP 1.....	\$ 42.40	21.00
GROUP 2.....	\$ 42.65	21.00
GROUP 3.....	\$ 41.90	21.00
GROUP 4.....	\$ 43.83	21.00
GROUP 5.....	\$ 40.25	21.00
GROUP 6.....	\$ 35.11	21.00
GROUP 7.....	\$ 36.61	21.00
GROUP 8.....	\$ 34.89	21.00

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, derricks, pile drivers (all types), with 100 ft.
boom (including jib and/or leads) up to 139 ft.

GROUP 2:

Cranes, derricks, pile drivers (all types), with 140 ft.
boom (including jib and/or leads) and over

GROUP 3:

Backhoe; crane (all types not included in groups 1 and 2);
dragline; front end loader (5 cu. yd. and over); gradall;
helicopter co-pilot; helicopter - communications engineer;
scooper (loader and shovel); Koehring scooper; trench

machine (cable plow)

GROUP 4:

Helicopter - pilot/engineer

GROUP 5:

"A" frame/backhoe combination; hoe loader; boring and drilling machines; ditching machine, small (Ditchwitch, Vermeer or similar type); forklift; front end loader (2 cu. yd. and over but less than 5 cu. yd.); grader, finish (fine); hydraulic crane, 10 tons and under (over 10 tons - crane rate applies); side boom; vacuum truck; winch truck (hoisting)

GROUP 6:

Backfiller; broom and sweeper; bulldozer; compressor (2 or 3 in battery); concrete cleaning/decontamination machine operator, when used for decontamination and remediation; front end loader (under 2 cu. yd.); generator; giraffe grinder; grader and motor patrol; heavy equipment robotic operator/technician, when used for decontamination and remediation; master environmental maintenance technician, when used for decontamination and remediation; mechanic; pipe bending machine (power); tractor; water and sprinkler truck; welder and repair mechanic; 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

GROUP 7:

Compressor (single); dope pot (mechanical with or without pump); dust collector; farm tractor; off-road back dump; pump (4-in. suction and over); pump (2-in. suction, up to, but less than, 4-in. suction); pump, diesel engine and hydraulic (immaterial of power); welding machine, gas or electric converter of any type, single; welding machine, gas or electric converter of any type, 2 or 3 in battery; multiple welders; wellpoint system (including installation and maintenance)

GROUP 8:

Oiler; grease, gas, fuel and oil supply truck; tire repair and maintenance

ENGI0825-009 07/01/2008

	Rates	Fringes
Power equipment operators:		
GROUP 1.....	\$ 41.27	21.00
GROUP 2.....	\$ 39.68	21.00
GROUP 3.....	\$ 37.77	21.00
GROUP 4.....	\$ 36.14	21.00
GROUP 5.....	\$ 34.43	21.00
GROUP 6.....	\$ 42.99	21.00

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, tigger, 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 07/01/2008

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.....	\$ 33.34	33.40
Structural.....	\$ 36.14	33.40

IRON0036-003 07/01/2008

WARREN COUNTY:

	Rates	Fringes
Ironworkers:.....	\$ 31.20	21.92

IRON0068-004 07/01/2008

MIDDLESEX COUNTY (south half); SOMERSET COUNTY (south half):

	Rates	Fringes
Ironworker.....	\$ 32.85	33.30

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.

LAB00172-002 03/01/2008

	Rates	Fringes
Laborers:		
FREE AIR TUNNEL:		
GROUP 1.....	\$ 32.45	18.65

GROUP 2.....	\$ 29.05	18.65
GROUP 3.....	\$ 28.90	18.65
GROUP 4.....	\$ 28.40	18.65

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:

Blaster

GROUP 2:

Skilled laborer (miner, drill runner, iron laborer, maintenance laborer, conveyor laborer, safety miner, rigger, blocklayer, cement finisher, rod person, caulker, powder carrier, all other skilled laborers)

GROUP 3:

Semi-skilled laborer (chuck tender, track laborer, nipper, brake person, derail person, cable laborer, hose laborer, grout laborer, gravel laborer, form laborer, pipelayer, conduit installer, bell or signal laborer (top or bottom), form laborer and mover, concrete worker, shaft person, tunnel laborer, all other semi-skilled laborers)

GROUP 4:

Powder watch person, change house attendant, top laborer

LAB00172-005 03/01/2008

	Rates	Fringes
Laborers:		
GROUP 1.....	\$ 28.00	18.40
GROUP 2.....	\$ 28.70	18.40
GROUP 3.....	\$ 28.95	18.40
GROUP 4.....	\$ 32.50	18.40

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

LAB00172-006 03/01/2008

MIDDLESEX COUNTY (south of the Raritan River):

Rates

Pringes

Laborers:

ASPHALT WORK:

GROUP 1.....	\$ 28.80	18.40
GROUP 2.....	\$ 28.40	18.40
GROUP 3.....	\$ 28.65	18.40
GROUP 4.....	\$ 28.50	18.40
GROUP 5.....	\$ 28.70	18.40

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

LAB00222-002 11/01/2008

BUILDING CONSTRUCTION:

	Rates	Fringes
Laborers:		
GROUP 1.....	\$ 27.25	18.22
GROUP 2.....	\$ 26.75	18.22
GROUP 3.....	\$ 22.74	18.22

DEFINITION OF GROUPS:

GROUP 1:

Jackhammer; tamper; motorized tamper and compactor; street cleaning machine; scaffold builder; hydro; demolition equipment; all types of motorized forklift; riding motor buggy operator; Bobcat operator; mortar person; burner; nozzle person on gunite work

GROUP 2:

All laborers not listed in Groups 1 or 3

GROUP 3:

Laborer doing janitorial-type light clean-up work associated with the turnover of the project to the owner; flag person; laborer manning temporary heat of all types

LAB01030-001 05/01/2007

	Rates	Fringes
Laborers:		
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).....	\$ 25.62	14.97

PAIN0711-003 05/01/2008

	Rates	Fringes
Glazier.....	\$ 36.50	16.38

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.

 PAIN0711-004 11/01/2008

Work on nuclear plants, towers, steeples, dams, hangars, elevated tanks, tank farms and refineries (does not include office and storage buildings):

	Rates	Fringes
Painters:		
Repaint work, on projects on which no major alterations occur (does not include work on bridges, stacks, elevated tanks and generating stations, the interior of all tanks, and ground tanks over 60 ft. in height):		
Brush and roller.....	\$ 26.67	13.80
Spray.....	\$ 29.34	13.80
All other industrial work:		
Brush and roller.....	\$ 35.81	16.30
Spray.....	\$ 39.39	16.30

 PAIN0711-009 11/01/2007

	Rates	Fringes
Painters:		
Work on bridges (all bridges that span major waterways, railroad bridges, bridges over canyons, overpasses, viaducts and appurtenances (does not include pedestrian bridges in casinos, condominiums, hotels, industrial plants, educational facilities, hospitals and offices).....	\$ 40.50	33% + 4.07

 PAIN0711-012 05/01/2008

	Rates	Fringes
Drywall finisher:.....	\$ 34.91	16.24

 PAIN0711-014 11/01/2008

All other work:

	Rates	Fringes
Painters:		
Repaint work, on projects on which no major alterations occur (does not include work on bridges, stacks, elevated tanks and generating stations, the interior of all tanks, and ground tanks over 60 ft. in height):		
Brush and roller.....	\$ 26.67	13.80
Paperhanger.....	\$ 27.37	13.88
Spray.....	\$ 29.34	13.80
All other work:		
Brush and roller.....	\$ 34.47	16.14
Paperhanger.....	\$ 35.37	16.24
Spray.....	\$ 37.92	16.14

 PLAS0008-006 05/01/2008

HUNTERDON, MIDDLESEX AND SOMERSET COUNTIES:

	Rates	Fringes
Plasterer.....	\$ 32.90	20.60

 PLAS0029-001 05/01/2008

BERGEN, ESSEX, HUDSON, MORRIS, PASSAIC, SUSSEX, UNION AND WARREN COUNTIES:

	Rates	Fringes
Cement mason and plasterer.....	\$ 38.00	19.55

Cement masons:
 Work on suspended staging, not supported from the ground:
 \$.50 per hour additional.

 PLAS0592-030 11/01/2008

HUNTERDON, MIDDLESEX, SOMERSET AND UNION COUNTIES:

	Rates	Fringes
Cement mason.....	\$ 35.75	23.13

 PLUM0009-001 09/01/2008

	Rates	Fringes
Air Conditioning & Refrigeration Mechanic.....	\$ 31.53	14.78

PAID HOLIDAYS:

New Year's Day, President's Day, Memorial Day, Fourth of July, Labor Day, Veteran's Day, Thanksgiving Day and Christmas Day.

SCOPE OF WORK:

Installation of air conditioning and refrigeration equipment for any type of building where the combined compressor tonnage does not exceed 15 tons for refrigeration and 25 tons for air conditioning; or, "packaged-unitary" rooftop type, the combined tonnage of which does not exceed 75 tons; Also, small works projects including the installation of comfort HVAC, refrigeration and sanitary plumbing for all retail gasoline stations; all free-standing fast-food and convenience stores; all commercial work involving a free-standing building not exceeding 13,000 sq. ft. including the repair, remodeling or additions to said building; and all residential housing over 4 stories, not to exceed 20 families.

 PLUM0009-002 07/01/2008

HUNTERDON COUNTY (south of a line drawn from a point where Bridge St. crosses the Delaware River, continuing along Bridge St. through Frenchtown to Rt. 513; then, continuing along Rt. 513 to Rt. 12; then, continuing along Rt. 12 to Rt. 31/202; then, continuing south on Rt. 31/202 to Rt. 514 (Amwell Rd. or Old York Rd.); then, making a left turn in a northeasterly direction onto Rt. 514 (Amwell Rd. or Old York Rd.); then, continuing along Rt. 514 (Amwell Rd. or Old York Rd.) to Reaville and the intersection with County Rd. Rt. 609 (Manner's Rd.); then, making a right turn onto County Rd. Rt. 609 (Manner's Rd.); then, continuing south along County Rd. Rt. 609 (Manner's Rd.) until it reaches County Rd. Rt. 602 (Wertsville Rd.); then, making a right turn onto Rt. 602 (Wertsville Rd.); then, continuing south along Rt. 602 (Wertsville Rd.) until it reaches Rt. 607 (Rileyville Rd., also known as Hopewell - Wertsville Rd.); then, making a left turn onto Rt. 607 (Rileyville Rd., also known as Hopewell - Wertsville Rd.); then, continuing along Rt. 607 (Rileyville Rd., also known as Hopewell - Wertsville Rd.) until it reaches the Hunterdon/Mercer county line); MIDDLESEX COUNTY (does not include the Boroughs of Dunellen and Middlesex; Township of Piscataway; Borough of South Plainfield); SOMERSET COUNTY (Township of Montgomery; Borough of Rocky Hill):

	Rates	Fringes
Plumber/pipefitter.....	\$ 42.68	24.75

 PLUM0014-002 05/01/2008

BERGEN COUNTY; HUDSON COUNTY (does not include the Borough of East Newark; Towns of Harrison and Kearney); MORRIS COUNTY (does not include the Borough of Chatham; Township of Chatham; Borough of Chester; Townships of Chester, Harding and Long Hill; Borough of Mendham; Townships of Mendham and Mount Olive; Township of Washington (Town of Long Valley only)); PASSAIC AND SUSSEX COUNTIES; WARREN COUNTY (Township of Allamuchy; Borough of Alpha; Township of Blairstown; Township of Franklin (does not include the towns of Asbury and New Village); Township of Prelinghuysen; Town of Hackettstown; Townships of Hardwick, Independence, Knowlton, Liberty and Mansfield; Township of Pohatcong (does not include the towns of Carpentersville,

Riegelsville and Warren Glen); Borough of Washington; Township of Washington):

	Rates	Fringes
Plumber.....	\$ 45.96	22.59

 PLUM0024-001 11/01/2008

ESSEX COUNTY; HUDSON COUNTY (Borough of East Newark; Towns of Harrison and Kearney); HUNTERDON COUNTY (north of a line drawn from a point where Bridge St. crosses the Delaware River, continuing along Bridge St. through Frenchtown to Rt. 513; then, continuing along Rt. 513 to Rt. 12; then, continuing along Rt. 12 to Rt. 31/202; then, continuing south on Rt. 31/202 to Rt. 514 (Amwell Rd. or Old York Rd.); then, making a left turn in a northeasterly direction onto Rt. 514 (Amwell Rd. or Old York Rd.); then, continuing along Rt. 514 (Amwell Rd. or Old York Rd.) to Reaville and the intersection with County Rd. Rt. 609 (Manner's Rd.); then, making a right turn onto County Rd. Rt. 609 (Manner's Rd.); then, continuing south along County Rd. Rt. 609 (Manner's Rd.) until it reaches County Rd. Rt. 602 (Wertsville Rd.); then, making a right turn onto Rt. 602 (Wertsville Rd.); then, continuing south along Rt. 602 (Wertsville Rd.) until it reaches Rt. 607 (Rileyville Rd., also known as Hopewell - Wertsville Rd.); then, making a left turn onto Rt. 607 (Rileyville Rd., also known as Hopewell - Wertsville Rd.); then, continuing along Rt. 607 (Rileyville Rd., also known as Hopewell - Wertsville Rd.) until it reaches the Hunterdon/Mercer county line); MIDDLESEX COUNTY (Boroughs of Dunellen and Middlesex; Township of Piscataway; Borough of South Plainfield); MORRIS COUNTY (Borough of Chatham; Township of Chatham; Borough of Chester; Townships of Chester, Harding and Long Hill; Borough of Mendham; Townships of Mendham and Mount Olive; Township of Washington (Town of Long Valley only)); PASSAIC COUNTY; SOMERSET COUNTY (does not include the Township of Montgomery; Borough of Rocky Hill); UNION COUNTY; WARREN COUNTY (Town of Belvidere; Township of Franklin (Towns of Asbury and New Village only); Townships of Greenwich, Harmony, Hope, Lopatcong and Oxford; Town of Phillipsburg; Township of Pohatcong (Towns of Carpentersville, Riegelsville and Warren Glen only); Township of White):

	Rates	Fringes
Plumber.....	\$ 43.00	23.70

 PLUM0274-002 11/01/2008

BERGEN COUNTY; 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); PASSAIC AND SUSSEX COUNTIES:

	Rates	Fringes
Pipefitter.....	\$ 45.96	23.59

 PLUM0274-005 11/01/2008

	Rates	Fringes
Pipefitters:		
Gas distribution work:		
Pipefitter; welder.....	\$ 46.29	16.34

 PLUM0475-001 11/01/2008

ESSEX COUNTY; HUNTERDON COUNTY (north of a line drawn from a point where Bridge St. crosses the Delaware River, continuing along Bridge St. through Frenchtown to Rt. 513; then, continuing along Rt. 513 to Rt. 12; then, continuing along Rt. 12 to Rt. 31/202; then, continuing south on Rt. 31/202 to Rt. 514 (Amwell Rd. or Old York Rd.); then, making a left turn in a northeasterly direction onto Rt. 514 (Amwell Rd. or Old York Rd.); then, continuing along Rt. 514 (Amwell Rd. or Old York Rd.) to Reaville and the intersection with County Rd. Rt. 609 (Manner's Rd.); then, making a right turn onto County Rd. Rt. 609 (Manner's Rd.); then, continuing south along County Rd. Rt. 609 (Manner's Rd.) until it reaches County Rd. Rt. 602 (Wertsville Rd.); then, making a right turn onto Rt. 602 (Wertsville Rd.); then, continuing south along Rt. 602 (Wertsville Rd.) until it reaches Rt. 607 (Rileyville Rd., also known as Hopewell - Wertsville Rd.); then, making a left turn onto Rt. 607 (Rileyville Rd., also known as Hopewell - Wertsville Rd.); then, continuing along Rt. 607 (Rileyville Rd., also known as Hopewell - Wertsville Rd.) until it reaches the Hunterdon/Mercer county line); MIDDLESEX COUNTY (Boroughs of Dunellen and Middlesex; Township of Piscataway; Borough of South Plainfield); MORRIS COUNTY (Borough of Chatham; Township of Chatham; Borough of Chester; Townships of Chester, Harding and Long Hill; Borough of Mendham; Townships of Mendham and Mount Olive; Township of Washington (Town of Long Valley only); PASSAIC COUNTY; SOMERSET COUNTY (does not include the Township of Montgomery; Borough of Rocky Hill); UNION COUNTY; WARREN COUNTY (Town of Belvidere; Township of Franklin (Towns of Asbury and New Village only); Townships of Greenwich, Harmony, Hope, Lopatcong and Oxford; Town of Phillipsburg; Township of Pohatcong (Towns of Carpentersville, Riegelsville and Warren Glen only); Township of White):

	Rates	Fringes
Pipefitter.....	\$ 47.75	21.70

 ROOF0004-002 06/01/2006

ESSEX AND HUDSON COUNTIES; MIDDLESEX COUNTY (north and east of Route #18); MORRIS COUNTY; SOMERSET COUNTY (north of a line drawn from the Mercer/Somerset County line north along Route #206 to Route #514; then, west along Route #514 to the Hunterdon/Somerset county line); SUSSEX, UNION AND WARREN COUNTIES:

	Rates	Fringes
Roofer.....	\$ 31.57	16.50

Mop person:

\$.30 per hour additional.

Work on a job where pitch is being applied:
\$.50 per hour additional.

ROOF0008-004 07/01/2006

HUDSON COUNTY (east of the Hackensack River):

	Rates	Fringes
Roofer.....	\$ 33.83	20.10

Workers laying brick:
\$.40 per hour additional.

Workers using machinery:
\$1.00 per hour additional.

ROOF0010-002 06/01/2008

BERGEN AND PASSAIC COUNTIES:

	Rates	Fringes
Roofers:		
Mop person.....	\$ 33.75	15.20
Roofer.....	\$ 33.00	15.20

Work operating slag chipping machine, felt laying machine,
power broom machine and adhesive machine:
 New work: \$1.00 per hour additional (operator only).
 Re-roofing: \$.50 per hour additional (operator only).

Work operating mechanized equipment (felt-layer, hot
spreader, slag spreader) (on new work
only):
\$.50 per hour additional (for entire crew).

Work involving the use of pitch, including all
tear-offs:
\$1.00 per hour additional.

Work involving asbestos removal:
\$1.00 per hour additional.

Work operating adhesive machine on one-ply system (on new
work only):
\$.50 per hour additional (for entire crew).

ROOF0030-020 05/01/2008

HUNTERDON COUNTY; MIDDLESEX COUNTY (south and west of Route
#18); SOMERSET COUNTY (south of a line drawn from the
Mercer/Somerset county line north along Route #206 to Route
#514; then, west along Route #514 to the Hunterdon/Somerset
county line):

	Rates	Fringes
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Roofer		
SHINGLES.....	\$ 22.75	12.27
SLATE AND TILE.....	\$ 25.75	12.27
ALL OTHER WORK.....	\$ 29.50	20.70

Mopper, and operator of felt-laying machine: \$.50 per hour additional.

Work applying roofing material, on any new construction job, on those days on which a felt-laying machine or slag-dispensing machine is used: \$.50 per hour additional.

PAID HOLIDAY:

The last working day before Christmas, to be paid at the rate of four hours pay.

 * SFNJ0669-001 01/01/2009

HUNTERDON COUNTY; MIDDLESEX COUNTY (remainder of county); SOMERSET COUNTY (Townships of Branchburg and Montgomery; Borough of Rocky Hill); WARREN COUNTY:

	Rates	Fringes
Sprinkler fitter.....	\$ 42.50	17.80

 SFNJ0696-001 07/01/2006

BERGEN, ESSEX AND HUDSON COUNTIES; MIDDLESEX COUNTY (Township of Old Bridge); MORRIS AND PASSAIC COUNTIES; SOMERSET COUNTY (remainder of county); UNION COUNTY:

	Rates	Fringes
Sprinkler fitter.....	\$ 46.05	15.06

 SHEE0019-017 06/01/2008

WARREN COUNTY:

	Rates	Fringes
Sheet metal worker.....	\$ 28.98	27.18

PAID HOLIDAY:

Election Day.

 SHEE0025-001 09/01/2008

BERGEN, ESSEX, HUDSON, MORRIS, PASSAIC, SOMERSET, SUSSEX AND UNION COUNTIES:

	Rates	Fringes
Sheet metal workers: Work on apartments over 4 stories, up to and including 6 stories; Also, work on light commercial HVAC duct systems,		

provided that the total mechanical capacity per packaged unit does not exceed 90,000 BTU's, 7-1/2 tons, or 3,000 CFM's.....\$ 20.50 1.97

PAID HOLIDAYS:

New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day and Christmas Day; provided that the worker works the scheduled work day before and the scheduled work day after the holiday, unless he or she is unable to do so due to sickness, or other absence excused by the employer.

VACATION:

After one year of employment: one week vacation period and forty hours vacation pay.

After five years of employment: two weeks vacation period and eighty hours vacation pay.

After ten years of employment: three weeks vacation period and one hundred and twenty hours vacation pay.

After fifteen years of continuous employment: four weeks paid vacation as of January 1 of the calendar year following the worker's fifteenth year anniversary date.

SHEE0025-004 06/01/2008

BERGEN, ESSEX, HUDSON, MORRIS, PASSAIC, SOMERSET, SUSSEX AND UNION COUNTIES:

	Rates	Fringes
Sheet metal workers:		
All other work.....	\$ 41.69	29.13

SHEE0027-001 06/01/2007

HUNTERDON AND MIDDLESEX COUNTIES:

	Rates	Fringes
Sheet metal workers:		
Work on light commercial projects, provided that the total mechanical capacity per packaged unit does not exceed 90,000 BTU's, 7-1/2 tons, or 3,000 CFM's (does not include assisted living facilities, major shopping mall stores (whether new or renovation work), major chain stores, movie complexes, industrial work).	\$ 26.00	6.35

VACATION PAY:

After one year of employment: one week vacation period and forty (40) hours vacation pay.

After five years of employment: two weeks vacation period and eighty (80) hours vacation pay.

After ten years of employment: three weeks vacation period and one hundred and twenty (120) hours vacation pay.

SHEE0027-005 06/01/2007

HUNTERDON AND MIDDLESEX COUNTIES:

	Rates	Fringes
Sheet metal workers:		
All other work.....	\$ 39.76	27.26

TEAM0408-001 05/01/2008

ESSEX, MORRIS, SUSSEX AND UNION COUNTIES:

	Rates	Fringes
Truck drivers:		
Group 1.....	\$ 33.10	12.16+a
Group 2.....	\$ 33.00	12.16+a
Group 3.....	\$ 32.90	12.16+a
Group 4.....	\$ 32.85	12.16+a

a. Employer contributes \$1304.35 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 truck; 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

TEAM0469-001 05/01/2008

HUNTERDON, MIDDLESEX AND SOMERSET COUNTIES; UNION COUNTY (south of Wood Ave.); WARREN COUNTY:

	Rates	Fringes
Truck drivers:		
Group 1.....	\$ 33.10	19.185
Group 2.....	\$ 33.00	19.185
Group 3.....	\$ 32.90	19.185
Group 4.....	\$ 32.85	19.185

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 truck; 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

TEAM0560-001 05/01/2008

BERGEN, HUDSON AND PASSAIC COUNTIES:

	Rates	Fringes
Truck drivers:		
Group 1.....	\$ 30.85	21.28
Group 2.....	\$ 30.90	21.28
Group 3.....	\$ 31.00	21.28
Group 4.....	\$ 31.10	21.28

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.

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)).

In the listing above, the "SU" designation means that rates listed under the identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

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 3.8 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.

=====

END OF GENERAL DECISION

**NOTIFICATION
OF
MINORITY BUSINESS ENTERPRISES
AND
WOMEN'S BUSINESS ENTERPRISES
ON-LINE DIRECTORY
AND
FORMS**

The Port Authority has a long-standing practice of making its contract 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. The Port Authority's on-line Directory of Qualified MBE/WBEs lists the firms that are registered to assist Contractors in meeting and exceeding their Good Faith Goals.

The MBE/WBE Directory 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.

Contractors are provided with an interactive directory and the ability to view and print a current listing of M/WBE contractors. Information may be selected and sorted according to categories, state, dollar range, and type (MBE, WBE, DBE, and SBE).

To view the directory, type in www.panynj.gov/mwbe or go to www.panynj.gov, select Engineering - M/W/S/DBE Information (under Doing Business with the Port Authority), and then select MWBE Qualified Vendor Search. For further information about MWBE Qualified Vendors, contact the Office of Business and Job Opportunity at (212) 435-7802.

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		

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)

<u>Permanent</u>	<u>Temporary</u>	<u>Field</u>
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

Mall 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:	<i>The Port Authority of NY & NJ Office of Business and Job Opportunity 233 Park Avenue South, 4th Floor New York, NY 10003</i>
<i>Firms not currently certified should call (212) 435-7808 for information</i>	

(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 COMPLETE 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:

<u>NAME & TITLE</u>	<u>SEX</u>	<u>GROUP CODE*</u>	<u>FIRM</u>
FINANCIAL DECISIONS			
_____	<input type="checkbox"/> M <input type="checkbox"/> F	_____	_____
_____	<input type="checkbox"/> M <input type="checkbox"/> F	_____	_____
MANAGEMENT DECISIONS, SUCH AS:			
ESTIMATING			
_____	<input type="checkbox"/> M <input type="checkbox"/> F	_____	_____
_____	<input type="checkbox"/> M <input type="checkbox"/> F	_____	_____
MARKETING AND SALES			
_____	<input type="checkbox"/> M <input type="checkbox"/> F	_____	_____
_____	<input type="checkbox"/> M <input type="checkbox"/> F	_____	_____

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

CONSTRUCTION
MBE/WBE/DBE PARTICIPATION PLAN
MODIFIED

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.

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.

**THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3RD FLOOR
NEWARK, NJ 07102**

July 31, 2009

ADDENDUM NO. 11

**TO PROSPECTIVE BIDDERS ON CONTRACT EWR-154.028 - NEWARK LIBERTY
INTERNATIONAL AIRPORT - REHABILITATION OF PARKING LOT P6 AND GAS
STATION SITE**

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 initialled 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 initialled.

CHANGES TO THE CONTRACT DRAWINGS

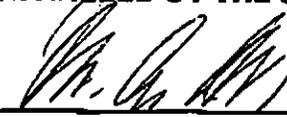
- Dwg S012 - In the lower left portion of drawing, in Section S2, make the following changes:
 - A. In the top center of the section, delete "19'-6" " and substitute therefor "Varies, see Civil Dwg."
 - B. Just below the aforementioned change, delete "18-0" " and substitute therefor "Varies, see Civil Dwg."
- Dwg C045 - In the right column of details, make the following changes to the detail entitled "CONCRETE PAVEMENT MEETING SIDEWALK (HEADER)":
 - A. Delete "Parking Lot Pavement" and substitute therefor "Pavement Type I".
 - B. Delete "2" A.C." and substitute therefor "3" Warm Mix A.C."
- Dwg C049 - In the upper left corner of Dwg, just below the detail title "FLEXIBLE PAVEMENT RESTORATION", delete "(ALL PAVEMENTS OTHER THAN IN PARKING LOT)" without substitution therefor.

2009 AUG -3 PM 3:26
PROJECT/RENT

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

**Francis J. Lombardi, P.E.
Chief Engineer**

INITIALLED BY THE BIDDER:



THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3RD FLOOR
NEWARK, NJ 07102

July 24, 2009

ADDENDUM NO. 10

TO PROSPECTIVE BIDDERS ON CONTRACT EWR-154.028 - NEWARK LIBERTY
INTERNATIONAL AIRPORT - REHABILITATION OF PARKING LOT P6 AND GAS
STATION SITE

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 initialled 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 initialled.

CHANGES IN THE CONTRACT BOOKLET

Page 1 - In the first paragraph, change the day and date for receipt of Proposals to
"Monday, August 3, 2009".

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Francis J. Lombardi, P.E.
Chief Engineer

JUL 27 2009

INITIALLED BY THE BIDDER:



2009 AUG - 3 PM 3: 26

PROCUREMENT

**THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3RD FLOOR
NEWARK, NJ 07102**

July 23, 2009

JUL 24 2009

ADDENDUM NO. 9

TO PROSPECTIVE BIDDERS ON CONTRACT EWR-154.028 – NEWARK LIBERTY INTERNATIONAL AIRPORT – REHABILITATION OF PARKING LOT P6 AND GAS STATION SITE

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 BOOKLET

Page vii - Make the following changes:

- A. After Section 07720 PREFABRICATED CURB AND EQUIPMENT SUPPORT UNITS insert the following:

"07721 ROOF HATCHES AND HEAT/SMOKE VENTS"
- B. After Section 09503 LAY-IN PANEL ACOUSTICAL CEILINGS insert the following which was previously deleted by Addendum No. 4:

"09514 EXTERIOR SNAP-IN METAL PAN CEILINGS"

Page 6 - In the clause entitled "Available Documents", after the text of E. insert the following:

- "F. Drawing bearing the general title "The Port Authority of NY & NJ – Engineering Department – Geotechnical – F.A.A. Building Foundation Site I" which is separately numbered and entitled as follows:

*EWR-SL-472 Boring Location Plan and Presentation of Borings
- G. Drawings bearing the general title "The Port Authority of NY & NJ – Engineering Department – Geotechnical – Port Street and Brewster Road Improvements" which are separately numbered and entitled as follows:

- *EWR-SL-563 Project Site Map, Boring Location Plan, General Notes, Legend, Abbreviations & Symbols, Soil Classifications
- *EWR-SL-564 Presentation of Borings
- *EWR-SL-565 Presentation of Borings"

Page 696 - Following this page, insert new Section 07721 entitled "Roof Hatches And Heat/Smoke Vents" (pages 696A through 696E) which are attached hereto and made a part hereof.

Page 779 - Following this page, insert new Section 09514 entitled "Exterior Snap-In Metal Pan Ceilings" (pages 779A through 779M) which are attached hereto and made a part hereof.

CHANGES TO THE CONTRACT DRAWINGS

Dwg. E302 Delete the text of Note 7 in its entirety and substitute therefor the following:

"7. Roadway Lighting Base – See Typical Roadway Handhole and Lighting Pole Base Detail on Drawing E605."

Dwg. E303 Delete the text of Note 7 in its entirety and substitute therefor the following:

"7. Roadway Lighting Base – See Typical Roadway Handhole and Lighting Pole Base Detail on Drawing E605."

Dwg. E304 Delete the text of Note 5 in its entirety and substitute therefor the following:

"5. Roadway Lighting Base – See Typical Roadway Handhole and Lighting Pole Base Detail on Drawing E605."

REVISED CONTRACT DRAWINGS

Contract Drawing E601 has been revised as of 7/17/09. Copies of this drawing are forwarded herewith. Destroy the Contract Drawing of this number now in your possession and substitute therefor the revised Contract Drawing.

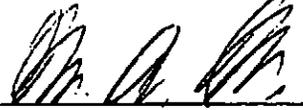
NEW AVAILABLE DOCUMENTS

Transmitted herewith for the bidder's convenience are Drawings Nos. EWR-SL-472, EWR-SL-563, EWR-SL-564 and EWR-SL-565.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Francis J. Lombardi, P.E.
Chief Engineer

INITIALED BY THE BIDDER:



2009 AUG -3 PM 3:26

PROCUREMENT

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.

	<u>American Society for Testing and Materials (ASTM)</u>
ASTM A 653	Steel Sheet, Zinc-Coated (Galvanized) (OR Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
	<u>Federal Specifications (FS)</u>
FS TT-P-664D	Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant
	<u>National Fire Protection Association (NFPA)</u>
NFPA 204M	Smoke and Heat Venting
	<u>Steel Structures Painting Council (SSPC)</u>
Paint 12	Cold Applied Asphalt Mastic (Extra Thick Film)
PA-1	Shop, Field and Maintenance Painting
	<u>Underwriters Laboratories Inc. (UL)</u>
	"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 A 653 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.

1. 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. 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.

C. Fabricate Units of size(s) shown on the Contract Drawings with welded construction.

D. 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.

E. 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-PA 1 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.

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.

END OF SECTION

SECTION 07721

ROOF HATCHES AND HEAT/ SMOKE VENTS

SUBMITTALS

APPENDIX "A"

Submit the manufacturer's product data, installation and care instructions, along with dimensioned drawings indicating fastening method and recommendations in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division - 1 GENERAL PROVISIONS.

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DIVISION 9

SECTION 09514

EXTERIOR SNAP-IN METAL PAN CEILINGS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for snap-in metal pan ceilings, including suspension system.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Architectural Manufacturers Association (AAMA)

- AAMA 606.1 Voluntary Guide Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum.
- AAMA 607.1 Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes Architectural Aluminum.
- AAMA 608.1 Voluntary Guide Specifications and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.

American Society for Testing and Materials (ASTM)

- ASTM A 123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- ASTM A 153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- ASTM C 634 Definition of Terms Relating to Environmental Acoustics.
- ASTM C 635 Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- ASTM C 636 Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
- ASTM D 523 Test Method for Specular Gloss.
- ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials.
- ASTM E 699 Standard 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 E 1264 Standard Classification for Acoustical Ceiling Products.

National Association of Architectural Metal Manufacturers (NAAMM)

Metal Finishes Manual for Architectural and Metal Products.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Metal pan ceilings and suspension system shall conform to the requirements of this Section including the following criteria:
 - 1. Shall withstand inward and outward acting wind pressure loading as shown on the Contract Drawings and normal thermal movement, without showing permanent deformation of ceiling system components including pans and suspension systems.
 - a. Normal thermal movement is defined as that resulting from a maximum change (range) in ambient temperature of 100 degrees F.
 - 2. Shall withstand noise or metal fatigue caused by vibration, deflection and displacement of ceiling units.
 - 3. Shall be capable of resisting permanent damage to fasteners and anchors.
- B. Perform laboratory test of a 4 foot by 6 foot section of snap-in metal pan ceiling and components to demonstrate compliance with wind pressure loading stipulated in 1.03 A, based on testing of ceiling and components identical to that to be furnished and installed as Work of this Section.
- C. For Work in New York City, metal suspension systems shall conform to the Building Code of the City of New York, except that metal deck tabs shall not be used for the top hanger attachment.
- D. For Work in New Jersey, metal suspension systems shall conform to ASTM C 635 and ASTM C 636, except for design and installation of hangers and their top and bottom connections.
 - 1. For the design and installation of hangers and their top and bottom connections, the above ASTM standards shall be revised as follows:
 - a. The hanger and its connections shall safely carry the total supported load plus 200 pounds.
 - b. Hangers for suspending carrying channels or main runners shall be as specified in this Section.
 - c. Metal deck tabs shall not be used for top hanger attachment.
- E. A professional engineer shall perform structural calculations to show compliance with 1.03, where required by the Contract Drawings

1.04 ENVIRONMENTAL REQUIREMENTS

Do not install metal pan ceilings until space is enclosed and weatherproof and until wet Work in space is completed and nominally dry.

1.05 QUALITY ASSURANCE

- A. Definitions and Performance Data

Except as otherwise shown on the Contract Drawing or referenced in this Section, technical acoustical terminology as it is used in this Section is defined in ASTM C 634.

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B. Fire Performance Characteristics

Provide metal pan ceiling units, including sound absorption pads that are identical to those tested in accordance with ASTM E 84 by an independent testing laboratory acceptable to the Engineer, to provide the following surface burning characteristics:

1. Flame Spread: 25 or less.
2. Smoke Developed: 50 or less.

C. The entity performing installation Work of this Section shall be a firm that has successfully completed metal pan ceiling installations similar in material, design, and extent to that shown on the Contract Drawings for Work of this Contract.

D. **Single-Source Responsibility:** Obtain each type of metal pan ceiling system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

E. **Job Mock-Up:** Prior to installation of metal pan ceiling system, erect a sample mock-up using system components where directed by the Engineer. The mock-up shall be a minimum of ten feet x ten feet, unless otherwise shown on the Contract Drawings, and shall include all component parts of the ceiling system. Obtain Engineer's acceptance of visual qualities of mock-up before start of ceiling installation. Accepted ceiling mock-up panel may be incorporated into the finished ceiling.

F. Professional Engineer Qualifications

Professional engineer shall be licensed to practice in the state where the project is located and experienced in providing engineering services for the successful installation of sheet metal fabrications similar in material, design and extent to that indicated in these Specifications and shown on the Contract Drawings for Work of this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. Extra Materials

Where requirement for extra materials are shown on the Contract Drawings, deliver the materials to the Engineer prior to issuance of the Certificate of Final Completion. Deliver materials in the manufacturer's original, unopened packaging with label or marking indicating brand name and Contract Number, and an attached packing list indicating quantity of solid and perforated panels included in packages. Furnish extra materials in quantities shown on the Contract Drawings.

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 by one of the following, or approved equal:

Alcan Building Products Corp., Charlotte, NC
Hunter Douglas Architectural Products, Inc., Atlanta, GA
Simplex Ceiling Corp., New York, NY
Steel Ceilings, Inc., Coshocton, OH

2.02 MATERIALS

A. Standard for Metal Pan Ceiling Units

Provide units of configuration as shown on the Contract Drawings which comply with ASTM E 1264.

B. Colors, Textures and Patterns

Provide metal facing (pans) with characteristics as specified in this Section for the ceiling types shown on the Contract Drawings.

C. Sound Absorption (Acoustical) Pads

Where perforated metal pan ceiling units are shown on the Contract Drawings, provide sound absorptive pads conforming to 1.04 B, of thickness required to produce NRC rating shown on the Contract Drawings or, if NRC grade is not shown, as follows:

1. Pad Material

Glass fiber of 1 lb./cu. ft. density, wrapped in plastic bags, installed over metal spacer grid to separate pad from pan. Use of polyvinyl chloride wrapper is not permitted.

2. Pad Thickness: 1 inch.

3. Spacer Grid Metal

Aluminum to match metal facing (pans) or galvanized steel at steel and stainless steel facing (pans).

D. Metal Facing (Pans)

As follows where shown on the Contract Drawings:

1. Type V Units

Steel pans, die-formed from cold-rolled steel sheet into pans with beveled edges and continuous beads on flanges for snap-in engagement with suspension system, and complying with the following:

a. Gauge

24, unless greater material thicknesses are required for conformance with 1.03 A.

b. Finish

Manufacturer's standard baked enamel finish color as required by Appendix "A", 2 coats on face and 1 coat on back, over electrolytic zinc-and-phosphate-coated steel.

c. Pattern

Diagonal uniform perforations, 0.125-inch diameter, 576 holes per sq. ft., 1/2-inch on center, 4.9 percent open area, unless otherwise shown on the Contract Drawings.

d. Size

12 inches wide, either 12 inches long or multiples of 12 inches long scored at 12 inch intervals to appear as 12 inches x 12 inches ceiling tiles unless otherwise shown on the Contract Drawings.

2. Type VI Units

Aluminum pans, die-formed from aluminum sheet into pans with square or beveled edges as shown on the Contract Drawings, and continuous beads on flanges for snap-in engagement with the suspension system, and complying with the following:

a. Thickness

0.040 inch for facing panels and 0.025 inch for backer sheets, unless otherwise required to conform to 1.03 A.

b. 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) Fluoropolymer Coating (where "Kynar 500" finish and/or "Duronar XL" is shown on the Contract Drawings)

For exposed exterior surfaces, full-strength 70 percent "Kynar 500" coating baked-on for 15 minutes at 450 degrees F (232 degrees C), in a dry film thickness of 1.0 mil, 30 percent reflective gloss, unless otherwise shown on the Contract Drawings, (ASTM D 523), over minimum 0.2 mil baked-on modified epoxy primer.

Where "Duronar XL" finish is shown on the Contract Drawings, finish system shall be composed of base and top coats, as specified above and a clear Duronar top coat, spray-applied in factory, according to specifications of Pittsburgh Plate Glass, Pittsburgh, PA.

- (3) Anodized Finish (where shown on the Contract Drawings)

- (a.) Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- (b.) Where clear anodized finish is shown on the Contract Drawings - Class I Clear Anodized Finish: AA-M12C22A41 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class I Architectural, clear film thicker than 0.7 mil) complying with AAMA 607.1.
- (c.) Where light bronze anodized, medium bronze anodized, dark bronze anodized, black anodized or color anodized finish is shown on the Contract Drawings - Class I Color Anodized Finish: AA-M12CCA42/A44 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, Medium Matte; Anodic Coating: Class I Architectural, film thicker than 0.7 mil with integral color or electrolytically deposited color) complying with AAMA 606.1 or AAMA 608.1.

c. Pattern

- (1) Diagonal uniform perforations, 0.125-inch diameter
- (2) 576 holes per sq. ft., 1/2-inch on center, 4.9 percent open area, unless otherwise shown on the Contract Drawings.

d. Stiffener Core (where shown on the Contract Drawings)

Corrugated 0.040-inch aluminum reinforcement designed to snap into pan for added rigidity of units. Perforated at metal pan ceiling units which are shown on the Contract Drawings to be perforated and scheduled to receive absorption pads.

e. Size

12 inches wide, either 12 inches long or multiples of 12 inches long scored at 12 inch intervals to appear as 12 inches x 12 inches ceiling tiles, unless otherwise shown on the Contract Drawings.

3. Type VII Units

Stainless steel pans, die-formed from 24-gauge stainless steel sheet into pans with beveled edges and continuous beads on flanges for snap-in engagement with the suspension system, and complying with the following:

a. Alloy

AISI Type 303/304, unless otherwise shown on the Contract Drawings or other type of alloy is required to produce finish shown on the Contract Drawings.

b. Finish

Manufacturer's standard satin finish, unless otherwise shown on the Contract Drawings.

c. Pattern

Diagonal uniform perforations, 0.125-inch diameter, 576 holes per sq. ft., 1/2-inch on center, 4.9 percent open area, unless otherwise shown on the Contract Drawings.

d. Size

24 inches by 24 inches nominal, unless otherwise shown on the Contract Drawings.

E. Snap-In Metal Pan Concealed Suspension Systems

1. General

Provide intermediate-duty system, as defined in ASTM C 635, unless otherwise shown on the Contract Drawings, complete with snap-bars, splice plates, connector clips, alignment clips, carrying channels, hangers, trim and other suspension components required to support ceiling units and other ceiling-supported Work, as required for application shown on the Contract Drawings.

2. Type of System

Indirect-hung suspension system, as defined in ASTM C 635, with snap-bars clipped to suspended carrying channels installed perpendicular to the snap-bars.

3. Structural Performance

Provide a suspension system capable of supporting ceiling loads shown on the Contract Drawings and specified in 1.03 A with deflections limited to 1/360 of span between support points.

4. Metal and Finish of Snap-Bars

Of same basic material as ceiling facing (pan), gage as required to conform to 1.03 B and the following:

a. Steel: ASTM A 123 or ASTM A 153 galvanized, 1.5 oz. minimum.

b. Aluminum: Mill finish.

c. Stainless Steel: Same alloy as stainless steel snap-in pan units.

F. Exposed Fillers and Trim

Provide exposed members as shown on the Contract Drawings or required for edges of ceiling, fixture trim, beams, fascias at changes in ceiling height and other conditions; of metal and finish matching snap-in metal ceiling units.

G. Access Panels

For access at locations shown on the Contract Drawings, provide snap-in ceiling units, each with 2 access knobs; place one access knob at each end of panel near corners.

H. Miscellaneous Materials

1. Concrete Inserts

Type recommended by suspension system manufacturer, sized for pull-out resistance of not less than 5-times hanger design load for structural classification as shown on the Contract Drawings (ASTM C 635, Table 1, Indirect Hung) or loading indicated in 1.03, whichever is greater.

2. Attachment Devices

Type recommended by suspension system manufacturer for attachment or anchorage of ceiling hangers to structure, sized for not less than 5-times hanger design load for structural classification as shown on the Contract Drawings (ASTM C 635, Table 1, Indirect-Hung) or loading indicated in 1.03, whichever is greater.

3. Hangers for attachment of suspension system to structure above shall be 1-1/2 inches x 1-1/2 inches x 1/8 inch hot or cold rolled galvanized steel angles, unless otherwise shown on the Contract Drawings or if greater sizes are required, as determined by structural analysis. Hangers finish shall be hot-dip zinc coating, 1.5 oz. minimum, ASTM A 123 or ASTM A 153 as applicable, unless otherwise shown on the Contract Drawings.

4. Carrying Channels

Hot-rolled or cold-rolled steel channels for support of the ceiling runners with deflections less than $1/360 \times$ spans; but in no case less than 1-1/2 inch section weighing 0.475 lbs. per in. Ω , and in no case less than required to conform to 1.03 A.

a. Carrying Channel Finish

Hot-dip zinc coating, 1.5 oz. minimum, ASTM A 123 or ASTM A 153 as applicable, unless otherwise shown on the Contract Drawings.

b. Carrying Channel/Hanger/Primary Framing Attachments

Minimum 3/8 inch diameter round head bolts located at least 3/8 inch from end of hanger or clipped to hangers with approved clips or other approved fastening device.

5. Sealant, where shown on the Contract Drawings, shall be resilient, non-staining, non-shrinking, non-hardening, non-skinning, non-drying, non-sag sealant intended for perimeter sealing and exterior sealing of concealed construction joints.

2.03 CONSTRUCTION FEATURES

Where backer sheet is shown on the Contract Drawings, fabricate panels with an airtight and watertight seal between backer sheet and panel flanges. Provide adequate space in cavity between facing sheet and backing sheet for sound absorption pads and spacer grids specified in 2.02 C.

PART 3. EXECUTION

3.01 PREPARATION

A. Concrete Inserts

Where cast-in-place concrete is shown on the Contract Drawings for support of metal pan ceilings, deliver required suspension system inserts to the construction site well in advance of when formwork is completed. Furnish placement layouts and instructions showing required locations and spacings for inserts. Do not support ceilings directly from permanent metal forms; furnish inserts and extend hangers through forms into concrete inserts.

B. Supports in Metal Decking

Where metal decking is shown on the Contract Drawings to support metal pan ceilings, furnish placement layouts and instructions to the decking installer well in advance of decking installation. Show required locations and spacings for clips, slots and other provisions in decking to receive ceiling support hangers. Use of metal deck tabs will not be permitted.

C. Pre-Installation Conference

Prior to start of metal pan ceiling installation, meet at construction site with installers of related Work, including lighting, ductwork and similar Work in ceiling plenum. Review areas of potential interference and resolve conflicts before proceeding with Work. Coordinate ceiling layout with the layout of other work that penetrates or is supported by ceiling in each space of the Work.

D. Plan each layout to balance border widths at opposite edges of each ceiling area, unless otherwise shown on the Contract Drawing. Avoid use of less-than-half width units wherever possible. Comply with reflected ceiling plans shown on the Contract Drawings and approved shop drawings.

3.02 INSTALLATION

A. General

Install metal pan ceiling in accordance with the manufacturer's printed instructions, applicable portions of ASTM C 636, the Contract Drawings and approved shop drawings.

- B. Suspend ceiling hangers from building structure only. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of the supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal force by bracing, countersplaying or other equally effective means. Space hangers not more than 4 feet on center along each member supported directly from hangers and as required by 1.03 B and provided hanger is not more than 6 inches from the ends of each member.

- C. Install edge moldings of the type shown on the Contract Drawings or, if not shown, provide the manufacturer's standard edge molding at the edges of each metal pan ceiling area, and at locations where edge of units would otherwise be exposed after the completion of Work.

1. Apply continuous ribbon of sealant on back of molding vertical leg before fastening to vertical surface. Locate so that sealant will be concealed after installation. Also apply sealant at locations shown on the Contract Drawings or, if not shown, apply as required to seal against air migration.

2. Secure moldings to building construction by fastening through holes drilled in vertical leg. Space holes not more than 3 inches from each end and not more than 16 inches on center. Draw-up fasteners for tight set against vertical surfaces.

a. Masonry and Concrete

Fasten with wood or machine screws into lead-shield type anchors drilled into construction.

b. Hollow Masonry or Stud Construction

Fasten with toggle bolts or similar self-expanding screw anchors.

3. Miter corners of moldings accurately to provide hairline joints.
4. Level moldings with ceiling suspension system, to level tolerance of 1/8 inch in 12 feet.

- D. Scribe and cut metal pan units for accurate fit at borders and at interruptions and penetrations by other Work through ceilings. Stiffen edges of cut units as required to eliminate evidence of oil canning or buckling.

- E. Install snap-in metal pan units, complete with acoustical pads where perforated units are shown on the Contract Drawings, in coordination with the suspension system and snap-bars.

1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis, or existing adjacent in-place ceiling, in both directions, unless otherwise shown on the Contract Drawings.

2. Fit adjoining tile to form flush, tight joints. Scribe and cut for accurate fit at borders and around Work that penetrates the ceiling.

3.03 PROTECTION

- A. Clean exposed surfaces of metal acoustical units and trim, edge moldings, and suspension members and comply with the manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace Work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.
- B. Institute required protection for metal acoustical ceilings, including temperature and humidity limitations and dust control, so that Work will be without damage and deterioration at the time of issuance of the Certificate of Final Completion.

END OF SECTION

SECTION 09514

EXTERIOR SNAP-IN METAL PAN CEILINGS

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, installation instructions and cleaning recommendations including precautions against materials and methods which may be detrimental to finish.

B. Shop Drawings

Complete shop drawings and reflected ceiling plans, fully coordinated with regard to penetration and ceiling mounted items drawn accurately to scale, and indicating the following:

1. Locations of all utilities concealed by the ceiling with dimensions referenced to visible features of construction, and the location of ceiling referenced to field survey bench mark, if any.
2. Joint pattern.
3. Ceiling suspension members, method of anchorage to building structure and framing for supported items, including materials and properties of all elements of the ceiling framing system.
4. Direction of ceiling and suspension system.
5. Sections or details of mounting and support conditions, terminations and fasteners, including calculated hanger loadings.
6. Identification and description of materials, components and integration with related mechanical and electrical components and adjacent existing construction.
7. Ceiling-mounted items including light fixtures; air outlets and inlets; speakers; sprinkler heads; access panels; and special moldings at walls, column penetrations and other junctures with adjoining construction.
8. Design loadings specified in this Section or shown on the Contract Drawings.
9. Bottom elevations of ceiling and bottom of ceiling support framing elements.

C. Samples

For approval by the Engineer, prior to ordering materials, samples in triplicate of each element of the ceiling system including:

1. Minimum 12-inch square of ceiling assembly with all components assembled, including perforated and solid ceiling panels.
2. Minimum 12-inch lengths of ceiling panels, carriers, filler strips and trim, if any.
3. Manufacturer's standard color chart of colors and finish of ceiling panels, filler strips and trim, if any, when color is not shown on the Contract Drawings.

D. Certifications

1. Qualifications of testing laboratory required under 1.03 B, for approval. Such laboratory must demonstrate to the Engineer's satisfaction, based on evaluation of laboratory submitted criteria conforming to ASTM E 699, that it has experience and capability to satisfactorily conduct the indicated testing without delaying the progress of Work of this Section.
2. Copies of M.E.A. certification documents issued by the city of New York for metal pan ceiling system, of type shown on the Contract Drawings and in accordance with this Specification.

E. Test Reports

Results of tests required under 1.03 B.

F. Qualifications

Qualification data for entities specified in 1.03 C 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"

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3RD FLOOR
NEWARK, NJ 07102

July 21, 2009

JUL 22 2009

ADDENDUM NO. 8

TO PROSPECTIVE BIDDERS ON CONTRACT EWR-154.028- NEWARK LIBERTY INTERNATIONAL AIRPORT - REHABILITATION OF PARKING LOT P6 AND GAS STATION SITE

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 initialled 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 initialled.

CHANGES IN THE CONTRACT BOOKLET

Page 38 (Revised by - Delete this page in its entirety and physically attach in its place new
Addendum No. 7) page 38 which is attached hereto and made a part hereof.

Page 40 (Revised by - Delete the last paragraph on the page in its entirety and substitute
Addendum No. 7) therefor the following:

"In the case of Item No. 10 (Base Course), the quantity for payment shall be the number of cubic yards of aggregate base course (ABC), dense graded aggregate base course (DGABC), open graded aggregate base course (OGABC), and reused millings actually placed, computed by the Engineer using the Average End Area Method, based upon the cross-sections taken by the Contractor before and after placement of the ABC, DGABC, OGABC and reused millings."

REVISED CONTRACT DRAWINGS

Contract Drawing ES104 has been revised as of 7/16/09 and Contract Drawings T006 and T014 have been revised as of 7/17/09. Copies of these drawings are forwarded herewith. Destroy the Contract Drawings of these numbers now in your possession and substitute therefor the revised Contract Drawings.

Contract EWR-154.028
Addendum No. 8

2

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Francis J. Lombardi, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:



PROCUREMENT
2009 AUG -3 PM 3: 28

I. SCHEDULE OF UNIT PRICES FOR CLASSIFIED WORK				
Item No.	Estimated Quantities	Items of Classified Work With Unit Prices Written	Figures	
			Unit Prices	Amounts ²¹
8	116,800 S.Y.	TACK COAT, PER SQUARE YARD _____ DOLLARS _____ CENTS		
9	151,990 S.Y.	RUBBERIZED COAL TAR EMULSION SEALCOAT, PER SQUARE YARD _____ DOLLARS _____ CENTS		
10	6,500 C.Y.	BASE COURSE, PER CUBIC YARD _____ DOLLARS _____ CENTS		
11	685 TON	PLANT MIX MACADAM, PER TON _____ DOLLARS _____ CENTS		
12	15,000 LBS.	REPLACEMENT OF CARBON IN THE WATER TREATMENT SYSTEM'S LIQUID PHASE GRANULAR ACTIVATED CARBON UNIT, PER POUND _____ DOLLARS _____ CENTS		
ESTIMATED TOTAL FOR CLASSIFIED WORK ²²				

²² The Estimated Total for Classified Work shall be computed by totaling the amounts inserted in the "Amounts" column.

**THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3RD FLOOR
NEWARK, NJ 07102**

July 17, 2009

ADDENDUM NO. 7

**TO PROSPECTIVE BIDDERS ON CONTRACT EWR-154.028- NEWARK LIBERTY
INTERNATIONAL AIRPORT - REHABILITATION OF PARKING LOT P6 AND GAS
STATION SITE**

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 initialled 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 initialled.

CHANGES IN THE CONTRACT BOOKLET

Pages 37, 38 - Delete these pages in their entireties and physically attach new pages 37,
40, and 41 38, 40, and 41, which are attached hereto and made a part hereof.

REVISED CONTRACT DRAWINGS

Contract Drawings C003, C045, and C053 (dated 7/16/09) have been revised. Copies of these drawings are forwarded herewith. Destroy the Contract Drawings of these numbers now in your possession and substitute therefor the revised Contract Drawings.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Francis J. Lombardi, P.E.
Chief Engineer

JUL 20 2009

INITIALLED BY THE BIDDER:



2009 AUG -3 PM 3:29

PROUREMENT

I. SCHEDULE OF UNIT PRICES FOR CLASSIFIED WORK				
Item No.	Estimated Quantities	Items of Classified Work With Unit Prices Written	Figures	
			Unit Prices	Amounts ²¹
1	75,665 S.Y.	MILL ASPHALT CONCRETE TO 2" BELOW FINISHED GRADE, PER SQUARE YARD _____ DOLLARS _____ CENTS		
2	40,345 S.Y.	FULL DEPTH FLEXIBLE PAVEMENT REMOVAL - 6" ASPHALT CONCRETE AND 6" AGGREGATE BASE COURSE, PER SQUARE YARD _____ DOLLARS _____ CENTS		
3	2,300 S.Y.	FULL DEPTH FLEXIBLE PAVEMENT REMOVAL - 4" ASPHALT CONCRETE AND 6" AGGREGATE BASE COURSE, PER SQUARE YARD _____ DOLLARS _____ CENTS		
4	3,612 S.Y.	REMOVE CONCRETE SIDEWALK OR CONCRETE ISLANDS, PER SQUARE YARD _____ DOLLARS _____ CENTS		
5	260 C.Y.	REMOVE CONCRETE SLAB, PER CUBIC YARD _____ DOLLARS _____ CENTS		
6	830 TON	ASPHALT CONCRETE MIX I-4 PG 64-22, PER TON _____ DOLLARS _____ CENTS		
7	27,685 TON	WARM MIX ASPHALT CONCRETE PG 64-22, PER TON _____ DOLLARS _____ CENTS		

²¹ The amount for each item shall be computed by multiplying the estimated quantity of that item by the unit price for the item.

PROCESSED

I. SCHEDULE OF UNIT PRICES FOR CLASSIFIED WORK				
Item No.	Estimated Quantities	Items of Classified Work With Unit Prices Written	Figures	
			Unit Prices	Amounts ²¹
8	116,800 S.Y.	TACK COAT, PER SQUARE YARD _____ DOLLARS _____ CENTS		
9	151,990 S.Y.	RUBBERIZED COAL TAR EMULSION SEALCOAT, PER SQUARE YARD _____ DOLLARS _____ CENTS		
10	5,970 C.Y.	DENSE GRADED AGGREGATE BASE COURSE (DGABC), PER CUBIC YARD _____ DOLLARS _____ CENTS		
11	685 TON	PLANT MIX MACADAM, PER TON _____ DOLLARS _____ CENTS		
12	15,000 LBS.	REPLACEMENT OF CARBON IN THE WATER TREATMENT SYSTEM'S LIQUID PHASE GRANULAR ACTIVATED CARBON UNIT, PER POUND _____ DOLLARS _____ CENTS		
ESTIMATED TOTAL FOR CLASSIFIED WORK ²²				

²² The Estimated Total for Classified Work shall be computed by totaling the amounts inserted in the "Amounts" column.

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 PROCEEDMENT

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

In the case of Item No. 1 (MILL ASPHALT CONCRETE TO 2" BELOW FINISHED GRADE), the quantity for payment shall be the number of square yards of existing asphalt concrete pavement actually milled 2" below finished grade prior to asphalt concrete paving, measured on the surface of the pavement after milling.

In the case of Item No. 2 (FULL DEPTH FLEXIBLE PAVEMENT REMOVAL - 6" ASPHALT CONCRETE AND 6" AGGREGATE BASE COURSE), the quantity for payment shall be the number of square yards of existing full depth flexible pavement (6" Asphalt concrete, 6" Aggregate Base Course) actually removed; measured on the surface of the pavement after full depth flexible pavement removal.

In the case of Item No. 3 (FULL DEPTH FLEXIBLE PAVEMENT REMOVAL - 4" ASPHALT CONCRETE AND 6" AGGREGATE BASE COURSE), the quantity for payment shall be the number of square yards of existing full depth flexible pavement (4" Asphalt concrete, 6" Aggregate Base Course) actually removed, measured on the surface of the pavement after full depth flexible pavement removal.

In the case of Item No. 4 (REMOVE CONCRETE SIDEWALK OR CONCRETE ISLANDS), the quantity for payment shall be the number of square yards of existing concrete sidewalk or concrete island actually removed, measured on the surface of the pavement after concrete sidewalk or concrete island removal.

In the case of Item No. 5 (REMOVE CONCRETE SLAB), the quantity for payment shall be the number of cubic yards of existing 8" thick concrete actually removed, measured on the surface of the pavement after concrete slab removal.

In the case of Item No. 6 (ASPHALT CONCRETE MIX I-4, PG 64-22), the quantity for payment shall be the number of tons of asphalt concrete, PG 64-22, mix I-4 PG 64-22 actually placed. The weight of this item shall be based on the certified scale weight of material in trucks weighed on approved scales, or at the option of the Engineer, on certified automated printouts at plants using an automatic batching and mixing system. In case of conflict between the printout weight and the scale weight, the scale weight shall control.

In the case of Item No. 7 (WARM MIX ASPHALT CONCRETE, PG 64-22), the quantity for payment shall be the number of tons of warm mix asphalt concrete, PG 64-22, actually placed. The weight of this item shall be based on the certified scale weight of material in trucks weighed on approved scales, or at the option of the Engineer, on certified automated printouts at plants using an automatic batching and mixing system. In case of conflict between the printout weight and the scale weight, the scale weight shall control.

In the case of Item No. 8 (TACK COAT), the quantity for payment shall be the number of square yards of surface on which tack coat is actually placed, measured on the surface after placement. No deductions from the measured area will be made for catch basins, manholes or other horizontal structures and no vertical surfaces will be measured for payment.

In the case of Item No. 9 (RUBBERIZED COAL TAR EMULSION SEALCOAT), the quantity for payment shall be the number of square yards of surface on which rubberized coal tar emulsion sealcoat is actually placed, measured on the surface of the pavement after placement. No deductions from the measured area will be made for catch basins, manholes or other horizontal structures and no vertical surfaces will be measured for payment.

In the case of Item No. 10 (DENSE GRADED AGGREGATE BASE COURSE (DGABC)), the quantity for payment shall be the number of cubic yards of dense graded aggregate base course (DGABC) actually placed, computed by the Engineer using the Average End Area Method, based upon the cross-sections taken by the Contractor before and after placement of the dense graded aggregate base course.

In the case of Item No. 11 (PLANT MIX MACADAM), the quantity for payment shall be the number of tons of plant mix macadam actually placed. The weight of this item shall be based on the certified scale weight of material in trucks weighed on approved scales, or at the option of the Engineer, on certified automated printouts at plants using an automatic batching and mixing system. In case of conflict between the printout weight and the scale weight, the scale weight shall control.

In the case of Item No. 12 (REPLACEMENT OF CARBON IN THE WATER TREATMENT SYSTEM'S LIQUID PHASE GRANULAR ACTIVATED CARBON UNIT), the quantity for payment shall be the number of pounds of carbon replaced in the water treatment system's liquid phase granular activated carbon unit, as determined by the Engineer.

23. 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.

24. 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, an amount equal to the actual net cost in money of the labor and materials required for the provision of such services, plus seven per cent (7%) of such net cost.
- 2.) For Extra Work consisting of performance of construction work at the construction site, an amount determined as follows:
 - a. In the case of Extra Work performed by the Contractor personally, an amount equal to the actual net cost in money of the labor and materials required for such Extra Work, plus twenty per cent (20%) of such net cost, plus such rental for equipment (other than small tools) required for such Extra Work as the Engineer deems reasonable.
 - b. In the case of Extra Work performed by a subcontractor, an amount equal to the actual net cost in money of the labor and materials required for such Extra Work, plus twenty per cent (20%) of such net cost plus such rental for equipment (other than small tools) required for such Extra Work as the Engineer deems reasonable, plus seven per cent (7%) of the sum of the foregoing cost, percentage of cost, and rental.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3RD FLOOR
NEWARK, NJ 07102

July 16, 2009

JUL 17 2009

ADDENDUM NO. 6

TO PROSPECTIVE BIDDERS ON CONTRACT EWR-154.028- NEWARK LIBERTY
INTERNATIONAL AIRPORT - REHABILITATION OF PARKING LOT P6 AND GAS
STATION SITE

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 initialled 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 initialled.

CHANGES IN THE CONTRACT BOOK

Pages 722 - Delete these pages and substitute therefor new pages 722 through 725A,
725 which are attached and made a part hereof.

Page 829B - Delete 2.01.A and substitute therefor the following:

- A. Subject to compliance with the requirements of this Section, provide toll booths from a single source from one of the following manufacturers:
- 1.) Keystone Structures, Kennett Square, PA
 - 2.) Kullman Industries, Lebanon, NJ
 - 3.) Moli Metal Inc., Montreal Canada
 - 4.) Revenue Markets Inc., Accord, NY

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Francis J. Lombardi, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:



SECTION 08715

APPENDIX "A"

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.

<u>Item</u>	<u>Manufacturer</u>	<u>Symbol</u>
Locks/Latches	Best*	B*
	Corbin	C
	Yale	Y
Butts/Hinges	Hager	H
	McKinney	MC
	Stanley*	ST*
Door Bolts	Builders Brass Works	BW
	Ives*	I*
	Stanley	ST
Overhead Closers	Corbin	C
	LCN*	LCN*
	Yale	Y
Door Stripping, Drop Seal & Threshold	A.J. May	M
	Pemko	P
	Zero*	Z*
Silencers	Builders Brass Works	BW
	Ives*	I*
	Quality	Q
Door Trim/Stops	Builders Brass Works	BW
	Glynn-Johnson	GJ
	Ives*	I*
Padlock	Best**	B**

HARDWARE SETS

HW1	For Each Door No. 101: 1 Mortise lockset 1 ½ pairs Butt Hinges 4 ½"x4 ½" 1 Overhead closer with stop (ADA compliant) Door weather stripping 1 Threshold Silencers	Mfr & Number B*-45H-7-AB-12-M-630-RHRB ST*-FBB 191-32D/630 LCN*-4111-LH-(MC)US26D-3077CNS (no through bolt) Z* -#328AA cont. at head & jamb Z* -#568A I* -No. 20
HW2	For Each Door No. 102A 1 Mortise lockset 1 ½ pairs Butt Hinges 4 ½"x4 ½" Silencers	Mfr & Number B*-45H-7-LT-12-R-630-LHR ST*-FBB 191-US 26D/626 I* -No. 20
HW3	For Each Door Pair No. 102B 1 Mortise deadbolt (active leaf) 1 Dummy Trim Knob (active leaf) 3 pairs Butt Hinges 4 ½"x4 ½" 1 pair Manual Flush Bolts (inactive leaf) top and bottom Silencers	Mfr & Number B*-48H-7-K-SI-626 B*-83K-0-1DT-4-C-no strike-626 ST*-FBB 191-US 26D/626 I*-FB457N-B26D with dust proof strike at floor. I* -No. 20
HW4	For Each Door No. 103, 104 1 Mortise lockset 1 ½ pairs Butt Hinges 4 ½"x4 ½" 1 Overhead closer with stop Door weather stripping 1 Threshold Silencers	Mfr & Number B*-45H-7-D-12-M-630-RHRB-TAC ST*-FBB 191-32D/630 LCN*-4111-LH-(MC)US26D-3077CNS (no through bolt) Z* -#328AA cont. at head, jamb & sill Z* -#568A I* -No. 20
HW5	For Each Roof Hatch 1 Padlock with chain	Mfr & Number B** -41B772 with M5 chain

END OF APPENDIX "A"

SECTION 08715

APPENDIX "B"

KEYING

- A. Construction Key System
 - 1. Construction key system is required.
 - 2. Equip locks with cylinders for interchangeable core pin tumbler inserts.
 - a. Furnish and install temporary cores for the construction period. Remove cores when directed by the Engineer.
 - b. Furnish and install final cores.
 - c. Install final inserts provided by the Authority.
 - d. Final inserts provided and installed by the Authority.
- B. Keying System
 - 1. General: Meet with the Engineer and the facility manager to finalize keying requirements and obtain final instructions in writing.
 - a. Submit detailed keying schedule as required by 1.06 C.2 of this Specification Section to indicate final keying of locks. Provide the following:
 - (1) Keying system schematic diagram and floor plan(s) with corresponding key symbols indicated for each door.
 - (2) Copy of final keying schedule as transmitted to lock manufacturer.
 - (3) When keying is an extension of an existing system, include all references and registry numbers of existing keying.
 - 2. Provide new master key system.
 - 3. Provide (new) (integrated) (master) (grandmaster) (great-grandmaster) keying system, with the existing system.
 - 4. Mark the keying symbol on key bow only.
 - 5. Mark the keying symbol on face of cylinder barrel only.
 - 6. Mark the key symbol on key bow and face of cylinder barrel.
 - 7. Do not mark the keying symbol on key bow or face of cylinder barrel.
- C. Keys
 - 1. Key Material: Nickel silver, without substitution.
 - 2. If a construction key system is required by 1.01 A hereof, deliver construction keys and the temporary cores from the lock manufacturer to the Engineer via registered mail. Schedule mail delivery to provide key and core receipt to the Engineer prior to construction site delivery of finish hardware items.

3. **Key Quantity:** Deliver the following keys from the lock manufacturer to the Engineer via registered mail.
 - a. Prior to construction site delivery of finish hardware items:
 - (1) 4 change keys
 - (2) 4 of each master key, grandmaster key or great-grandmaster key.
 - b. Prior to issuance of the Certificate of Final Completion, 4 control keys for initial construction.

D. Key Control System

1. A key control system is required.
2. Furnish (and install where directed by the Engineer) (and deliver to the Engineer) a (Multiple drawer cabinet system), (hinged door surface mounted wall system), (hinged door recessed mounted wall system), (portable index tray system) of key control with 10 key capacity and provision for 50% per cent expansion.
 - a. Include envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers and permanent markers all as recommended by control system manufacturer.
3. Instruction at the construction site by a direct representative of the key control system manufacturer is not required.
4. The contractor shall arrange for a direct representative of the key control system manufacturer to be available at the construction site for a minimum of 4 hours when requested by the Engineer. Provide full instructions to Authority personnel on required management procedures to issue, record, receive and maintain the keys and control system records.

END OF APPENDIX "B"

SECTION 08715

APPENDIX "C"

MAINTENANCE PROVISIONS

- A. Extra Stock
 - 1. Extra stock for finish hardware items is not required.
- B. Specialized tools are not required.

END OF APPENDIX "C"

**THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3RD FLOOR
NEWARK, NJ 07102**

July 14, 2009

ADDENDUM NO. 5

**TO PROSPECTIVE BIDDERS ON CONTRACT EWR-154.028 – NEWARK LIBERTY
INTERNATIONAL AIRPORT – REHABILITATION OF PARKING LOT P6 AND GAS
STATION SITE**

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 initialled 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 initialled.

REVISED CONTRACT DRAWINGS

Contract Drawings C040 and C041 (dated 7/10/09), Contract Drawing C045 (dated 7/13/09), and Contract Drawing ES101 (dated 7/8/09) have been revised. Copies of these drawings are forwarded herewith. Destroy the Contract Drawings of these number now in your possession and substitute therefor the revised Contract Drawings.

CHANGES TO CONTRACT BOOK

Page 6 - Delete this page and substitute therefor new page 6, which is attached hereto and made a part hereof.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Francis J. Lombardi, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

JUL 16 2009

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PROCUREMENT

5. 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.

6. 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, One Madison Avenue, 7th Floor, New York NY 10010.

7. 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.

Said documents are as follows:

- *A. Port Authority of New York and New Jersey Remedial Investigation Testing Report (July 2008)
- *B. Building 75 Monitoring Well Installation Details for Rehabilitation of Parking Lot P6 and Gas Station Site (May 2009)
- *C. Building 75 Soil and Groundwater Monitoring Results and Figures for Rehabilitation of Parking Lot P6 and Gas Station Site (May 2009)
- D. Port Authority Facility Condition Survey Program: Group I Buildings – Condition Survey (December 1997)
- E. Building 75 Paint Containing Lead Analytical Report (May 2009)

* NOTE: For the Bidder's Convenience, these documents will be Transmitted with the Contract Documents

**THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3RD FLOOR
NEWARK, NJ 07102**

July 10, 2009

ADDENDUM NO. 4

TO PROSPECTIVE BIDDERS ON CONTRACT EWR-154.028- NEWARK LIBERTY INTERNATIONAL AIRPORT - REHABILITATION OF PARKING LOT P6 AND GAS STATION SITE

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 initialled 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 initialled.

CHANGES IN THE CONTRACT BOOK

- Page vii - Delete the listing for specification 09514.
- Page 6 - Delete this page and substitute therefor new page 6, which is attached hereto and made a part hereof.
- Page 627- Following this page, insert new pages 627A to 627Q (Section 05580) which are attached hereto and made a part hereof.
- Pages 1308 - Delete these pages and substitute therefor new pages 1308, 1309, and 1309A, and 1309 which are attached hereto and made a part hereof.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Francis J. Lombardi, P.E.
Chief Engineer

JUL 13 2009

INITIALLED BY THE BIDDER:

2009 JUL 13 3:27 PM
PROCUREMENT


5. 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.

6. 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, One Madison Avenue, 7th Floor, New York NY 10010.

7. 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.

Said documents are as follows:

- *A. Port Authority of New York and New Jersey Remedial Investigation Testing Report (July 2008)
 - B. Building 75 Monitoring Well Installation Details (May 2009)
 - *C. Building 75 Soil and Groundwater Monitoring Results and Figures for Rehabilitation of Parking Lot P6 and Gas Station Site (May 2009)
 - D. Port Authority Facility Condition Survey Program: Group I Buildings – Condition Survey (December 1997)
 - E. Building 75 Paint Containing Lead Analytical Report (May 2009)
- * NOTE: For the Bidder's Convenience, these documents will be Transmitted with the Contract Documents

DIVISION 5
SECTION 05580
SHEET METAL FABRICATIONS

PART 1. GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for formed sheet metal fabrications.
- B. Items specified in this Section include, but are not limited to the following, where shown on the Contract Drawings
 - 1. Closures and trim.
 - 2. Window stools.
 - 3. Pockets for window treatment.
 - 4. Filler panels.
 - 5. Column covers.
 - 6. Lighting troughs.
 - 7. Heating-cooling unit enclosures.
 - 8. Interior and exterior fascia panels.
 - 9. Interior and exterior soffit panels.
- C. Refer to Division 7 Section on Flashing and Sheet Metal for formed metal items used for flashing purposes, if any.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	<u>American Architectural Manufacturers Association (AAMA)</u>
AAMA 611	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 Society for Testing and Materials (ASTM)</u>
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 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 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 C 283	Test Method for Resistance of Porcelain Enameled Utensils to Boiling Acid.
ASTM C 538	Test Method for Color Retention of Red, Orange and Yellow Porcelain Enamels.
ASTM C 665	Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
ASTM C 916	Specification for Adhesives for Duct Thermal Insulation.
ASTM D 1056	Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.
ASTM E 136	Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.
	<u>American Welding Society, Inc. (AWS)</u>
AWS D1.2	Structural Welding Code – Aluminum.
AWS D1.3	Structural Welding Code – Sheet Steel.
	<u>National Association of Architectural Metal Manufacturers (NAAMM)</u>
	Metal Finishes Manual for Architectural and Metal Products.
	<u>Porcelain Enamel Institute (PEI)</u>
PEI-1001	Specifications for Architectural Porcelain Enamel.
	<u>The Society for Protective Coatings (SSPC)</u>
SSPC-PA 1	Shop, Field and Maintenance Painting of Steel.
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.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications

Firm that employs skilled persons, has successfully fabricated products similar to those required for Work of this Section and has sufficient capacity to produce required units without causing delay in the Work.

B. Engineer Qualifications

Professional engineer licensed to practice in state where the project is located and experienced in providing engineering services for the successful installation of sheet metal fabrications similar in material, design and extent to those indicated in these Specifications and shown on the Contract Drawings for Work of this Section.

C. Welding Standards

Comply with applicable provisions of AWS D1.2 *Structural Welding Code – Aluminum* 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.

D. Single Source Responsibility

Obtain sheet metal fabrications from a single manufacturer.

E. Field Measurements

Where sheet metal fabrications are shown on the Contract Drawings to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication and show recorded measurements on final Shop Drawings before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal fabrications as factory assembled units, with protective crating and covering.
- B. Store products on elevated platforms in a dry location.

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 by one of the following or approved equal:

Brandt-Airflex Corp., East Farmingdale, NY
Custom Enclosures, Inc., Wheeling, IL
Metal Sales & Service, Inc., Kennett Square, PA
Milgo/Bufkin, Brooklyn, NY

2.02 MATERIALS

A. General

Furnish sheet metals selected for their surface flatness, smoothness and freedom from surface blemishes where exposed to view in the finished unit. Use materials whose exposed surfaces do not exhibit pitting, seam marks, roller marks, variations in flatness exceeding those permitted by referenced standards for stretcher-leveled metal sheet, stains, discoloration or other imperfections.

B. Ferrous Metals

1. Galvanized Steel Sheet

ASTM A 653, commercial or forming steel classification, coating designation G90, mill phosphatized.

2. Steel Sheet

ASTM A 1008, cold rolled, commercial steel (CS) Type B sheet, or structural steel (SS) Grade 25, exposed; electrolytic zinc-coated, unless otherwise shown on the Contract Drawings or specified in this Section to be uncoated, complying with the following requirements as applicable:

- a. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591, chemically treated in mill with phosphate solution and light chromate rinse.
- b. Uncoated Steel Sheet: ASTM A 1008 per above, matte finish.

3. Stainless Steel Sheet: ASTM A 666, Type 304.

C. Aluminum Sheet

ASTM B 209; alloy and temper recommended by manufacturer for intended use and as suitable for application of finish shown on the Contract Drawings, with not less than strength and durability properties specified in ASTM B 209 for alloy 5005-H15.

D. Porcelain Steel Panels

1. Sheet Steel for Porcelain Steel Panels: Special purpose "enameling iron or steel" of low metalloids and copper content, especially manufactured and processed for the production of porcelain enamel panels and conforming to the requirements of ASTM A 424, commercial quality, Type II.

- a. Enameling Iron: Thickness 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 for porcelain enamel panels.

2. Aluminum Honeycomb Core for Porcelain Steel Panels

1-1/2 inch aluminum honeycomb with a minimum foil thickness of 0.003 inch, cell size 3/4 inch and density of 1.8 lbs. per cubic foot.

3. Aluminum Backer 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 required for structural performance, but not less than manufacturer's recommended minimums for profiles and applications shown on Contract Drawings and not less than 0.040 inches for exterior panels.

E. Miscellaneous Materials

Where shown on the Contract Drawings and as follows:

1. Sound-Deadening Insulation

Unfaced mineral fiber blanket or batt insulation complying with ASTM C 665 for Type I, passing ASTM E 136 test.

2. Fire Resistant Insulation Adhesive

Cold-applied, synthetic elastomer adhesive complying with ASTM C 916.

3. 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 D1.2 or D1.3 requirements and as required for strength and compatibility of the alloys of the filler metals used in the welds and the base metal being welded.

- a. Filler metals and welding procedures shall result in welds that blend with and match the color of sheet metal being joined.

4. Fasteners

Same metal and alloy as fastened metal, or – where same metal and alloy is not available -use metals that are non-corrosive and compatible with metals joined.

- a. Concealed Fasteners: For interconnection of sheet metal fabrications and for their attachment to other Work, except where exposed fasteners are unavoidable or are the manufacturer's standard fastening method.

- b. Exposed Fasteners, if any: Phillips flathead screws, unless otherwise shown on the Contract Drawings.

5. Anchors and Inserts

Type, size and material required for type of loading and installation shown on the Contract Drawings or as recommended by manufacturer, unless otherwise shown on the Contract Drawings. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance.

6. Flexible Cellular Neoprene Gaskets

ASTM D 1056, Type I, Class A, Grade as recommended by gasket manufacturer to obtain airtight seal for specified application and as shown on the Contract Drawings.

7. Bituminous Paint

Cold-applied, asphalt mastic complying with SSPC-Paint 12 containing no asbestos fibers.

8. Joint Sealants for Concealed Joints: Butyl-polyisobutylene sealant.

2.03 FABRICATION

A. General

Fabricate sheet metal fabrications to comply with the Contract Drawings for design, profile, dimensions, materials, joinery and performance.

1. Shop Assembly: Preassemble sheet metal fabrications in the 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. Coordinate dimensions and attachment methods of sheet metal fabrications with adjoining products and construction to produce integrated assemblies with closely fitting joints, with edges and surfaces aligned with one another. Locate fabrications in relation to adjoining construction as shown on the Contract Drawings.
3. Form sheet metal fabrications in maximum practical lengths to minimize joints and without exposed cut edges. Fold back exposed ends of unsupported sheet metal to form a 1/2 inch wide hem on the concealed side or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners. Produce flat, flush surfaces without cracking and grain separation at bends.
4. Increase metal thickness or reinforce metal with concealed stiffeners or backing materials, or both, as required to provide surface flatness specified for stretcher-leveled metal sheet and to impart sufficient strength for use shown on the Contract Drawings.
5. Fill space between stiffeners with sound-deadening insulation permanently attached to face sheet with cold-applied asphalt mastic where shown on the Contract Drawings.
6. Continuously weld joints and seams in accordance with the requirements of this Section, except where other methods of joining are shown on the Contract Drawings. Grind, fill and dress welds to produce smooth and flush exposed surfaces in which welds are invisible after final finishing is completed.
7. Build in straps, plates and brackets as required for support and anchorage of fabricated items to adjoining construction. Reinforce sheet metal units as required for attachment and support of other construction.

B. Closures and Trim

1. Form closures and trim members, if any, from sheet metal of type and minimum nominal thickness as indicated below, unless otherwise shown on the Contract Drawings. Incorporate components required for support and installation of closures and trim. Fabricate closures and trim to tightly close with adjoining construction.
 - a. Metal for Interior Installations: Steel Sheet: 0.0478 inch (18 gage).

- b. Metal for Exterior Installations: Galvanized Steel Sheet: 0.0516 inch (18 gage), with weather-tight joints.
2. Fasteners shall conform to 2.02 E.4. Locate to be as inconspicuous as possible. Size fasteners to support closures and trim, with fasteners spaced to prevent buckling or waviness in finished surfaces.
3. Drill and tap holes required for securing closures and trim to other surfaces.
4. Incorporate gaskets where shown on the Contract Drawings or where required for concealed, continuous seal at abutting surfaces.
5. Support joints with concealed stiffeners as required to hold exposed faces of adjoining sheets in flush alignment.
6. Miter or cope trim members at corners to form tight joints.

C. Window Stools

Form window stools, if any, from sheet metal of type and thickness shown on the Contract Drawings and minimum thickness as indicated below, including end closures.

1. Galvanized Steel Sheet: 0.0516 inch (18 gage), with weather-tight joints at exterior installations.
2. Aluminum Sheet: 0.063 inch.
3. Stainless Steel Sheet: 0.050 inch (18 gage).

D. Blind and Drapery Pockets

1. Form pockets, if any, from sheet metal of type and thickness shown on the Contract Drawings and minimum thickness as indicated below, including end closures. Coordinate dimensions and attachment methods with blind and drapery equipment, window frames, ceiling suspension system and other related construction, to produce a coordinated, closely fitting assembly.
 - a. Aluminum Sheet: 0.063 inch.
 - b. Steel Sheet: 0.0478 inch (18 gage).
 - c. Galvanized Steel Sheet: 0.0516 inch (18 gage).
2. Reinforce pocket for attachment of window treatment equipment and hardware or increase metal thickness.
3. Divide continuous pockets by means of built-in partitions located to separate adjoining drapery and blind units, to coincide with window mullions and to receive filler panels at ends of partitions.

E. Filler Panels

1. Form filler panels, if any, for closing ends of partition systems from sheet metal of type and thickness shown on the Contract Drawings and minimum thickness as indicated below, and at other locations as shown on the Contract Drawings. Incorporate reveals, trim and concealed anchorages for attachment to adjacent surfaces.
 - a. Steel Sheet: 0.0598 inch (16 gage).
 - b. Galvanized Steel Sheet: 0.0635 inch (16 gage).

2. Fill interior of panel with sound-deadening insulation permanently attached to inside panel faces where shown on the Contract Drawings.
3. Adhesively attach gaskets to filler panel edges that abut glass. Use 1 inch square material, unless otherwise shown, set approximately 1/4 inch into channeled edge of filler panel.
4. Attach gaskets to panel edges that abut adjacent surfaces to form a continuous seal. Use compressible gaskets of mastic sealing tape, applied to center of panel edges to be concealed from view, unless otherwise shown on the Contract Drawings.

F. Column Covers

Form column covers, if any, from sheet metal of type and thickness shown on the Contract Drawings, and minimum thickness as indicated below. Incorporate reveals, trim and concealed anchorages for attachment to columns or adjacent construction as indicated.

1. Snap-Together Type
 - a. Form column covers to shapes shown on the Contract Drawings. Return edges and bend to form hook that engages continuous mounting clips.
 - b. Form returns at joints to provide reveal at joints of size shown on the Contract Drawings. Furnish snap-in metal filler strips at reveals.
2. Metal Type and Thickness:
 - a. Steel Sheet: 0.0598 inch (16 gage).
 - b. Aluminum Sheet: 0.063 inch.
 - c. Stainless Steel Sheet: 0.050 inch (18 gage).
3. For Drywall-Type Construction
 - a. Form column covers from 0.125 inch aluminum, rolled to radii shown on the Contract Drawings. Taper edges of adjoining pieces of column covers for taping and spackling, to 0.094 inch thickness in an approximately 1 inch width. Punch tapered edges for drywall screws at 1/2 inch o.c. and mill grooves in tapered edge to provide bonding surface for joint compound.
 - b. Joint Treatment Materials: Compounds and reinforcing tape shall comply with requirements of the applicable Division 9 Section on gypsum drywall.

G. Lighting Troughs

Form lighting troughs, if any, from sheet metal of type and thickness shown on the Contract Drawings and minimum thickness as indicated below. Coordinate size of troughs, location of cutouts for electrical wiring and method of attachment to adjoining construction.

1. Steel Sheet: 0.0478 inch (18 gage).
2. Galvanized Steel Sheet: 0.0516 inch (18 gage).
3. Aluminum Sheet: 0.063 inch.

H. Heating-Cooling Unit Enclosures

Fabricate heating-cooling unit enclosures, if any, from galvanized steel sheet of minimum nominal thickness as indicated below, unless otherwise shown on the Contract Drawings.

1. Galvanized Steel Sheet

- a. Framing: 0.108 inch (12 gage).
- b. Sills and Stools: 0.079 inch (14 gage).
- c. Front Panels and Bases: 0.064 inch (16 gage).
- d. Concealed Panels and Trim: 0.040 inch (20 gage).

2. Structural Performance

Design and fabricate enclosures so that when installed, they shall be capable of withstanding 100 lbs. per sq. foot or concentrated load of 300 lbs. per 4 sq. inch, whichever produces the greatest stress without exceeding the allowable design working stress of materials, including anchors and connections, and without exhibiting permanent deformation in any components making up enclosures.

3. Incorporate stiffeners or laminated backing using noncombustible materials as required for strength and rigidity. Include brackets, plates and straps in assemblies for support of other Work.
4. Incorporate grilles of size, type and materials shown on the Contract Drawings.
 - a. For removable grilles use modular units with recessed openings and enclosures formed into surfaces of enclosures, without use of blank filler panels between grilles, so that face panels and stools are continuous. Fabricate removable grilles and openings to close tolerances to produce well-fitted assemblies free of warp or rattle with grilles supported continuously along parallel edges and tops flush with top of enclosure.
 - b. Form grille supports to serve also as collars for connection to discharge opening in heating-cooling units where shown on the Contract Drawings or where required for operation.
5. Incorporate removable tops and fronts where shown on the Contract Drawings or where required for access to heating-cooling units and to piping, ductwork, controls and electrical service. Fabricate panels and openings as follows:
 - a. Fit with a tolerance of not less than 1/32 inch and not more than 1/10 inch at each edge, with face of panels flush with adjoining fixed surfaces of enclosure.
 - b. Hold panels in place with concealed clips and hardware that prevent warp or rattle, and which enable easy removal of panels without interfering with adjoining construction or furniture.
6. Incorporate hinged access panels in enclosures for access to heating-cooling unit controls, either as separate elements or integrated with grille openings, as shown on the Contract Drawings.
7. Coordinate construction, configuration and dimensions of enclosures with those of heating-cooling units. Provide blind knockouts for piping, ductwork, control lines and electrical conduit and wiring. Provide support for those elements and for heating-cooling units where shown on the Contract Drawings or as required.

8. Locate fixed surfaces of enclosure to coincide precisely with window mullions and partition system terminations. Furnish closures at ends of units, at recessed openings in base of units and other locations where required to conceal from view unfinished wall or floor surfaces, piping, conduit, ductwork or heating-cooling units.
 - a. Where shown on the Contract Drawings, furnish built-in partitions (bulkheads) within enclosures between heating-cooling units, located to coincide with mullions and partition system terminations. Fabricate panels in manner similar to exposed filler panels to prevent transmission of sound.
9. Furnish and install sound-deadening materials at concealed faces of metal panels over 6 inches wide, consisting of a heavy coating of fire-resistive mastic applied at the minimum rate of 20 sq. ft. per gallon. Apply coating after completion of shop finishing.

I. Fascia Panels

Form fascia panels, if any, from aluminum sheet metal of 0.040 inch minimum nominal thickness, unless otherwise shown on the Contract Drawings.

1. Structural Performance (exterior panels only)

Design and fabricate exterior fascia panels so that when installed they are capable of withstanding wind pressure of not less than 30 psf inward and 30 psf outward without exceeding the allowable design working stress of materials, including anchors and connections, and without exhibiting permanent deformation in any components making up the fascia panels.
2. Fabricate exterior fascia panel systems that allow no uncontrolled water penetration.
3. Incorporate stiffeners or laminated backing using noncombustible materials as required for strength and rigidity.
4. Locate fasteners to be as inconspicuous as possible, sized to support fascia panels and spaced to prevent buckling or waviness in finished surfaces. Drill and tap holes required for securing fascia panels to other surfaces.
5. Miter or cope fascia panels at corners to form tight joints.
6. Refer to the applicable Division 7 Section on sealants, where perimeter sealant is shown on the Contract Drawings or where required to maintain watertightness of fascia panel system at exterior applications.

J. Soffit Panels

Form soffit panels, if any, from aluminum sheet metal of 0.040 inch minimum nominal thickness, unless otherwise shown on the Contract Drawings.

1. Structural Performance (exterior panels only)

Design and fabricate exterior soffit panels so that when installed, they are capable of withstanding wind pressure of not less than 37.5 psf inward and 37.5 psf outward without exceeding the allowable design working stress of materials, including anchors and connections, and without exhibiting permanent deformation in any components making up the soffits.
2. Fabricate exterior soffit panel systems that allow no uncontrolled water penetration.

3. Incorporate stiffeners or laminated backing using noncombustible materials as required for strength and rigidity.
4. Locate fasteners to be as inconspicuous as possible, sized to support soffit panels and spaced to prevent buckling or waviness in finished surfaces.
5. Drill and tap holes required for securing soffit panels to other surfaces.
6. Miter or cope soffit panels at corners to form tight joints.
7. Refer to Division 7 Section on sealants where perimeter sealant is shown on the Contract Drawings or where sealant is required to maintain watertightness of soffit panel system at exterior applications.

2.04 SHOP FINISHING

A. Finishes

1. Comply with NAAMM's *Metal Finishes Manual for Architectural and Metal Products* for recommendations relative to application and designations of stainless steel and aluminum finishes.
2. Comply with SSPC-PA 1 for steel sheet paint finishes.
3. Complete mechanical finishes of flat sheet metal surfaces before fabrication wherever possible. After fabrication, finish joints, bends, abrasions and other surface blemishes to match sheet finish.
4. Apply organic and anodic finishes to sheet metal fabrications after assembly.
5. Protect finishes on exposed surfaces from damage by application of adhesive paper or other temporary protective covering, prior to shipment. Retain cover until installation has been completed.

B. Aluminum Finishes

Where shown on the Contract Drawings and as follows:

1. 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*.
2. Class II Clear Anodic Finish at Interior Locations
AA M12-C22-A31 (Mechanical Finish: nonspecular, as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: clear coating, 0.4 to 0.7 mils).
3. Class I Clear Anodic Finish at Exterior Locations
AA M12-C22-A41 (Mechanical Finish: nonspecular, as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: clear coating, 0.7 mil or thicker), complying with AAMA 611.

4. Class I Color Anodic Finish

AA M12-C22-A42/A44 (Mechanical Finish: nonspecular, as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: integrally colored or electrolytically deposited coating, 0.7 mil or thicker), complying with AAMA 611, of color as shown on the Contract Drawings.

5. Baked Enamel Finish

AA C12-C42-R1x (Chemical Finish: chemically cleaned with inhibited chemicals, conversion coated with an acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating and painting.

- a. Organic Coating: Manufacturer's standard thermosetting modified acrylic enamel primer/topcoat system, minimum dry film thickness of 1.5 mils, medium gloss.
- b. Color: As selected by Engineer from manufacturer's full color range.

6. High Performance Organic Coating

- a. AA C12-C42-R1x (Chemical Finish: chemically cleaned with inhibitive chemicals, pretreated with acid chromate-fluoride-phosphate conversion coat; Organic Coating: as specified below). Apply in strict accordance with coating and resin manufacturer's instructions by a licensed applicator.
 - (1) Fluoropolymer 2-Coat System, where shown on the Contract Drawings: Manufacturer's standard 2-coat thermo-cured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene (PVDF) resin by weight, complying with AAMA 2605.
 - (2) Fluoropolymer 3-Coat System, where shown on the Contract Drawings: Manufacturer's standard 3-coat thermo-cured system composed of specially formulated inhibitive primer, fluoropolymer topcoat, with both color coat and clear coat containing not less than 70 percent PVDF resin by weight, complying with AAMA 2605.
- b. Resin Manufacturers

Subject to compliance with requirements, fluoropolymer coating systems shall contain resins produced by Arkema Group ("Kynar 500") or by Solvay Solexis, Inc. ("Hylar 5000").
- c. Colors or color matches and gloss shall be as shown on the Contract Drawings or, if not otherwise shown, as selected by the Engineer from manufacturer's full color range.

C. Paint Finish on Galvanized Steel Sheet

1. Surface Preparation

Clean surfaces of dirt, grease and other contaminants. Follow with a conversion coating of type suitable for organic coating application. Clean welds, mechanical connections and abraded areas. Follow with SSPC-Paint 20 galvanizing repair paint with dry film containing minimum 94 percent zinc dust content, applied in accordance with ASTM A 780.

2. Shop Priming for Field Painted Finish

Where field painting after installation is shown on the Contract Drawings, apply air-dried primer, specified in Division 9 Section on Painting, immediately following cleaning and pretreatment.

D. Paint Finish on Uncoated 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. Shop Priming for Field Painted Finish

Apply shop primer, specified in Division 9 Section on Painting, immediately following surface preparation and pretreatment.

E. Baked Enamel Finish on Steel

To be used as a steel or galvanized steel finish system where shown on the Contract Drawings.

1. Immediately after cleaning and pretreatment, apply manufacturer's standard 2-coat baked enamel finish, consisting of prime coat and thermosetting topcoat, with not less than 1.0 mil dry film thickness for topcoat. Comply with paint manufacturer's instructions for application and baking to achieve a minimum dry film thickness of 2.0 mils.

2. Color and Gloss: As shown on the Contract Drawings by reference to manufacturer's standard color and gloss designations.

F. Porcelain Enamel on Steel

1. Preparation: Porcelain enamel face panels shall be thoroughly cleaned, degreased, acid etched and neutralized.

2. Application: Apply porcelain enamel by spray application. Panels shall 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 specified colors. Back and other concealed panel areas 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 coat thickness shall be minimum 2.5 mils. Combined ground and cover coat thickness on the front or exposed surface of panels shall be minimum 8.5 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.
 - c. Fabrications of 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.
3. 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, if any, shall pass the cupric sulfate test in accordance with ASTM C 538.
4. 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.
5. Surface Appearance: Porcelain enamel on surfaces exposed to weathering shall be free of blemishes in the coating that may impair the serviceability or detract from the general appearance of the panel when viewed from a 5 foot distance.
6. Compliance Statement: Obtain from manufacturers at time of submission of bid written certification that the porcelain enameling will be performed in accordance with PEI 1001.

G. 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 and polished finish indicated, free of cross scratches. Run grain of directional finishes 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. 7 finish.
 - e. Nondirectional Finish: #BJNDF-60 finish, as manufactured by Milgo Industrial, Inc., Brooklyn, NY or approved equal. Refer to Division 5 Section on Stainless Steel Finish for requirements.
4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3. EXECUTION

3.01 PREPARATION

Coordinate setting drawings, diagrams, templates, instructions and directions for the installation of anchorages 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.

3.02 INSTALLATION

- A. Locate and place sheet metal fabrications plumb, level and in alignment with adjacent construction.
- B. Use concealed anchorages where possible. Fit brass or lead washers to screws where required to protect sheet metal surfaces and to make weather-tight connections.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for joint sealants as shown on the Contract Drawings. Joint sealants for exposed joints are specified in another Division 7 Section.
- D. Install concealed gaskets, flashing, sealants, fillers and insulation as the Work progresses to make exterior installations weather-tight and sealed and to make interior installations sealed or soundproof as shown on the Contract Drawings.
- E. Corrosion Protection: Protect zinc-coated, galvanized and nonferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces that come in contact with concrete, masonry or dissimilar metals.

3.03 ADJUSTING

Repair finishes damaged during installation and construction period so that no evidence remains of correction. Return items that cannot be field refinished to the factory. Make required alterations and refinish entire unit or furnish and install new units as directed by the Engineer.

3.04 PROTECTION

Protect finishes of sheet metal fabrications from damage during construction period. Remove temporary protective coverings immediately prior to inspection for issuance of the Certificate of Partial or Final Completion, as applicable for the Work of this Contract.

END OF SECTION

SECTION 05580

SHEET METAL FABRICATIONS

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 product specified in this Section where shown on the Contract Drawings.

B. Shop Drawings

For sheet metal fabrications, including plans, elevations and detail sections. Indicate jointing, fasteners, anchorage and accessory items and specify finishes.

1. Coordination drawings for sheet metal fabrications housing items specified under other Sections.

C. Samples

1. For selection: Manufacturer's standard samples and color charts indicating full range of color, texture and patterns.
2. For verification purposes: 8 inch square units of each metal finish, color, texture and pattern shown on the Contract Drawings, prepared on metal of same composition and thickness to be used in final construction.
 - a. For color anodized aluminum, submit sets for each color, texture and pattern shown on the Contract Drawings showing full range of variations expected in these characteristics.

D. Certifications

Porcelain Enamel Finish, if any: Compliance with PEI 1001.

E. Design Calculations

Where installed products are indicated in this Section or shown on the Contract Drawings to comply with certain structural performance criteria, include structural computations, material properties and other information needed for structural analysis that has been prepared by, or under the supervision of a qualified professional engineer licensed in the state in which the Work is to be performed. Information submitted shall be signed and sealed with a professional seal for the State in which the Work is to be performed.

F. Qualifications

1. **Manufacturer:** Demonstrate capabilities and experience. Include list of completed projects with project names, addresses, names of architects and owners.
2. **Professional Engineer:** Demonstrate capabilities and experience. Include list of completed projects with project names, addressees, names of architects and owners.
3. **Welder:** Evidence of current AWS certification.

END OF APPENDIX "A"

Office of Business and Job Opportunity

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: _____
 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
1308					
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.

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.

**THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3RD FLOOR
NEWARK, NJ 07102**

July 7, 2009

ADDENDUM NO. 3

**TO PROSPECTIVE BIDDERS ON CONTRACT EWR-154.028- NEWARK LIBERTY
INTERNATIONAL AIRPORT - REHABILITATION OF PARKING LOT P6 AND GAS
STATION SITE**

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 BOOKLET

Page 1 - In the first paragraph, change the date for receipt of Proposals to "July 29, 2009".

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Francis J. Lombardi, P.E.
Chief Engineer

INITIALED BY THE BIDDER:



JUL - 8 2009

2009 AUG - 3 PM 3: 27
PROCUREMENT

**THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3RD FLOOR
NEWARK, NJ 07102**

July 6, 2009

ADDENDUM NO. 2

TO PROSPECTIVE BIDDERS ON CONTRACT EWR-154.028- NEWARK LIBERTY INTERNATIONAL AIRPORT - REHABILITATION OF PARKING LOT P6 AND GAS STATION SITE

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 initialled 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 initialled.

CHANGES IN THE CONTRACT BOOKLET

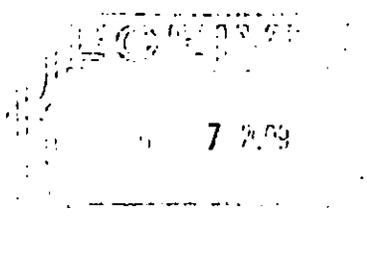
Page 829 - Following this page, insert new section 11033 entitled TOLL BOOTHS (new pages 829A through 829F), which are attached hereto and made a part hereof.

REVISED CONTRACT DRAWINGS

Contract Drawings C049 and C051 (dated 7/02/09) and Contract Drawing N002 (dated 7/01/09) have been revised. Copies of these drawings are forwarded herewith. Destroy the Contract Drawings of these numbers now in your possession and substitute therefor the revised Contract Drawings.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Francis J. Lombardi, P.E.
Chief Engineer



INITIALLED BY THE BIDDER:

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7/7/09 3:27 PM

PROCUREMENT

DIVISION 11
SECTION 11033
TOLL BOOTHS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for Toll Booths as indicated on the drawings.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

<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 480	General Requirements for Flat Rolled Stainless and Heat Resisting Steel Plate, Sheet and Strip
ASTM D 2240	Test Method For Rubber Property-Durometer Hardness
ASTM F 593	Specification for Stainless Steel Bolts, Hex Cap Screws and Studs
ASTM F 594	Specification for Stainless Steel Nuts

<u>US Product Standards (PS)</u>	
PS-1	Standard for Construction and Industrial Plywood

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

- A.** Furnish and install toll booths, as follows:
- Prior to shipment to the construction site: shop fabricate, assemble, wire, interconnect and test toll booths complete with interior wall, floor and ceiling surfaces, doors, lights, built-in furniture, HVAC controls and operating equipment; disassemble, match mark components and tag identify wire terminations to allow rapid reassembly on prepared foundations at the construction site.
- B.** Furnish and install toll booths fabricated to dimensions and of materials shown on the Contract Drawings. Materials shown on the Contract Drawings but not specified in this Section shall conform to requirements for such materials specified in other Sections.
- C.** Prior to fabrication of toll booths, fabricate one prototype sliding toll booth door. Prototype shall be complete with glazing, frame and operating hardware. After testing and approval by the Engineer the prototype may be installed in the work.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Protect components by the use of strippable covering which shall remain in place until directed to be removed by the Engineer.
- B. Place loose accessories necessary for assembly, if any, in plastic containers or wrappers and secure within the marked cartons.

1.05 QUALITY ASSURANCE

- A. Verify that fabricator of toll booth and components is an entity that has been fabricating similar items for a period of not less than five years with successful experience producing components of the type and quality required herein.
- B. Mockup: Build mockup to verify selections made under sample submittals, to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical toll booth, including insulation, supports, attachments and accessories in fabricator's shop.
 - 2. Approval of mockup will not constitute approval of deviations from the Contract Documents contained in mockup unless Engineer specifically approves such deviations in writing.
 - 3. Approved mockup may become part of the completed Work.

1.06 SUBMITTALS

For submittals requirements see Appendix "A".

PART 2. PRODUCTS

2.01 MANUFACTURER

- A. Subject to compliance with the requirements of this Section, provide toll booths from a single source.

2.02 MATERIALS

- A. General: Use materials selected for surface flatness, smoothness and freedom from surface blemishes where exposed to view.

- B. Stainless Steel

Meeting General Requirements for Flat Rolled Stainless and Heat Resisting Steel Plate, Sheet and Strip per ASTM A 480 and ASTM A 167, Type 316. Finish in accordance with ASTM A 400 and as follows, unless otherwise shown on the Contract Drawings:

- 1. Sheet and Strip
 - a. Exposed surfaces: Non-directional Angel Hair finish to match stainless steel wall and roof panels on the Service Building.

- b. Concealed surfaces: No. 2B
- 2. Plate and Shapes
 - a. Exposed surfaces: Hot-rolled or cold-rolled, annealed, surface cleaned and polished with a Non-directional Angel Hair finish to match stainless steel wall and roof panels on the Service Building.
 - b. Concealed surfaces: Hot-rolled or cold-rolled, annealed and pickled, No. 2B finish.
- C. Neoprene Pads: ASTM D 2240, Type A Shore Durometer.
- E. Fasteners: Of type, size and same basic metal as material to be fastened, unless otherwise shown on the Contract Drawings. Do not use metals which are corrosive or incompatible with metals joined.
 - 1. Bolts: ASTM F 593
 - 2. Nuts: ASTM F 594
- F. Plywood Subfloor: One inch thick underlayment, exterior marine grade, C-C plugged per US Product Standards PS-1.

2.03 ACCESSORIES

Furnish and install products of the following manufacturers, or approved equal, unless otherwise shown on the Contract Drawings:

- A. Drawer and Window Slides: Grant Hardware Co., West Nyack, NY
 - 1. Cat. No. 3320 (Drawer)
 - 2. Cat. No. 3370 (Window)
- B. Drawer Pulls: Selby Hardware Co., NY, NY. Cat. No. 15.043
- C. Drawer Locks: Chicago Lock Co., Chicago, Illinois. Ace Seven Pin Tumbler, 4000 Series
- D. Continuous Piano Hinge: Marlboro Mfg., Alliance, Ohio. Wrought stainless steel finish to match cabinets.
- E. Counter Top Heater: Electro Flex Heat Inc., Bloomfield, CN. Multi-filament mesh type or printed circuit heater capable of producing 50 watts per sq. foot with a maximum capacity of 200 watts, controlled by a remote location dimmer rheostat.
- F. Sliding door spring counterbalance: Pullman Mfg. Corp., Rochester, NY; number and size as recommended by the manufacturer.
- G. Sliding door weather-stripping: Zero International Inc., Bronx, NY; catalog numbers as shown on Contract Drawings.
- H. Sliding door track and hanger: Richard-Wilcox, Aurora, IL
 - 1. Track: Cat. No. 37C
 - 2. Hanger: Cat. No. 3300P3

- I. Glazing: insulated glass units as shown on Contract Drawings shall be type IG 4 to match the Service Building as specified in Division 08805 Glass and Glazing.

2.04 FABRICATION

- A. Fabricate to comply with dimensions, joinery and design shown on the Contract Drawings to produce units with close fitting joints, and aligned edges and surfaces. Furnish and install counter tops and faces of continuous sheet material.
- B. Ensure gages of metal, fabrication and reinforcement are as shown on the Contract Drawings or, if not shown, as adequate for conditions of use shown on the Contract Drawings. Build in plates and brackets as required for support and anchorage to other construction.
- C. Form edges smooth and hem and roll cutout edges so that no rough sharp edges are exposed.
- D. Provide cutouts, drilled holes and reinforcement for switches, controls and electrical or other devices which are built into or form an integral part of units. Furnish and install wire troughs with removable covers where required for protection or concealment and provide removable covers for maintenance access of installed equipment.
- E. Continuously weld exposed joints and seams, except where other joining methods are shown on the Contract Drawings. Grind, fill and dress exposed welds to produce smooth flush surfaces with welds invisible after finishing.
- F. Non-weld Connections: Use countersunk flathead type fasteners, concealed where practical.
- G. Sliding Door and Frame:

Furnish and install doors of design as shown on the Contract Drawings, 1-3/4 inch thick, of not less than 16 gauge face sheets with no visible seams, reinforced with internal 22-gauge channel sections spot welded to face sheets and 16-gauge top and bottom channels to provide weather seal. Provide weep holes in door bottoms.

 1. Furnish and install mineral wool or other insulating material solidly packed within door core.
 2. Prepare and reinforce doors and frames to receive mortised and surface-applied hardware.
 3. Fabricate frames of 14-gauge, full-welded unit construction with mitered reinforced corners.
 4. Fabricate sliding door with a vertically sliding spring counterbalanced panel equipped with an inside key lock and spring loaded jamb stops to permit secure movement from one vertical position to another and a horizontal sliding plastic glazed window equipped with an inside key lock.

PART 3. EXECUTION

3.01 INSTALLATION

- A. Install in accordance with the installation details shown on the approved shop drawings. Verify that all mechanical and electrical components to be concealed within the counter and cabinet have been installed and tested prior to installation of counter and cabinet. Install counter and cabinets rigid, plumb and level, with moving parts operating smoothly and correctly.
- B. Frames: Plumb, align, and anchor. Terminate frame bottom at finished floor level and anchor to structural floor. If structural floor level differs from finished floor level, extend frame bottom with floor anchors. Anchor head with not fewer than two anchors and anchor each jamb on not more than 24-inch centers. If construction will permit concealing frame spreaders, spreaders may be left in place; otherwise remove spreaders after frames have been anchored. Secure doorframe anchors to adjoining construction.
- C. Doors: Hang and adjust to provide quiet, smooth and easy operation, with no binds or warps.

3.02 PROTECTION

- Upon Engineer's approval of the installation remove protective covering and clean stainless steel Work with a water-soluble mild detergent and soft sponge. Leave clean and dry without streaks. Replace Work which cannot be repaired by polishing to match acceptable finish, as determined by the Engineer.

END OF SECTION

SECTION 11033

TOLL BOOTHS

APPENDIX "A"

SUBMITTALS

Submittals shall be made 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 and general recommendations, as applicable to materials and finishes for each component and for toll booth. Operation and Maintenance Manual, as required by this Section

B. Shop Drawings

- a. Show dimensions, type and gauge of metal, finish, type of hardware, fasteners, anchors and details and locations of mechanical and electrical equipment interface.
- b. Coordinate with each trade and prepare Shop Drawings indicating all required mechanical, electrical, plumbing and electronics. Indicating how work of each trade is to fit together and in relation to each other. Show accurately and to scale, as physical items with actual appearance, location and dimensions of devices, equipment, and conduit runs, in lieu of symbols. This will supplement information on Mechanical, Electrical, plumbing and Electronics Shop Drawings that are conventionally diagrammatic (showing only symbols).
- c. Show fabrication and installation details of the Work and all associated Work including, but not limited to, the following:
 - 1) Plan details including foundation, floor, reflected ceiling and roof.
 - 2) Elevations and cladding details.
 - 3) Sections and details including framing, anchorage and reinforcement.
 - 4) Interior elevations and details including equipment.

C. Samples

- a. Submit samples of all materials to be included in the Work as follows:
 - 1) Stainless Steel - four (4) 12" x 12" pieces of manufacturer prepared samples for each specified finish.
 - 2) Interior finishes, minimum 12" x 12" for each.
 - 3) Glass - four (4) 12" x 12" samples of each glass type.
 - 4) Sealant materials - four (4) each.

END OF APPENDIX "A"

**THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3RD FLOOR
NEWARK, NJ 07102**

July 2, 2009

ADDENDUM NO. 1

**TO PROSPECTIVE BIDDERS ON CONTRACT EWR-154.028- NEWARK LIBERTY
INTERNATIONAL AIRPORT - REHABILITATION OF PARKING LOT P6 AND GAS
STATION SITE**

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 initialled 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 initialled.

CHANGES IN THE CONTRACT BOOKLET

Page i - After 16. JOB MIX SUBMITTAL.....21 insert the following:

"16A. COMPARISON OF PROPOSALS.....21A"

Page 1 - After the last paragraph in 1. FORM AND SUBMISSION OF PROPOSALS insert the following:

"A bidder submitting a Proposal on Contract EWR-154.028 must also submit a Proposal on Contract EWR-154.028M entitled "Newark Liberty International Airport - Rehabilitation of Parking Lot P6 and Gas Station Site - Landscape and Hardscape Maintenance". The Proposal for Contract EWR-154.028M does not form a part of Contract EWR-154.028 but the price for Contract EWR-154.028M must be filled in and the Proposal executed and submitted with the Bidder's Proposal on Contract EWR-154.028."

Page 21- After this page insert new page 21A which is attached hereto and made a part hereof.

JUL - 6 2009

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Francis J. Lombardi, P.E.
Chief Engineer

INITIALED BY THE BIDDER:



PROCUREMENT
2009 AUG - 3 PM 3: 27

16A. COMPARISON OF PROPOSALS

A bidder submitting a Proposal on Contract EWR-154.028 must submit a Proposal on Contract EWR-154.028M. In comparing Proposals, the Authority will use the following figures inserted by the bidder herein referred to as the "Total":

	Figures ^{1A}
A. The "Estimated Total Contract Price" for Contract EWR-154.028 (insert same figure as inserted in Clause of the Form of Contract entitled "Unit Prices and Lump Sum").	
B. The "Total Price for Maintenance" for Contract EWR-154.028M (insert same figure as inserted in the clause of the Contract EWR-154.028M entitled "Price for Maintenance").	
C. TOTAL COMPENSATION FOR CONTRACT EWR-154.028 AND CONTRACT EWR-154.028M (insert the total of A. and B. above). ^{2A}	

Such "Total" shall be computed by adding amounts in A. and B. above.

Such "Total" is solely 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.

If the Authority accepts any Proposals for Contract EWR-154.028 and Contract EWR-154.028M the Authority will accept the Proposals, both from the same bidder, which have the lowest total amount in C. above.

^{1A} In case of discrepancy between amounts inserted in this Summary and the amounts inserted in the Unit Prices and Lump Sum hereto and the Total Price for Maintenance for Contract EWR-154.028M, the amount given in such Unit Prices and Lump Sum and the Total Price for Maintenance shall control.

^{2A} The Estimated Total Contract Price for Contract EWR-154.028 plus the Total Price for Maintenance for Contract EWR-154.028M shall be used for bid comparison purposes only.



THE PORT AUTHORITY OF NY & NJ

CA04-154.028

F.F.
C.M.

NEWARK LIBERTY INTERNATIONAL AIRPORT

**REHABILITATION OF PARKING LOT P6 AND GAS
STATION SITE
LANDSCAPE AND HARDSCAPE MAINTENANCE**

CONTRACT EWR-154.028M

JULY 2009

This proposal is not complete unless bidder's
Signature appears on page M11

**REHABILITATION OF PARKING LOT 6 AND GAS STATION SITE
LANDSCAPE AND HARDSCAPE MAINTENANCE
PROPOSAL**

1. GENERAL AGREEMENT.....	M1
2. DEFINITIONS.....	M1
3. PRICE FOR MAINTENANCE.....	M2
4. TERM OF CONTRACT AND TERMINATION.....	M2
5. EXTRA WORK AND COMPENSATION FOR EXTRA WORK.....	M3
6. RISKS ASSUMED BY THE CONTRACTOR.....	M6
7. INSURANCE PROCURED BY THE CONTRACTOR.....	M7
8. MAINTENANCE.....	M9
9. WORK SITE CONDITIONS AND PROCEDURES.....	M9
10. ADDITIONAL CONDITIONS AND PRECAUTIONS.....	M10

Section

Title

DIVISION 2 - SITE WORK

02972

Maintenance of Permanent Planting and Hardscape (New Jersey)

JUL - 6 2009

REHABILITATION OF PARKING LOT 6 AND GAS STATION SITE LANDSCAPE AND HARDSCAPE MAINTENANCE

PROPOSAL

1. GENERAL AGREEMENT

The undersigned, the bidder under Contract EWR-154.028, ("Contractor") agrees to perform for the Port Authority of New York and New Jersey ("Authority") maintenance of the landscape and hardscape constructed within Parking Lot P6 under Contract EWR-154.028. Maintenance shall include work required under the clause hereof entitled "MAINTENANCE" and the performance of such other duties and obligations as are provided for under this Contract EWR-154.028M ("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 all its duties and obligations under this Contract the lump sum monthly amount set forth in the "Monthly Price for Maintenance" herein subject only to such additions or deductions in the compensation as may be provided for elsewhere herein this Contract EWR-154.028M.

The entire agreement between the parties is contained herein and 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 by its duly authorized representative, provided that termination as provided for herein shall be effective.

2. DEFINITIONS

As used in this Contract, "Work Site" shall mean Parking Lot P6 and the vicinity thereof at Newark Liberty International Airport.

As used in this Contract, the term "Manager" shall mean the General Maintenance Manager at Newark Liberty International Airport, for the time being, or his successor in duties for the purpose of this Contract, acting personally, or through his duly authorized representative acting within the scope of the particular authority vested in him for the purpose of this Contract.

"Base Date" as used in this Contract shall mean the date of issuance of the Certificate of Final Completion by the Engineer for Contract EWR-154.028.

As used in this Contract, "Contract Drawings" shall mean the Contract Drawings for Contract EWR-154.028.

3. PRICE FOR MAINTENANCE ^{PROCUREMENT}

A. Monthly Price for Maintenance¹ ^{2008 AUG - 3 PM 3:28}

\$ 4,150.00

(Forty-one Hundred Fifty Dollars Per Month)

B. Total Price for Maintenance²

The total price for twelve (12) months of maintenance, excluding extra work or any other compensation provided for herein, is

\$ 49,800.00

4. TERM OF CONTRACT AND TERMINATION

This Contract shall become effective on the date the Authority mails or delivers a notice in writing specifically indicating acceptance of the Contractor's Proposal, herein designated "Effective Date", and Work of this Contract shall commence on the day following the Base Date specified in Clause 2 herein entitled "Definitions" and shall continue for a period of one (1) year thereafter, unless terminated as hereinafter provided.

This Contract may be terminated by the Authority for cause at any time during the term of this Contract. The Authority shall have the right to terminate this Contract or any part thereof, with or without cause, at any time, upon 30 days written notice to the Contractor.

In addition, at any time during the existence of an interruption or substantial curtailment of performance of services by the Contractor, whether or not within the control of the Contractor, the Authority shall have the right to terminate this Contract by giving not less than forty-eight (48) hours prior written notice to the Contractor, provided that such right of termination shall not exist if such interruption or curtailment is due to wrongful acts of the Authority.

The rights of termination described above shall be in addition to any rights and remedies that the Authority would have at law or in equity resulting from the Contractor's breach of this Contract.

The Contractor shall have no right of termination except for cause. Termination shall be by certified mail.

Should this Contract be terminated as provided herein the Contractor shall receive no compensation for any services not yet performed nor shall the Contractor be entitled to any anticipated profits.

¹ Insert price in words and figures. In case of conflict, words shall control.

² The Total Price for Maintenance is computed by multiplying the Monthly Price for Maintenance by twelve (12) whether or not such Total Price for Maintenance is correctly shown in the Contractor's Proposal. Insert price in figures.

5. EXTRA WORK AND COMPENSATION FOR EXTRA WORK

A. Extra Work

The Contractor shall perform promptly all repairs and replacements regardless of the reason for necessity thereof and the Authority will pay the Contractor under the provisions of this Section, in addition to the Monthly Price For Maintenance set forth hereinbefore, for such portion of the cost of any repairs and replacements as are necessitated directly by negligence, misuse, accidents or abuse which are not the fault of the Contractor (which portion is herein called "Extra Work"). However, no repair or replacement work which the Contractor deems to entitle him to compensation additional to the Monthly Price for Maintenance shall be performed without the prior approval of the Manager. It shall be presumed that all repairs and replacements are required under the clause "MAINTENANCE" or are caused by negligence, misuse, accidents or abuse which are the responsibility of the Contractor and that the Contractor shall be entitled to no additional compensation therefor unless it is otherwise affirmatively demonstrated by the Contractor.

B. Replacement of Materials

When it is necessary for the Contractor to replace any item of material during the performance of Extra Work under this Contract, the Contractor shall first submit to the Authority for its approval the name of the item, the identifying number therefor, if any, the quantity needed, the name of the proposed supplier and the proposed purchase price or if supplied by the Contractor the price that the Authority is to be billed therefor. The Authority shall have the option of a) approving same; or b) supplying said material to the Contractor itself provided it is of equal quality to that to be supplied by the Contractor.

If the Authority exercises its option in regard to (b) above, the Authority agrees to indemnify the Contractor against and save it harmless from all expense incurred in the defense, settlement or satisfaction of any claim for patent infringement asserted against said material, excepting a claim for patent infringement made by (1) the Contractor in regard to a replacement of any material originally obtained by the Contractor (in accordance with plans, specifications, or performance requirements which were designed by the Contractor) from such materialman or subcontractor under the Contract. The obligation expressed in the preceding sentence is expressly conditioned upon the Contractor notifying the Authority promptly after receipt by the Contractor of any notice of claim asserting patent infringement. The Authority shall promptly thereafter notify the Contractor whether it elects to defend such claim on behalf of the Contractor. If the Authority does so elect, the Contractor shall not incur expenses without the Authority's authorization therefor and the Authority shall have the sole right and obligation to conduct all negotiations with respect to, and defend or settle such claim, without expense to the Contractor. The Contractor shall not be responsible for the quality, performance or workmanship of any material furnished to the Contractor by the Authority under option (b) of the preceding paragraph but the Contractor shall be responsible for the proper installation of said material. The Authority shall indemnify the Contractor against and save it harmless from any and all damages or claims for damages that the Contractor may sustain by reason of injury or death to persons or damage to property caused by defects in any material furnished to the Contractor by the Authority under option (b) of the preceding paragraph.

C. Compensation for Extra Work

If Extra Work is performed, the Contractor's compensation shall be increased by the following amounts and such amounts only:

- 1.) In the case of Extra Work performed by the Contractor personally:
 - a. For purchased materials: An amount equal to the net cost to the Contractor of such materials, plus twenty percent (20%) of such net costs.
 - b. For materials supplied by the Contractor: The invoiced price of such materials supplied by the Contractor.
 - c. For Labor: The actual straight time hourly labor cost in money of the labor required plus twenty percent (20%) of such net cost.
 - d. For rental of equipment (other than small tools and portable equipment): For such rentals deemed reasonable and required by the Manager, the actual money cost of such rental including the reasonable cost of transporting such equipment to and from the Work Site, and for work in New Jersey and work at New York aviation facilities, taxes on the rental actually paid by the Contractor.
- 2.) In the case of Extra Work performed by a subcontractor:
 - a. For Materials and Labor: An amount equal to the actual straight time hourly labor cost in money of the labor and net cost of material plus twenty percent (20%) of such straight time hourly labor and net costs.
 - b. For rental of equipment (other than small tools and portable equipment): The amount determined as provided in subparagraph 1.)d above for rentals approved by the Manager.
 - c. Plus seven percent (7%) of the sum of the foregoing a. and b. cost, percentage of cost, and rental.

As used in this Contract "labor" means workers employed in the New York - New Jersey metropolitan area, whether employed by the Contractor or by the subcontractor, and "straight time hourly labor cost" shall have the meaning set forth in 5.D. hereof.

The purchase by the Contractor of any materials sold hereunder pursuant to this clause will be a purchase for resale and therefor not subject to New Jersey, New York State or New York City sales or compensating use taxes and the sale of such materials by the Contractor to the Authority which is a governmental agency, will not be subject to such taxes provided that replacement of materials pursuant to the clause hereof entitled "Risks Assumed by the Contractor" shall not be a purchase for resale and shall be subject to the above taxes.

Invoices for compensation due for Extra Work shall be submitted to the Manager. Within thirty (30) days after the Manager certifies the correctness of such invoices, the Authority will pay to the Contractor by check, the amounts so certified. No certificates or payment shall, at any time, preclude the Authority from recovering any money paid in excess of that due hereunder.

The payment under this Section shall consist solely of the cost of repairs or replacement determined as above. However, the Manager shall have authority to agree to a lump sum or unit price amount on behalf of the Authority as compensation for Extra Work in lieu of the method of determining such payment described in 1 and 2 above.

The Authority shall have access, at the Contractor's principal place of business and during normal business hours, to all records and documents of the Contractor directly relating to labor and materials used in the performance of Extra Work for which the Contractor has been compensated or is to be compensated on any basis other than an agreed lump sum or unit price amount. Such records and documents shall include but not be limited to time tickets, payroll records and related reports provided to unions, vendor's invoices, cancelled checks and published price lists of the Contractor relating to any amounts for which the Contractor has been compensated, or claims it should be compensated by the Authority. If certain materials manufactured by the Contractor do not appear on the published price lists, the Contractor may be requested to display evidence that the charges to the Authority are comparable to those that are being charged to other customers of the Contractor. For the purpose of this paragraph, the Contractor shall not be obligated to retain such records and documents for a period longer than three years following the date of the Contractor's invoice to the Authority for such Extra Work.

D. Straight Time Hourly Labor Cost

As used in this Contract, the phrase "straight time hourly labor cost" shall mean the sum of the straight time hourly labor rate paid in the locality where the maintenance is to be performed, plus an average hourly cost of the fringe benefits paid within the New York-New Jersey metropolitan region of the Contractor's operations. The words "fringe benefits" mean employee benefits granted in lieu of, or in addition to, hourly rate increases and include only those items the Contractor is required to pay pursuant to contractual obligations upon the basis of such wages, such as pensions, vacations, paid holidays, group life, sickness, accident and hospital insurance and including taxes actually paid by the employer pursuant to law upon the basis of such wages. The straight time hourly labor costs applicable to this Contract are those in effect on the Base Date. The Authority shall have access, at the Contractor's principal place of business and during normal business hours, to all records and documents of the Contractor directly relating to labor used for which the Contractor has been compensated or is to be compensated on any basis other than an agreed lump sum or unit price amount.

E. **Extra Work Procedures**

Whenever any work is performed by the Contractor and the Contractor deems that such work entitles the Contractor to compensation other than an agreed lump sum or unit price basis but in addition to the Monthly Price for Maintenance, the Contractor shall, as a condition precedent to payment for such work, furnish to the Manager or his authorized representative at the end of each day daily time slips showing (a) the name and number of each workman employed on such work, and the number of hours which he is employed thereon, and (b) a brief description of the nature of the work performed and a list of material used. This information shall be supplemented by the Contractor at a later date with a statement indicating from whom the material was purchased and the amount paid therefor or copy of the Contractor's price list, and all of the rates used in computing compensation for labor. Such daily time slips and memoranda are for the purpose of enabling the Manager or his authorized representative to determine the amounts to be paid to the Contractor; accordingly, failure on the part of the Contractor to furnish them with respect to any particular work shall be deemed to constitute a conclusive and binding determination on the Contractor's part that such work does not entitle the Contractor to additional compensation, and shall constitute a waiver by the Contractor of any claims for such additional compensation.

4. 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 execution of this Contract with actual and wilful intent to cause the loss, damage and injuries described in subparagraphs A through C below:

- A. The risk of loss or damage to property of the Authority arising out of the performance of the services hereunder; and to materials supplied hereunder by the Contractor prior to installation. The Contractor shall forthwith repair, replace and make good any such loss or damage without cost to the Authority;
- B. The risk of claims, just or unjust, by third persons against the Contractor or the Authority on account of injuries (including wrongful death) loss or damage of any kind whatsoever arising or alleged to arise out of or in connection with the performance of the Contract (whether or not actually caused by or resulting from the performance of the Contract) or out of or in connection with the Contractor's operations or presence at or in the vicinity of the Work Site or Authority premises including claims for workers' compensation, whether such claims are made and whether such injuries, damage and loss are sustained at any time both before and after the completion of the services provided for herein;
- C. 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, workers and others performing the Contract, occurring at any time prior to the completion of removal of such property from or in the vicinity of the Work Site or Authority premises.

The Contractor shall indemnify the Authority against all claims described in subparagraphs (b) and (c) 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 other applicable law. If so directed, the Contractor shall defend against any claims described in subparagraphs (b) and (c) above, in which event it 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 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 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 Authority's acceptance of service by the Contractor in part or in whole, nor the making of a payment shall release the Contractor from its 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 it 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 it assumes or is responsible for risks or claims only of the type enumerated in this numbered clause or in any other clause of this Agreement, or (c) to limit the risks which it would assume or the claims for which it would be responsible in the absence of such enumeration.

5. INSURANCE PROCURED BY THE CONTRACTOR

The Contractor shall take out, maintain, and pay the premiums on Commercial General Liability Insurance, including but not limited to premises-operations and products-completed operations, broad form property damage and independent contractors coverage, with contractual liability coverage covering the obligations assumed by the Contractor under this Contract, and, if vehicles are to be used to carry out the performance of this Contract, then the Contractor shall also take out, maintain, and pay the premiums on Automobile Liability Insurance covering owned, non-owned, and rented vehicles in the following minimum limits:

Commercial General Liability Insurance - \$2 million combined single limit per occurrence for bodily injury and property damage liability.

Automobile Liability Insurance - \$2 million combined single limit per accident for bodily injury and property damage liability.

In addition, the liability policy (ies) shall name The Port Authority of NY and NJ as additional insured, including but not limited to premise-operations, products-completed operations on the Commercial General Liability Policy. Moreover, the Commercial General Liability Policy shall not contain any provisions for exclusions from liability other than provisions for exclusion from liability forming part of the most up to date ISO form or its equivalent unendorsed Commercial General Liability Policy. The liability policy (ies) and certificate of insurance shall contain cross-liability language providing severability of interests so that coverage will respond as if separate policies were in force for each insured. These insurance requirements shall be in effect for the duration of the contract to include any warrantee/guarantee period.

The certificate of insurance and liability policy (ies) must contain the following endorsement for the above liability coverages:

"The insurer(s) shall not, without obtaining the express advance written permission from the General Counsel of the Port Authority, raise any defense involving in any way the jurisdiction of the Tribunal over the person of the Port Authority, the immunity of the Port Authority, its Commissioners, officers, agents or employees, the governmental nature of the Port Authority, or the provisions of any statutes respecting suits against the Port Authority."

The Contractor shall also take out, maintain, and pay premiums on Workers' Compensation Insurance in accordance with the requirements of law in the state(s) where work will take place, and Employer's Liability Insurance with limits of not less than \$1 million each accident.

Each policy above shall contain a provision that the policy may not be canceled, terminated, or modified without thirty (30) days' prior written notice to the Port Authority of NY and NJ, Att: Facility Contract Administrator, at the location where the work will take place and to the General Manager, Risk Management.

The Port Authority may at any time during the term of this Contract change or modify the limits and coverages of insurance. Should the modification or change results in an additional premium, The General Manager, Risk Management for the Port Authority may consider such cost as an out-of-pocket expense.

Within five (5) days after the award of this agreement or contract and prior to the start of work, the Contractor must submit an original certificate of insurance, to the Port Authority of NY and NJ, Facility Contract Administrator, at the location where the work will take place. This certificate of insurance must show evidence of the above insurance policy (ies), stating the agreement/contract number prior to the start of work. The General Manager, Risk Management must approve the certificate(s) of insurance before any work can begin. Upon request by the Port Authority, the Contractor shall furnish to the General Manager, Risk Management, a certified copy of each policy, including the premiums.

If at any time the above liability insurance should be canceled, terminated, or modified so that the insurance is not in effect as above required, then, if the Manager shall so direct, the Contractor shall suspend performance of the contract at the premises. If the contract is so suspended, no extension of time shall be due on account thereof. If the contract is not suspended (whether or not because of omission of the Manager to order suspension), then the Authority may, at its option, obtain insurance affording coverage equal to the above required, the cost of such insurance to be payable by the Contractor to the Port Authority.

Renewal certificates of insurance or policies shall be delivered to the Facility Contract Administrator, Port Authority at least fifteen (15) days prior to the expiration date of each expiring policy. The General Manager, Risk Management must approve the renewal certificate(s) of insurance before work can resume on the facility. If at any time any of the certificates or policies shall become unsatisfactory to the Port Authority, the Contractor shall promptly obtain a new and satisfactory certificate and policy.

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 them by law or by this or any other Contract.

6. MAINTENANCE

Maintenance shall be performed in accordance with Division 2 Section 02972 entitled "Maintenance of Permanent Planting and Hardscape (New Jersey)".

7. WORK SITE CONDITIONS AND PROCEDURES

- A. Maintenance shall be performed by trained workers, competently supervised, who shall be qualified to perform the plant maintenance operations. Any employee of the Contractor, or its subcontractors, deemed by the Manager not qualified to perform the work hereunder shall be immediately removed from the Work Site and replaced by the Contractor upon request by the Manager.
- B. In order to make replacements and repairs as expeditiously as possible, the Contractor shall stock, keep and maintain in the New York-New Jersey metropolitan area a sufficient supply of new parts and materials, tools or other equipment as may be necessary to make such replacements and repairs.
- C.
 - 1.) The Contractor will be permitted to perform the work without restriction as to hours of work.
 - 2.) The Contractor shall submit to the Manager, at least one week in advance, his scheduled hours of work for each week.
- D. Report in writing to the Manager and to the Authority's Manager, Claims Administration, all accidents whatsoever arising out of or in connection with the services hereunder which result in injuries or property damage, giving full details and statements of witnesses. In addition, if death or serious injuries or damages are caused the same shall be reported immediately to both of the said Authority representatives.
 - 1.) Should any claim be made by a third person against the Contractor on account of any accident resulting or alleged to have resulted out of the performance of the services hereunder, the Contractor shall promptly report the facts in writing to the Manager and the Authority's Manager, Claims Administration, giving full details of the claim.
- E. The Manager will provide such cooperation as may be necessary to permit entry into locked areas. The Contractor shall give a minimum of 48 hours notice of its intention to perform work (other than Emergency Services) under this Contract to the Manager or his designated representative in order that any necessary arrangements may be made by the facility. This notice shall include the Contractor's expected hours of arrival and departure, areas to be serviced and the number of workers or crews which will be working.

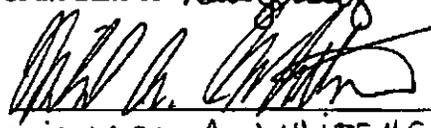
- F. The Authority will not furnish any free facility use passes or public parking spaces for the Contractor.
- G. At the time the Contractor is carrying out its operations there may be other persons working in the vicinity. The Contractor shall so conduct its operations as to work in harmony with and not endanger, interfere with or delay the operations of others, all to the best interests of the Authority and others as may be directed by the Manager.
- H. Provide employee identification badges approved by the Authority. Such badges shall be worn in a conspicuous and clearly visible position by all employees of the Contractor whenever present at the Work Site.
- I. The Contractor shall observe and obey (and compel its subcontractors, officers and employees and those doing business with it to observe and obey) the rules and regulations of the Authority and such further rules and regulations which may from time to time during the effective term of this Contract be promulgated by the Authority for reasons of safety, health, preservation of property or maintenance of a good and orderly appearance of the Work Site.
- J. In the event the Contractor encounters at the Work Site material reasonably believed to be asbestos, polychlorinated biphenyl (PCB) or any other hazardous material, the Contractor shall immediately stop work in the area affected and report the condition in writing to the Manager. 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 Manager.

8. ADDITIONAL CONDITIONS AND PRECAUTIONS

- A. Any breach of or delay in performing the maintenance obligations required hereunder shall be deemed a substantial breach of this Contract entitling the Authority at its option to take over the maintenance either itself or through others, and to collect from the Contractor, the additional cost, if any, of such maintenance or to terminate this Contract without liability to the Contractor; provided that in case of delay beyond the Contractor's control which it is unable to overcome by the exercise of all reasonable efforts or which it could not reasonably have anticipated or avoided, the Contractor shall not be deemed in breach. It shall be deemed that strikes, lockouts, fire, explosion, theft, floods, riots, civil commotion, war, acts of God and acts of government not yet specifically proposed or taken are beyond the Contractor's control. In case of delays beyond the Contractor's control, the Authority may at its option and without liability to the Contractor, take over the maintenance either itself or through others until the Contractor resumes performance of the maintenance, and collect from the Contractor the additional cost, if any, of such maintenance work.
- B. 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 herein. However, the Contractor shall not apply for any permits or licenses in the name of or on behalf of the Authority.

- C. Any assignment or other transfer of this Contract or of any monies due or to become due hereunder without the written consent of the Authority shall be void and of no effect as to the Authority, except that work may be sublet to such persons as the Manager expressly approves in writing. No subcontract shall create any rights against the Authority or relieve the Contractor of any obligations, and all subcontractors shall be deemed the Contractor's agents.
- D. The Authority by its officers, employees and representatives shall have the right at all times to examine the supplies, materials, and equipment used by the Contractor and to observe the operations of the Contractor, its subcontractors, agents, servants and employees and to do any act or thing which the Authority may be obligated or have the right to do under this Contract.
- E. Nothing in this Contract is intended to create any rights in third persons and neither the Contractor nor the Authority shall be deemed to have intended to confer any rights on third persons by virtue of this Contract unless specifically provided otherwise herein.
- F. The Contractor shall pay all duties and imposts, if any, on the importation of any materials used in work under this Contract.
- G. Neither the Commissioners of the Authority nor any officers, agent or employee thereof shall be charged personally by the Contractor with any liability or be held liable to it under any term or provision of this Contract, or because of its execution or attempted execution, or because of any breach hereof.
- H. This offer shall be irrevocable for the same number of days after the date on which the Authority opens the Proposal for Contract EWR-154.028, bound herewith.

2009 AUG -3 PM 3:28
 PROCUREMENT

CONTRACTOR: Gawing Materials and Construction Company, Inc.
 a corporation organized under
 The laws of the State of New Jersey
 By 
 MICHAEL A. WHITEHEAD
 Title VICE PRESIDENT
 Date July 15, 2009

3
 Insert bidder's name. If a corporation, give state or 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 in (1) above for each participant in the joint venture.

DIVISION 2

SECTION 02972

MAINTENANCE OF PERMANENT PLANTING AND HARDSCAPE (NEW JERSEY)

PART 1. GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for maintenance of permanent planting, hardscape and automatic irrigation system.
- 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, 3 Perimeter Rd. - Unit 1, Manchester, NH 03031.
- E. Base standards for weather conditions on reports on the weather radio band of the National Oceanic and Atmospheric Administration, Washington Science Center, Rockville, MD 20852, and on its publication entitled "Local Climatological Data With Comparative Data", published 12 times a year as a monthly and once a year as an annual.
- 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 facility Manager.
- 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 "Cornell Recommendations for Pest Control for Commercial Production and Maintenance of Trees and Shrubs" and "Cornell Recommendations for Florist Crops, Part II: Pest Control - Diseases, Insects and Weeds", published by Cornell University, Ithaca, NY. These publications are available from the Distribution Center, Research Park, Cornell University, Ithaca, NY 14850. Telephone (607) 255-2080.
- 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.

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 New Jersey Certified Tree Expert and a member of the International Society of Arboriculture and State Chapter where it is located.
4. Make arrangements to have a New Jersey Certified 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 Certified 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 by New Jersey Board of Tree Experts during the year(s) this individual is working on this Contract.

b. Quality Assurance

Qualifications: Ensure that the entity performing the Work of this Contract utilizes the services of a New Jersey Certified 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: plant material 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 in either the State of New Jersey or New York, has experience in topsoil testing and performs 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 Manager prior to delivery to the construction site.

2. After delivery to the construction site, the Manager, 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 Manager 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. IrrigationAny 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 Manager.

The Manager 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 Manager.
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. Keep all records that are or may be required by Federal, State or Local laws. Submit copies of these records to the Manager within 5 days when so requested.
- c. Not less than forty-eight hours prior to a proposed spray operation, submit to the Manager 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 shall be subject to inspections by the Manager. The Manager 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 Manager 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. Trees, Shrubs and Ground Cover

- a. Coordinate all arrangements and accompany the Manager on all inspections of plants at the nursery. Provide a minimum of 48 hours prior notice to the Manager. Do not dig or remove any plant prior to inspection by the Manager.
- b. All plants inspected by the Manager at the nursery will be sealed with Authority seals, or at the discretion of the Manager, 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 Manager's nursery inspection records.
- d. Unsealed plants that, in the sole opinion of the Manager, 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 Manager.
- 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 Manager. Such rejected plants shall be removed from Authority property and replaced at no additional cost to the Authority.
- g. At the discretion of the Manager, typical representative numbers of plants may be removed from their growing containers for inspection.

2. 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 Engineer of Materials, 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 shall not be accepted.**
- c. Prior to delivery to the construction site, advise the Engineer of Materials of the location of the source of the screened Loam Soil and submit a two pound sample to the Engineer of Materials.**
- 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 topsoil 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 Engineer of Materials 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 the expense of the Contractor.**

3. Loam Soil Mix

- a. Do not combine Loam Soil mix components until components have been approved in writing by the Engineer of Materials.**
- b. After Loam Soil mixing operations have been completed and prior to delivery to the construction site, submit a representative sample of the Loam Soil 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 Engineer of Materials, 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, 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, advise the Engineer of Materials of the location of the source of Loam Soil mix and submit a two pound sample to the Engineer of Materials.**
- e. Do not deliver Loam Soil mix to the construction site until the Engineer of Materials has approved the submittal in writing.**

- f. After delivery of Loam Soil 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 Engineer of Materials 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 the expense of the Contractor.

D. Certification

Prior to delivery of screened Loam Soil and/or Planting mix to the construction site, furnish the Engineer of Materials with a written statement from the Loam Soil supplier giving the depth of stripped Loam Soil and certification that topsoil has never been treated with herbicides.

E. Replacement

1. Replace unsatisfactory furnished and installed trees, shrubs, ground cover and perennials which, in the sole opinion of the Manager, 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 Manager.

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 Manager.
 3. Dispose of spilled materials and surplus products away from Authority property.
- D. Specific Requirements
 1. Loam Soil and Planting Mix

Conform to requirements of 1.04 C.3 and 1.04 C.4.
 2. Trees, Shrubs, Ground Cover and Perennials

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 Manager.

- 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 SPARE PARTS

Furnish and deliver the following list of spare parts to the Manager's Office in Building 80 at Newark Liberty International Airport, within the first 30 days of each year of the two year landscape maintenance:

Quantity:	Equipment Description/Model Number:
20	Rain Bird Model 3500-SAM-N, or approved equal.
3	Rain Bird Model 5000-SAM-N, or approved equal.
3	Rain Bird Model 10 SERIES MPR, or approved equal.
1	Rain Bird Model 12 SERIES MPR, or approved equal.
6	Rain Bird Model PESB-PRS-D, or approved equal.

1.07 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:

<u>Passing</u>	<u>Retained On</u>	<u>Percentage</u>
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 homogenous 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 Buoyoucouc 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 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 topsoil mix shall contain:
 - a. 3 3/4 cubic yards of screened topsoil;
 - b. 1 1/4 cubic yards of compost
 - c. 17 lbs. of Hydrogel
- 4. Loam Soil 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. In addition, compost shall conform to the following:

<u>Parameters</u>	<u>Range</u>
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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)
Nitrogen	>1.5%
Phosphorus	>0.5%
Potassium	>0.1%

2. Compost shall be "Agresoil Compost - Fairfield, CT" as supplied by Agresource - The Source for Compost, Amesbury MA 01913 or an approved equal.

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.
"Round-up Pro" as manufactured by Monsanto, St. Louis, MO 63167 or approved equal.
41% - Glyphosate N - (phosphonomethyl) glycine
59% - Inert Ingredients

E. Hydrogel

"Viterra Gelscape" shall be as manufactured by Amereq. Inc., New City, N.Y. 10956 or an approved equal and shall conform to the following:

99.5% Potassium Propenoate - Propenamide Copolymer
0.5% Inert Ingredients

F. Nursery Stock

1. Furnish trees, shrubs and ground cover 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, 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. 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 Manager. Container-grown plants shall be free from girdling roots.
 - l. 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 sunscald injuries, abrasions of the bark, girdled trunk or branches, head malformed from overcrowding, 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 Manager.
 - (4) Have been properly pruned to ensure a strong, sturdy canopy.
 - (5) 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.
 - m. With respect to their roots, trees shall:
 - (1) Be free from girdling roots.
 - (2) If girdling roots are present, then the Contractor's NJ Certified tree expert shall remove them at no cost to the Authority.
 - (3) 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.

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. Iron Sulphate

Commercial iron sulphate as manufactured by Bonide Products, Inc. Oriskany, NY 13424, or approved equal.

2. Granulated Dolomitic 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:

<u>Ingredients:</u>	<u>% by Weight</u>
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.

J. Rodent Control

1. Rodent Control shall be a water soluble, non-toxic, colorless solution with the following active ingredients:

<u>Ingredient:</u>	<u>Percentage:</u>
Benzyl-diethyl (2,6 xylylcarbonyl) 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 as supplied by American Landscape Supply, Inc., Branchburg, NJ 08876 or approved equal.

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. Anti-desiccant

"Wilt-Pruf NCF" as manufactured by Wilt-Pruf Products, Inc., Greenwich, CT 06830-0280; "Cloud Cover" as manufactured by Easy Gardener, Waco, TX 76702-1025, "Transfilm" as manufactured by PCI-Gordon Corp., Kansas City, MO 64101.

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 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.

S. Spare Parts – Automatic Irrigation System Components

1. Sprinkler Heads shall be Rain Bird series with nozzles replaced 'In-Kind' or approved equal as follows:
 - a. Rotor Series Spinkler Head – 45 PSI Operating Pressure:
Rain Bird Model 3500-SAM-N
Rain Bird Model 5000-SAM-N
 - b. Spray Series Sprinkler Head – 25 PSI Operating Pressure:
Rain Bird Model 10 Series MPR
Rain Bird Model 12 Series MPR

2. Control Valves shall be Rain Bird Model PESB-PRS-D or approved equal.

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 Manager.
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 iron sulphate at 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 New Jersey Certified Tree Expert and the Manager.
- 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**

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.

C. **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 Manager 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 Manager 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 Manager.
 - 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 Manager.

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 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.
2. Apply one-inch deep mulch on planting beds and planters.
3. Apply burlap and/or snow fencing as shown on the Contract Drawings and as directed by the Manager.

H. Tree, Shrub and Ground Cover Removals

1. Within 24 hours of notification by the Manager, remove, at the Contractor's expense, all plants that are dead or otherwise become unsatisfactory as directed by the Manager. However, if it can be proven to the Manager, 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 Manager'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 Manager, 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 Manager.
3. In accordance with Appendix "D" or as directed by the Manager, 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 Manager.
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 Manager, 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 Manager.
 - (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 Manager.

(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 Manager, 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 Manager 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 Manager, replace, at the Contractor's expense, all plants that stop flowering or fail to flower, as determined by the Manager. However, if it can be proven to the Manager, 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 the Contractor's New Jersey Certified Tree Expert along with the Contractor shall be available to perform drive and walk through site inspections of the Area of Work, accompanied by the Manager, 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, transmit from the Contractor's New Jersey Certified Tree Expert to the Manager a Maintenance Inspection Report, to include but not be limited to: list of inspection attendees, item(s) discussed, a brief description of 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 Manager.

N. Precast Concrete Block Pavement, Asphalt Block Pavement and Screenings

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 (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 Manager 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 Manager 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 Manager 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, 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, Appendix B and Appendix C.
- D. Maintenance Reports
1. Once a month, submit to the Manager 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 Manager 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 Manager 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 (NEW JERSEY) AND HARDSCAPE

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%		
Buoyoucus 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 (NEW JERSEY) AND HARDSCAPE

APPENDIX "C"

Material: Planting Mix
Specification: Section 02954 – Trees, Shrubs and Ground Cover in Ground
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%		
Buoyocous 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 (NEW JERSEY) AND HARDSCAPE

APPENDIX "D"

A. Planting To Be Maintained

- Trees
- Shrubs
- Ground Cover
- Grass Lawn
- Perennials
- Precast Concrete Block Paver, Asphalt Block Pavement & Screenings

B. Maintenance To Be Performed

Activity	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 Manager.
	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
Litter Removal	January - December	Once a week

Function	Schedule	Description
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 New Jersey Certified 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 Manager prior to pruning. All pruning operations shall be supervised by New Jersey Certified Tree Expert.
Trimming – Hedges	May 15 - June 1 & July 15 - August 1	Shear to maintain shape & size shown on the Contract Drawings.

Function	Timing	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 15 th and October 15th	Inspect for frost heave or girdled roots and adjust or remove, as per recommendations of Certified 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 (Certified Tree Expert's Inspection Reports due within 48 hours of each inspection).

END OF APPENDIX "D"