



City of Newburgh

83 Broadway, Newburgh, New York 12250

Project Manual

Volume 1 of 1

**City of Newburgh
Orange County, New York**

Wastewater Treatment Plan (WWTP) Admin Building Renovation

Bid No. 7.24

September 2024

Prepared By:

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**CITY OF NEWBURGH
NEWBURGH, NEW YORK
WASTEWATER TREATMENT PLANT (WWTP) ADMIN BUILDING RENOVATION
BID NO. 7.24**

SEALS AND CERTIFICATIONS

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The seal and signature to the left applies to the following Specifications Divisions and Sections of this Project Manual:




- All except as noted below.

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The seal and signature to the left applies to the following Specifications Divisions and Sections of this Project Manual:

- Divisions 3.
- Division 4.

<p>Frank Almeida Andrade, PE License No. NY PE-096728</p> 	<p>The seal and signature to the left applies to the following Specifications Divisions and Sections of this Project Manual:</p> <ul style="list-style-type: none"> • Division 22.
<p>Alejandro Dsola, PE License No. NY PE-107868</p> 	<p>The seal and signature to the left applies to the following Specifications Divisions and Sections of this Project Manual:</p> <ul style="list-style-type: none"> • Division 23.
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Engineer's seal and signature does not apply to the documents that comprise Division 00, Bidding and Contracting Requirements.

It is a violation of applicable laws and regulations governing professional licensing and registration for any person, unless acting under the direction of the licensed and registered design professional(s) indicated above, to alter in any way the Specifications in this Project Manual.

++ END OF SEALS AND CERTIFICATIONS ++

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ADVERTISEMENT FOR BIDS

Bid No. 7.24
for
Wastewater Treatment Plant (WWTP) Admin Building Renovation

Sealed Bids for the construction of the Wastewater Treatment Plant (WWTP) Admin Building Renovation will be received by the City of Newburgh Comptroller's Office until **11:00 a.m.** (local time) **Thursday, November 7, 2024** at City Hall, City of Newburgh, 83 Broadway – 4th floor, Newburgh, New York 12550, at which time the Bids received will be opened and read aloud. All Bids must be submitted in a sealed envelope ***clearly marked*** "BID 7.24 for Wastewater Treatment Plant (WWTP) Admin Building Renovation".

The project consists of general, electrical, heating and ventilation and plumbing Work to completely rehabilitate the administrative offices, laboratory and miscellaneous spaces of the City of Newburgh's WWTP Admin Building, including exterior improvements.

Complete sets of the drawings, specifications, and bid forms, becoming available to the public on October 3, 2024, may be viewed and downloaded at no charge by visiting the Empire State Purchasing Group website at: www.BidNetDirect.com/new-york/city-of-newburgh, selecting the "Open Solicitations" tab and title of solicitation. Vendors may have to register if visiting this site for the first time.

Bidders must obtain and download all Bidding Documents, including any Addenda and other Bid correspondence, from the Empire State Purchasing Group (Issuing Office) website in order to be considered as, and placed on, the official Plan Holders list, receive Addenda and other Bid correspondence. Bids received from Bidders other than those on the official Plan Holders list will not be accepted.

All Bids must be made on the official Bid Form or an exact copy by reproduction thereof and enclosed in a sealed envelope. **All Bids must be in original form and signed in *blue ink*, except for a Notary Public.** Photocopies will not be accepted and will result in a rejection of the Bid.

All Bids must meet the requirements of the General Municipal Law of the State of New York and all other applicable federal, state and local statutes. Bidders are required to comply with the prevailing wage rates as prescribed by the laws of the State of New York. Bidders shall confirm the rates prior to the Bid and assemble Bid prices accordingly. Whenever State and Federal wage rate determinations list different minimum rate of pay for the same class of workers, the contractor and all subcontractors shall pay the higher of the two rates.

The City of Newburgh is exempt from sales and compensating use taxes of the State of New York and of cities and counties on all materials to be incorporated into the Work.

Bid security shall be furnished in accordance with Article 8 of the Instructions to Bidders.

Bidders shall furnish proof of qualifications to perform the Work as described in Article 3 the Instructions to Bidders.

Bidders shall comply with all statutory requirements in accordance with Article 24 of the Instructions to Bidders.

Time of commencement of the Work and Contract Times for completion shall be in accordance with Article 4 of the Agreement.

The successful Bidder will be required to furnish construction performance and payment bonds in the full amount of the contract price. The successful Bidder will be required to comply with all provisions of the Federal Government Equal Employment Opportunity clauses issued by the Secretary of Labor on May 21, 1968 and published in the Federal Register (41CFR Part 60-1, 33 F.2 7804).

published in the Federal Register (41CFR Part 60-1, 33 F.2 7804).

OWNER reserves the right to reject any and all Bids, to waive any and all informalities and the right to disregard all nonconforming, non-responsive or Conditional Bids.

OWNER:	Contact:	ENGINEER:	Contact:
City of Newburgh 83 Broadway Newburgh, NY 12550	Allison Spinelli Assistant City Engineer (845) 569-7447	Arcadis of New York, Inc. 201 Fuller Road, Suite 201 Albany, NY 12203	Liliane-Marie Abihabib Senior Architect liliane.abihabib@arcadis.com

BY ORDER OF THE CITY OF NEWBURGH

By:  Dated: September 26, 2024
Janice Gaston, City Comptroller

CITY OF NEWBURGH – AN EQUAL OPPORTUNITY EMPLOYER

Justice, Equity, Diversity and Inclusion are core values to the City of Newburgh, where there is a strong commitment to establishing and maintaining an environment free of discrimination. These values are promoted through the daily practice of professionalism, respect, acceptance and understanding. As such, City residents along with women, minorities, individuals with disabilities, members of the LGBTQ community, and veterans are encouraged to apply.

MEDIA SOURCE

Hudson Valley Press
Mid-Hudson Times

PUBLICATION DATE

Wednesday, October 2, 2024
Thursday, October 3, 2024

++ END OF ADVERTISEMENT FOR BIDS ++

**City of Newburgh
Wastewater Treatment Plant (WWTP) Admin Building Renovation
Bid No. 7.24**

INSTRUCTIONS TO BIDDERS

(ALL CONTRACTS)

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ARTICLE 1 – DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in the Bidding Requirements have the meanings indicated below which are applicable to both the singular and plural thereof.

- A. *Issuing Office*—The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

- 2.01 Complete sets of the Bidding Documents, becoming available to the public on October 3, 2024, may be viewed and downloaded at no charge by visiting the Empire State Purchasing Group website at: www.BidNetDirect.com/new-york/city-of-newburgh
- 2.02 Complete sets of Bidding Documents shall be used in preparing Bids; however, Bidders shall submit their Bid on the Bid Form provided as a separate downloadable file rather than submitting the entire Bid Document. Neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

- 3.01 Bidders shall be experienced in the kind of Work to be performed, shall have the necessary equipment therefor, and shall possess sufficient capital to properly execute the Work within the time allowed. Bids received from Bidders who have previously failed to complete work within the time required, or who have previously performed similar work in an unsatisfactory manner, may be rejected. A Bid may be rejected if Bidder cannot show that Bidder has the necessary ability, facilities, equipment, and resources to commence the Work at the time prescribed and thereafter to prosecute and complete the Work at the rate or within the times specified. A Bid may be rejected if Bidder is already obligated for the performance of other work which would delay the commencement, prosecution or completion of the Work.
- 3.02 To demonstrate qualifications to perform the Work, Bidder shall complete and submit with its Bid the Qualifications Statement which is bound in the Project Manual. Bidders may be asked to and shall furnish additional data to demonstrate Bidder's qualifications.
- 3.03 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
- 3.04 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.
- 3.05 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

- 3.06 Bidders shall be qualified to do business in the jurisdiction where the Project is located or covenant to obtain such qualification prior to signing the Agreement.
- 3.07 Bidder is advised that the Project is being funded with monies made available by the Drinking Water State Revolving Fund that has statutory requirements for non-discrimination in employment and affirmative action commonly known and MWBE/EEO/DBRA requirements described in the Supplementary Conditions.

ARTICLE 4 – SITE AND OTHER AREAS; EXISTING SITE CONDITIONS;
EXAMINATION OF SITE; OWNER’S SAFETY PROGRAM; OTHER WORK AT
THE SITE

4.01 *Site and Other Areas*

- A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

4.02 *Existing Site Conditions*

- A. Subsurface and Physical Conditions; Hazardous Environmental Conditions
 - 1. The Supplementary Conditions identify:
 - a. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
 - b. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities);
 - c. reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
 - d. Technical Data contained in such reports and drawings.
 - 2. Owner will make copies of reports and drawings referenced above available to any Bidder. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions (as may be modified by the Supplementary Conditions), has been identified and established in the proposed Contract Documents. Bidder is responsible for any

interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.
- B. *Underground Facilities:* Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or adjacent to the Site are set forth in the Contract Documents and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.
 - C. *Adequacy of Data:* Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions, as may be modified by the Supplementary Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions, as may be modified by the Supplementary Conditions.

4.03 *Site Visits and Testing by Bidders*

- A. Bidder shall conduct the required Site visit during normal working hours and shall not disturb any ongoing operations at the Site.
- B. Bidder is not required to perform any subsurface testing, or exhaustive investigations of Site conditions.
- C. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder access to the Site to perform such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site.
- D. Bidder shall comply with all applicable laws and regulations regarding excavation and location of utilities (including Underground Facilities), obtain all permits, and

comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.

- E. Bidder shall fill all holes and promptly clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

4.04 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner safety program. As the General Conditions indicate, if an Owner safety program exists, it will be noted in the Supplementary Conditions or the Division 01 Specifications.

4.05 *Other Work at the Site*

- A. Reference is made to Article 8 of the General Conditions and the Division 01 Specifications for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 5 – BIDDER'S REPRESENTATIONS

5.01 It is the responsibility of each Bidder before submitting a Bid to:

- A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;
- B. visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
- C. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;
- D. carefully study all reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings;
- E. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports

and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs;

- F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
 - G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
 - H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;
 - I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and
 - J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.
- 5.02 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with all requirements of Articles 4 and 5 of these Instructions to Bidders, that without exception the Bid is premised upon performing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, or procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions thereof by Engineer are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing the Work.

ARTICLE 6 – PRE-BID CONFERENCE

- 6.01 A pre-bid conference will be held at 10:00 AM local time on October 15, 2024, at the City of Newburgh Wastewater Treatment Plant located at 2 Renwick Street, Newburgh, NY, 12550.

- 6.02. Representatives of Owner and Engineer will be present at the pre-bid conference to discuss the Project. Bidders are encouraged to attend and participate in the conference. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

- 7.01 All questions about the meaning or intent of the Bidding Documents shall be submitted to Engineer electronically in writing and be addressed to liliane.abihabib@arcadis.com. To receive consideration, questions must be received by Engineer no later than 5:00 PM local time, Friday, October 18, 2024, unless longer period is indicated elsewhere in these Instructions to Bidders for certain types of requests, such as regarding substitutes and “or-equals” (when allowed during bidding). Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda and posted on BidNet for Bidders to download. It is the Bidder’s responsibility to download any addenda from the Empire State Purchasing Group. The last Addendum will be issued not later than five days prior to the date for the opening of Bids. Addenda may be issued after the stated period and before the receipt of Bids to change the date or time for receipt of Bids, or to make minor changes or clarifications to the Bidding Documents that will not have a significant effect on price. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.
- 7.02 Addenda may also be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Engineer. Such Addenda, if any, will be issued in the manner and within the time period stated in Paragraph 7.01 of these Instructions to Bidders.

ARTICLE 8 – BID SECURITY

- 8.01 A Bid shall be accompanied by bid security made payable to Owner in the amount of five percent of Bidder's maximum bid price and in the form of a bid bond or certified check.
- 8.02 When a bid bond is furnished as bid security, the bond shall be in the form of the specimen bid bond form bound into the Project Manual. Bid bond shall be issued by a surety complying with the requirements of Paragraph 6.01 of the General Conditions, as may be modified by the Supplementary Conditions.
- 8.03 *Bid Security of Successful Bidder*
- A. The bid security of the Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security, and complied with the other conditions of the Notice of Award, whereupon the bid security will be returned or disposed of in accordance with Paragraph 8.05.

- B. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within the number of days after the Notice of Award as indicated in Article 21 of these Instructions to Bidders for delivery of the executed Contract, Owner may annul the Notice of Award and the bid security will be forfeited to the Owner as liquidated damages for such failure. Such forfeiture shall be Owner's sole and exclusive remedy.

8.04 *Bid Security of Other Bidders*

- A. The bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of the seventh day after the Effective Date of the Contract or the sixty-first day after the Bid opening whereupon the bid security furnished by such Bidders will be returned or disposed of in accordance with Paragraph 8.05.
- B. The bid security of Bidders whom Owner believes do not have a reasonable chance of receiving an award will be returned (or disposed of in accordance with Paragraph 8.05) within seven days of the opening of Bids.

- 8.05 When the submitted form of bid security is a bid bond, Owner may, at Owner's option, destroy the bid bond submitted instead of returning it to the Bidder.

ARTICLE 9 – CONTRACT TIMES

- 9.01 The number of days within which the Work is to be substantially completed and completed and ready for final payment are set forth in the Agreement.

ARTICLE 10 – LIQUIDATED AND SPECIAL DAMAGES

- 10.01 Provisions for liquidated and special damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND “OR-EQUAL” ITEMS

- 11.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or “or-equal” items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or “or-equal” item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract. The procedure for submittal of any such request by Contractor and consideration by Engineer is set forth in the General Conditions which may be supplemented by the Division 01 Specifications.

- 11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Contract Documents, including Addenda (if any). Any assumptions regarding the possibility of post-bid-opening approvals of “or-equal” or substitute requests are made at Bidder’s sole risk.
- 11.03 Refer to Specifications Section 01 25 00, Substitution Procedures, for the period of time (if any) after the Effective Date of the Contract during which Engineer will accept applications for substitute items of material or equipment and substitutes for construction procedures indicated in the Contract Documents.

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 12.01 A Bidder shall be prepared to retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of the Work if required by the Bidding Documents (most commonly in the Specifications) to do so. If a prospective Bidder objects to retaining any such Subcontractor, Supplier, or other individual or entity, and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.
- 12.02 Subsequent to the submittal of the Bid, Owner may not require the Successful Bidder or Contractor to retain any Subcontractor, Supplier, or other individual or entity against which Contractor has reasonable objection.
- 12.03 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, or other individuals or entities. Declining to make requested substitutions will constitute grounds for forfeiture of the bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance after Effective Date of the Agreement as provided in Paragraph 6.06 of General Conditions.

ARTICLE 13 – PREPARATION OF BID

13.01 *The Bid Form*

- A. The Bid shall be made using the Bid Form included in the Bidding Documents. The Bid Form shall not be altered in any way.
- B. The Bid shall be made on the Bid Form furnished with the Bidding Documents made available on BidNet as a separate downloadable file.
- C. All blanks in the Bid Form shall be completed in ink or by typewriter and the Bid Form signed in *blue ink*, except for the Notary Public. Erasures or alterations shall be

initialed in ink by the person signing the Bid Form. A bid price shall be indicated for each lump sum and unit price listed therein. Ditto marks shall not be used.

13.02 *Execution of Bid*

- A. A Bid by a corporation shall be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation shall be indicated.
- B. A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The partnership's address for receiving notices shall be indicated.
- C. A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the firm's address for receiving notices shall be indicated.
- D. A Bid by an individual shall show the Bidder's name and the individual's address for receiving notices.
- E. A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture's address for receiving notices shall be indicated.
- F. The associated name shall be typed or printed in ink below each signature.

13.03 *Completion of Bid Form*

- A. The Bid shall contain an acknowledgment of the receipt of all Addenda, the numbers of which shall be filled in at the space provided on the Bid Form.
- B. Postal and e-mail addresses and telephone number for communications regarding the Bid shall be indicated.
- C. The Bid shall contain evidence of Bidder's authority and qualification to do business in the jurisdiction where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid.
- D. Bidder's license or registration number as a licensed contractor, if any, shall be indicated on the Bid Form.

13.04 Required attachments to the Bid are indicated at Article 7 of the Bid Form. Each document shall be properly completed and executed in the manner described in Paragraph 13.02 of the Instructions to Bidders unless another manner is indicated.

ARTICLE 14 – BASIS OF BIDS

14.01 *Lump Sum*

- A. Bidders shall submit a Bid on a lump sum basis as set forth in the Bid Form. When the Bid Form includes a series of lump sum items, Bidder shall submit its Bid on the basis of each lump sum item as set forth on the Bid Form and shall compute and enter the total of all lump sum items in the space provided on the Bid Form.

14.02 *Unit Price*

- A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.
- B. The “Bid Price” (sometimes referred to as the extended price) for each unit price bid item will be the product of the “Estimated Quantity” (which Owner or its representative has set forth in the Bid Form) for the item and the corresponding “Bid Unit Price” offered by the Bidder. The total of all unit price bid items will be the sum of these “Bid Prices”; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions, as may be modified by the Supplementary Conditions.
- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

ARTICLE 15 – SUBMITTAL OF BID

- 15.01 Bid shall be enclosed in an opaque sealed envelope clearly marked on the outside with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of the Bidder, and Bidder’s license or registration number (when applicable). Bid shall be accompanied by bid security and other required documents in accordance with the Bidding Documents.
- 15.02 If the Bid is sent by mail or other delivery method, the sealed envelope containing the Bid shall be enclosed in a separate envelope clearly marked on the outside with the notation “**BID ENCLOSED: Wastewater Treatment Plant (WWTP) Admin Building Renovation, Bid No. 7.24**”. A mailed Bid shall be addressed to: **City Comptroller, City of Newburgh, 83 Broadway, Fourth Floor, Newburgh, New York 12550.**

ARTICLE 16 – MODIFICATION OR WITHDRAWAL OF BID

16.01 Withdrawal Prior to Bid Opening

- A. A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.

16.02 Modification Prior to Bid Opening

- A. If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.

16.03 Withdrawal After Bid Opening

- A. If within 48 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bidder's bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 – OPENING OF BIDS

- 17.01 Bids will be opened at the time and place where Bids are to be submitted and, unless obviously non-responsive, will be read aloud publicly. An abstract of the Bids, including alternative items (if any), will be made available to Bidders after the opening and posted to BidNet for download.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 18.01 All Bids shall remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the bid security (or dispose of same in accordance with Paragraph 8.05 of the Instructions to Bidders) prior to the end of that period.

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

19.01 Rejection of Bids; Disqualification of Bidders

- A. Owner reserves the right to reject any or all Bids, including without limitation, non-conforming, non-responsive, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes

exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as non-responsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.

- B. Owner reserves the right to reject any Bid that, in its sole discretion, is considered to be unbalanced or unreasonable as to the amount bid for any bid item.
 - C. More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.
 - D. Owner reserves the right to reject any Bid not accompanied by required documentation and bid security.
 - E. Owner reserves the right to reject Bids for the reasons indicated in Paragraph 3.01 of these Instructions to Bidders.
- 19.02 If a Contract is to be awarded, Owner will award the Contract to the Bidder who has been neither disqualified nor rejected pursuant to Paragraph 19.01 or other provisions of these Instructions to Bidders, and who submitted the lowest responsive Bid.
- 19.03 *Evaluation of Bids*
- A. In evaluating the Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternatives, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.
 - B. *Series of Lump Sums:* For the determination of the apparent low Bid when lump sum and unit price Bids are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with lump sum items
 - C. Where prices are to be indicated on the Bid Form in both words and numerals, discrepancies between words and numerals will be resolved in favor of words. Arithmetic discrepancies will be resolved as indicated in Paragraph 14.02.C of these Instructions to Bidders.
- 19.04 In evaluating Bidders, Owner will consider the qualifications of Bidders, whether the Bids comply with the prescribed requirements, the alternatives (if any), the prices submitted, and other data as may be requested in the Bid Form, with the Bid, or prior to the Notice of Award.

- 19.05 Owner may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Bidding Documents.
- 19.06 If a Contract is awarded, Owner will issue to Successful Bidder a written Notice of Award, issued with accompanying documents as indicated in Articles 20 and 21 of these Instructions to Bidders.
- 19.07 If a Contract is awarded, Owner will issue to Successful Bidder a written Notice of Award, issued with accompanying documents as indicated in Articles 20 and 21 of these Instructions to Bidders.

ARTICLE 20 – BONDS AND INSURANCE

- 20.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements for furnishing by Contractor of performance and payment bonds and insurance. Performance bond, payment bond, and other contract bonds (if any) required by the Contract Documents shall be furnished on the forms included in the Contract Documents.
- 20.02 In accordance with Paragraph 2.01 of the General Conditions, when the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required bonds and insurance documentation (the latter furnished in accordance with Paragraph 6.02 of the General Conditions) acceptable form in accordance with the Contract Documents.

ARTICLE 21 – SIGNING OF AGREEMENT

- 21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days after the date indicated on the Notice of Award, Successful Bidder shall execute and deliver the required number of counterparts of the Agreement (and any bonds and insurance documentation required to be delivered by the Contract Documents) to Owner together with other Contract Documents. Within ten days thereafter, Owner shall deliver one fully-executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.
- 21.02 The Contract Times will commence running as provided in Paragraph 4.01 of the General Conditions, as may be modified by the Supplementary Conditions.

ARTICLE 22 – SALES AND USE TAXES

22.01 Owner is exempt from New York state sales and use taxes on materials and equipment to be incorporated in the Work. Said taxes shall not be included in the Bid. Refer to Paragraph SC-7.09 of the Supplementary Conditions for additional information.

ARTICLE 23 – NOT USED

ARTICLE 24 – ADDITIONAL REQUIREMENTS

24.01 State and Federal Wage Rate Schedules are included in the Supplementary Conditions. It is further stipulated that the laborers, workers, and mechanics employed on the work done in performance of said contract shall be paid not less than the highest rate of wages listed thereon for the trade or occupation of such laborer, etc., and also provided with each supplement listed on this schedule for such trade or occupation at not less than the amount so listed.

24.02 Refer to Article SC-19 of the Supplementary conditions for Statutory Requirements.

+ + END OF INSTRUCTIONS TO BIDDERS + +

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BID FORM

**City of Newburgh
Wastewater Treatment Plant (WWTP) Admin Building Renovation
General Construction
(Contract 1-G)
Bid No. 7.24**

ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

City Comptroller
City of Newburgh
83 Broadway
Fourth Floor
Newburgh, New York 12550

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Contract with Owner, by executing the Agreement form included in the Bidding Documents, to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for sixty days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

- A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda.

Addendum No.	Addendum Date

Addendum No.	Addendum Date

- B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has carefully studied all reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.

- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER’S CERTIFICATIONS

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of the Paragraph 4.01.D;
 - 1. “corrupt practice” means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
 - 4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

Item No.		
1	Lump Sum Bid Price for Base Bid for General Construction	\$

Item No.	Allowances	
2	Lump Sum Contingency Allowance	\$ 75,000

Total of All Lump Sums \$ _____

ARTICLE 6 – TIME OF COMPLETION

6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

6.02 Bidder accepts the provisions of the Agreement as to liquidated damages and special damages in the event of failure to complete the Work within the Contract Times. Bidder also accepts the provisions for performance damages, if any, included in the Contract Documents.

ARTICLE 7 – ATTACHMENTS TO THIS BID

7.01 The following documents are attached to and made a condition of this Bid:

- A. Required bid security.
- B. Required Qualifications Statement with supporting data.
- C. Listing of Subcontractors, Suppliers, and other individuals and entities required to be identified in this Bid.
- D. Waiver of Immunity / Non-Collusive Bidding Certificate.
- E. Workers' Compensation Affidavit.
- F. Iranian Energy Sector Divestment Form.

ARTICLE 8 – DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

9.01 This Bid submitted by:

BIDDER: [Indicate correct name of bidding entity]

By: [Signature] _____

[Printed name] _____

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

[Signature] _____

[Printed name] _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail
address: _____

Bidder's License
No.: _____

(where applicable)

+ + END OF BID FORM + +

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BID FORM

**City of Newburgh
Wastewater Treatment Plant (WWTP) Admin Building Renovation - Electrical
Construction
(Contract 2-E)
Bid No. 7.24**

ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

City Comptroller
City of Newburgh
83 Broadway
Fourth Floor
Newburgh, New York 12550

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Contract with Owner, by executing the Agreement form included in the Bidding Documents, to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for sixty days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

- A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda.

Addendum No.	Addendum Date

Addendum No.	Addendum Date

- B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has carefully studied all reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without

exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER’S CERTIFICATIONS

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of the Paragraph 4.01.D;
 - 1. “corrupt practice” means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
 - 4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

Item No.		
1	Lump Sum Bid Price for Electrical Construction	\$

Item No.	Allowances	
2	Lump Sum Contingency Allowance	\$ 50,000

Total of Lump Sums = Total Bid Price \$ _____

ARTICLE 6 – TIME OF COMPLETION

- 6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 6.02 Bidder accepts the provisions of the Agreement as to liquidated damages and special damages in the event of failure to complete the Work within the Contract Times. Bidder also accepts the provisions for performance damages, if any, included in the Contract Documents.

ARTICLE 7 – ATTACHMENTS TO THIS BID

7.01 The following documents are attached to and made a condition of this Bid:

- A. Required bid security.
- B. Required Qualifications Statement with supporting data.
- C. Listing of Subcontractors, Suppliers, and other individuals and entities required to be identified in this Bid.
- D. Waiver of Immunity / Non-Collusive Bidding Certificate.
- E. Workers' Compensation Affidavit.
- F. Iranian Energy Sector Divestment Form.

ARTICLE 8 – DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

9.01 This Bid submitted by:

BIDDER: [Indicate correct name of bidding entity]

By: [Signature] _____

[Printed name] _____

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

[Signature] _____

[Printed name] _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail
address: _____

Bidder's License

No.: _____

(where applicable)

+ + END OF BID FORM + +

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BID FORM

**City of Newburgh
Wastewater Treatment Plant (WWTP) Admin Building Renovation – HVAC Construction
(Contract 3-H)
Bid No. 7.24**

ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

City Comptroller
City of Newburgh
83 Broadway
Fourth Floor
Newburgh, New York 12550

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Contract with Owner, by executing the Agreement form included in the Bidding Documents, to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for sixty days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

- A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda.

Addendum No.	Addendum Date

Addendum No.	Addendum Date

- B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has carefully studied all reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without

exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER’S CERTIFICATIONS

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of the Paragraph 4.01.D;
 - 1. “corrupt practice” means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
 - 4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

Item No.		
1	Lump Sum Bid Price for HVAC Construction	\$

Item No.	Allowances	
2	Lump Sum Contingency Allowance	\$ 25,000

Total of Lump Sums = Total Bid Price \$ _____

ARTICLE 6 – TIME OF COMPLETION

- 6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 6.02 Bidder accepts the provisions of the Agreement as to liquidated damages and special damages in the event of failure to complete the Work within the Contract Times. Bidder also accepts the provisions for performance damages, if any, included in the Contract Documents.

ARTICLE 7 – ATTACHMENTS TO THIS BID

- 7.01 The following documents are attached to and made a condition of this Bid:
- A. Required bid security.
 - B. Required Qualifications Statement with supporting data.
 - C. Listing of Subcontractors, Suppliers, and other individuals and entities required to be identified in this Bid.
 - D. Waiver of Immunity / Non-Collusive Bidding Certificate.
 - E. Workers' Compensation Affidavit.
 - F. Iranian Energy Sector Divestment Form.

ARTICLE 8 – DEFINED TERMS

- 8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

9.01 This Bid submitted by:

BIDDER: [Indicate correct name of bidding entity]

By: [Signature] _____

[Printed name] _____

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

[Signature] _____

[Printed name] _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail
address:

Bidder's License
No.:

(where applicable)

+ + END OF BID FORM + +

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BID FORM

**City of Newburgh
Wastewater Treatment Plant (WWTP) Admin Building– Plumbing Construction
(Contract 4-P)
Bid No. 7.24**

ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

City Comptroller
City of Newburgh
83 Broadway
Fourth Floor
Newburgh, New York 12550

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Contract with Owner, by executing the Agreement form included in the Bidding Documents, to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for sixty days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

- A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda.

Addendum No.	Addendum Date

Addendum No.	Addendum Date

- B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has carefully studied all reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.

- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER’S CERTIFICATIONS

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of the Paragraph 4.01.D;
 - 1. “corrupt practice” means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
 - 4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

Item No.		
1	Lump Sum Bid Price for Plumbing Construction	\$

Item No.	Allowances	
2	Lump Sum Contingency Allowance	\$ 15,000

Total of Lump Sums = Total Bid Price \$ _____

ARTICLE 6 – TIME OF COMPLETION

- 6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 6.02 Bidder accepts the provisions of the Agreement as to liquidated damages and special damages in the event of failure to complete the Work within the Contract Times. Bidder also accepts the provisions for performance damages, if any, included in the Contract Documents.

ARTICLE 7 – ATTACHMENTS TO THIS BID

- 7.01 The following documents are attached to and made a condition of this Bid:
- A. Required bid security.
 - B. Required Qualifications Statement with supporting data.
 - C. Listing of Subcontractors, Suppliers, and other individuals and entities required to be identified in this Bid.
 - D. Waiver of Immunity / Non-Collusive Bidding Certificate.
 - E. Workers' Compensation Affidavit.
 - F. Iranian Energy Sector Divestment Form.

ARTICLE 8 – DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

9.01 This Bid submitted by:

BIDDER: [Indicate correct name of bidding entity]

By: [Signature] _____

[Printed name] _____

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

[Signature] _____

[Printed name] _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail
address:

Bidder's License
No.:

(where applicable)

++ END OF BID FORM ++

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BID BOND

Any singular reference to Bidder, Surety, Owner, or other party shall be considered plural where applicable.

BIDDER (*Name and Address*):

SURETY (*Name, and Address of Principal Place of Business*):

OWNER (*Name and Address*):

BID

Bid Due Date:

Description (*Project Name— Include Location*):

BOND

Bond Number:

Date:

Penal sum _____ \$ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER

SURETY

Bidder's Name and Corporate Seal

Surety's Name and Corporate Seal

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Note: Addresses are to be used for giving any required notice.

Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder any difference between the total amount of Bidder's Bid and the total amount of the Bid of the next lowest, responsible Bidder that submitted a responsive Bid as determined by Owner for the work required by the Contract Documents, provided that:

- 1.1 If there is no such next Bidder, and Owner does not abandon the Project, then Bidder and Surety shall pay to Owner the penal sum set forth on the face of this Bond, and
- 1.2 In no event shall Bidder's and Surety's obligation hereunder exceed the penal sum set forth on the face of this Bond.
- 1.3 Recovery under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

- 3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
- 3.2 All Bids are rejected by Owner, or
- 3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

QUALIFICATIONS STATEMENT

Prepared by



Issued and Published Jointly by



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National Society of Professional Engineers
1420 King Street, Alexandria, VA 22314-2794
(703) 684-2882
www.nspe.org

American Council of Engineering Companies
1015 15th Street N.W., Washington, DC 20005
(202) 347-7474
www.acec.org

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400
(800) 548-2723
www.asce.org

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QUALIFICATIONS STATEMENT

THE INFORMATION SUPPLIED IN THIS DOCUMENT IS CONFIDENTIAL TO THE EXTENT
PERMITTED BY LAWS AND REGULATIONS

1. SUBMITTED BY:

Official Name of Firm:

Address:

2. SUBMITTED TO:

3. SUBMITTED FOR:

Owner:

Project Name:

TYPE OF WORK:

4. CONTRACTOR'S CONTACT INFORMATION

Contact Person:

Title:

Phone:

Email:

5. AFFILIATED COMPANIES:

Name:

Address:

6. TYPE OF ORGANIZATION:

☐ SOLE PROPRIETORSHIP

Name of Owner:

Doing Business As:

Date of Organization:

☐ PARTNERSHIP

Date of Organization:

Type of Partnership:

Name of General Partner(s):

☐ CORPORATION

State of Organization:

Date of Organization:

Executive Officers:

- President:

- Vice President(s):

- Treasurer:

- Secretary:

☐ LIMITED LIABILITY COMPANY

State of Organization:

Date of Organization:

Members:

☐ JOINT VENTURE

Sate of Organization:

Date of Organization:

Form of Organization:

Joint Venture Managing Partner

- Name:

- Address:

Joint Venture Managing Partner

- Name:

- Address:

Joint Venture Managing Partner

- Name:

- Address:

7. LICENSING

Jurisdiction: _____

Type of License: _____

License Number: _____

Jurisdiction: _____

Type of License: _____

License Number: _____

8. CERTIFICATIONS

CERTIFIED BY:

Disadvantage Business Enterprise: _____

Minority Business Enterprise: _____

Woman Owned Enterprise: _____

Small Business Enterprise: _____

Other (_____): _____

9. BONDING INFORMATION

Bonding Company: _____

Address: _____

Bonding Agent: _____

Address: _____

Contact Name: _____

Phone: _____

Aggregate Bonding Capacity: _____

Available Bonding Capacity as of date of this submittal: _____

EJCDC® C-451, Qualifications Statement.

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and American Society of Civil Engineers. All rights reserved.

10. FINANCIAL INFORMATION

Financial Institution: _____

Address: _____

Account Manager: _____

Phone: _____

INCLUDE AS AN ATTACHMENT AN AUDITED BALANCE SHEET FOR EACH OF THE
LAST 3 YEARS

11. CONSTRUCTION EXPERIENCE:

Current Experience:

List on **Schedule A** all uncompleted projects currently under contract (If Joint Venture list each participant's projects separately).

Previous Experience:

List on **Schedule B** all projects completed within the last 5 Years (If Joint Venture list each participant's projects separately).

Has firm listed in Section 1 ever failed to complete a construction contract awarded to it?

☐ YES ☐ NO

If YES, attach as an Attachment details including project owner's contact information.

Has any corporate officer, partner, joint venture participant, or proprietor ever failed to complete a construction contract awarded to them in their name or when acting as a principal of another entity?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

Are there any judgments, claims, disputes or litigation pending or outstanding involving the firm listed in Section 1 or any of its officers (or any of its partners if a partnership or any of the individual entities if a joint venture)?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

12. SAFETY PROGRAM:

Name of Contractor's Safety Officer: _____

Include the following as attachments:

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) OSHA Form 300A - Summary of Occupational Injuries and Illnesses for each of the past 5 years. When requested by Owner or Engineer after receipt of Bids, promptly submit OSHA Form 300 – Log of Work-Related Injuries and Illnesses, for each of the past 5 years.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all OSHA Citations & Notifications of Penalty (monetary or other) received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all safety citations or violations under any state all received within the last five years (indicate disposition as applicable) - IF NONE SO STATE.

Provide the following for the firm listed in Section V (and for each proposed Subcontractor furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) the following (attach additional sheets as necessary):

Workers' compensation Experience Modification Rate (EMR) for the last 5 years:

YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____

Total Recordable Frequency Rate (TRFR) for the last 5 years:

YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____

Total number of man-hours worked for the last 5 Years:

YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____

Provide Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) Days Away From Work, Days of Restricted Work Activity or Job Transfer (DART) incidence rate for the particular industry or type of Work to be performed by Contractor and each of Contractor's proposed Subcontractors and Suppliers) for the last 5 years:

YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____

13. EQUIPMENT:

MAJOR EQUIPMENT:

List on **Schedule C** all pieces of major equipment available for use on Owner's Project.

I HEREBY CERTIFY THAT THE INFORMATION SUBMITTED HERewith, INCLUDING ANY ATTACHMENTS, IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

NAME OF ORGANIZATION: _____

BY: _____

TITLE: _____

DATED: _____

NOTARY ATTEST:

SUBSCRIBED AND SWORN TO BEFORE ME

THIS _____ DAY OF _____, 20__

NOTARY PUBLIC - STATE OF _____

MY COMMISSION EXPIRES: _____

REQUIRED ATTACHMENTS

1. Schedule A (Current Experience).
2. Schedule B (Previous Experience).
3. Schedule C (Major Equipment).
4. Audited balance sheet for each of the last 3 years for firm named in Section 1.
5. Evidence of authority for individuals listed in Section 7 to bind organization to an agreement.
6. Resumes of officers and key individuals (including Safety Officer) of firm named in Section 1.
7. Required safety program submittals listed in Section 13.
8. Additional items as pertinent.

SCHEDULE A

CURRENT EXPERIENCE

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE C - LIST OF MAJOR EQUIPMENT AVAILABLE

[illegible]

++ END OF QUALIFICATIONS STATEMENT ++

DOCUMENT 00 45 19
WAIVER OF IMMUNITY/NON-COLLUSIVE BIDDING CERTIFICATION
PURSUANT TO SECTION 103-D OF THE NEW YORK STATE
GENERAL MUNICIPAL LAW

A. By submission of this Bid, 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 organizations, under penalty of perjury, that to the best of knowledge and belief:

(1) The prices in this 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;

(2) Unless otherwise required by law, the prices which have been quoted in this Bid have not knowingly been disclosed by the Bidder and will not knowingly be disclosed by the Bidder, directly or indirectly, prior to opening, to any other Bidder or to any competitor;

(3) No attempt has been made or 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;

A Bid shall not be considered for award nor shall any award be made where (1), (2) and (3) above have not been complied with; provided, however, that in any case the Bidder cannot make the foregoing certification, the Bidder shall so state and shall furnish with the Bid a signed statement which sets forth in detail the reasons therefore. Where (1), (2) and (3) above have not been complied with, the Bid shall not be considered for award nor shall any award be made unless the head of the Purchasing Unit to the political subdivision, public department, agency or official thereof to which the Bid is made, or his designee, determines that such disclosure was not made for the purpose of restricting competition.

The fact that a Bidder (a) has published price lists, rates, or tariffs covering items being procured, (b) has informed prospective customers of proposed or pending publication of new or revised price lists for such items, or (c) has sold the same items to other customers at the same prices being Bid, does not constitute, without more, a disclosure within the meaning of paragraph A above.

B. Any Bid hereafter made to any political subdivision of the state or any public department, agency or official thereof by a corporate Bidder for work or services performed or to be performed or goods sold or to be sold, where competitive Bidding is required by statute, rule, regulation, local law, and where such Bid contains the certification referred to in paragraph A of this section, shall be deemed to have been authorized by the board of directors of the Bidder, and such authorization shall be deemed to include the submission of the Bid and the inclusion therein of the certificate as to non-collusion as the act and deed of the corporation.

Sworn to before me
this _____ day of _____

Signature

Title

Notary Public

Company Name

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DOCUMENT 00 45 20
AFFIDAVIT - WORKERS' COMPENSATION

STATE OF: _____)
_____) SS:

County of: _____)

I, _____ of the Town, Village, City of _____
in the County of _____ and the State of _____
of full age, being duly sworn according to law on my oath depose and say that:

I am _____, an officer of the firm of _____
being duly sworn, deposes and says that he now carries or that he has applied for a Workers' Compensation Policy to cover the
operations, as set forth in the preceding contract, and to comply with the provisions thereof.

Contractor Name

Subscribed and sworn to _____
Name of Affiant Title of Affiant

Signature of Affiant (in blue ink)

before me this _____ day of _____, 20 _____

Affix Notary Seal or Stamp below

Notary Public of _____

My commission expires: _____

Notary Signature: _____

This Affidavit must be completed by all Bidders

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DOCUMENT 00 45 21
IRANIAN ENERGY SECTOR DIVESTMENT
Certification Pursuant to Section 103-g of the New York State General Municipal Law

- 1 By submission of this bid/proposal, each bidder/proposer and each person signing on behalf of any bidder/proposer certifies, and in the case of a joint bid, each party thereto certifies as to its own organization, under penalty of perjury, that to the best of its knowledge and belief that each bidder is not on the list created pursuant to paragraph (b) of subdivision 3 of Section 165-a of the New York State Finance Law.
- 2 A Bid/Proposal shall not be considered for award, nor shall any award be made where the condition set forth in Paragraph 1 above has not been complied with; provided, however, that in any case the bidder/proposer cannot make the foregoing certification set forth in Paragraph A above, the bidder/proposer shall so state and shall furnish with the bid a signed statement which sets forth in detail the reasons therefor. Where Paragraph 1 above cannot be complied with, the Purchasing Unit to the political subdivision, public department, agency or official thereof to which the bid/proposal is made, or his designee, may award a bid/proposal, on a case by case business under the following circumstances:
- 2.1 The investment activities in Iran were made before April 12, 2012, the investment activities in Iran have not been expanded or renewed after April 12, 2012, and the Bidder/Proposer has adopted, publicized and is implementing a formal plan to cease the investment activities in Iran and to refrain from engaging in any new investments in Iran; or
- 2.2 The political subdivision makes a determination that the goods or services are necessary for the political subdivision to perform its functions and that, absent such an exemption, the political subdivision would be unable to obtain the goods or services for which the contract is offered. Such determination shall be made in writing and shall be a public document.

Name: _____ Title: _____

Signature: _____

Date: _____ Company Name: _____

Subscribed and sworn to _____
Name of Affiant *Title of Affiant*

Signature of Affiant (in blue ink)

before me this _____ day of _____, 20____

Affix Notary Seal or Stamp below

Notary Public of _____

My commission expires: _____

Notary Signature: _____

This Affidavit must be completed by all Bidders

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**City of Newburgh
Wastewater Treatment Plant (WWTP) Admin Building Restoration
Bid No. 7.24**

AGREEMENT

THIS AGREEMENT is by and between City of Newburgh (hereinafter called Owner) and

(hereinafter called Contractor).

Owner and Contractor, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE 1 – THE WORK

- 1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows: Contractor shall at its own cost and expense provide all labor, services, tools, materials, equipment, and incidentals necessary to complete all the Work as specified or indicated in the Contract Documents to construct the Wastewater Treatment Plant (WWTP) Admin Building Restoration Contract. The Work is generally described in Specifications Section 01 12 13, Summary of Work.

ARTICLE 2 – PROJECT

- 2.01 The Project for which the Work under the Contract Documents is a part is generally described as follows:

Wastewater Treatment Plant (WWTP) Admin Building Restoration includes General, HVAC, Plumbing and Electrical Work to restore the administrative and laboratory spaces.

ARTICLE 3 – ENGINEER

- 3.01 The part of the Project that pertains to the Work was designed by Arcadis of New York, Inc., 201 Fuller Road, Suite 201, Albany, New York 12203.
- 3.02 The Owner has retained Arcadis of New York, Inc. (“Engineer”) to act as Owner’s representative, assume all duties and responsibilities of, and have the rights and authority assigned to, Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

- A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Contract Times – Number of Days*

- A. *Substantial Completion and Completed and Ready for Final Payment:* The Work shall be substantially completed within 365 days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 395 days from the date when the Contract Times commence to run.

4.03 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):
 - 1. *Substantial Completion:* Contractor shall pay Owner \$1,000 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.
 - 2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$500 for each day that expires after such time until the Work is completed and ready for final payment.
 - 3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

4.04 *Special Damages*

- A. In addition to the amount provided for liquidated damages, Contractor shall reimburse Owner (1) for any fines or penalties imposed on Owner as a direct result

of the Contractor's failure to attain Substantial Completion according to the Contract Times, and (2) for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Substantial Completion (as duly adjusted pursuant to the Contract), until the Work is substantially complete.

- B. After Contractor achieves Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times, Contractor shall reimburse Owner for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Work to be completed and ready for final payment (as duly adjusted pursuant to the Contract), until the Work is completed and ready for final payment.

- 4.05 Owner may deduct liquidated damages and special damages as determined by the provisions of this Article 4 from progress payments due Contractor under the Contract.

ARTICLE 5 – CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the prices stated in the pricing schedule included in Contractor's Bid, which is attached hereto as an exhibit to this Agreement. As provided in Paragraph 13.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by Engineer as provided in Paragraph 10.06 of the General Conditions. Unit prices have been computed as provided in Paragraph 13.03 of the General Conditions.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 Submittal and Processing of Payments

- A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed as provided in the General Conditions, as may be augmented by the Supplementary Conditions and the Specifications.

6.02 Progress Payments; Retainage

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the first day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in

the Contract. A progress payment will not be made whenever the value of the Work completed since the last previous progress payment is less than \$5,000.

1. *Prior to Substantial Completion*

- a. Progress payments will be made in the amount of 95 percent of the Work completed, (with the balance being retainage), less the aggregate of payments previously made and less such amounts as Engineer shall determine, or Owner may withhold, in accordance with Paragraph 15.01 of the General Conditions; and
- b. 90 percent of the cost of materials and equipment not incorporated in the Work but suitably stored (with the balance being retainage).

2. *Upon Substantial Completion*

- a. Upon Substantial Completion of all the Work under the Contract, Owner shall pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less 200 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the "punch list" of Work items to be completed or corrected prior to final payment.

6.03 *Final Payment*

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06 of the General Conditions, as may be modified by the Supplementary Conditions.

ARTICLE 7 – INTEREST

- 7.01 All amounts not paid when due hereunder shall bear interest at three percent per annum.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

- 8.01 As part of the inducement for Owner to enter into this Contract, Contractor makes the following representations:
 - A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.
 - B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general,

local, and Site conditions that may affect cost, progress, and performance of the Work.

- C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Contractor has carefully studied all reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
- E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor's safety precautions and programs.
- F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

- A. The Contract Documents consist of the following:
 - 1. This Agreement (pages 1 to 9, inclusive).
 - 2. Performance Bond (pages 1 to 3, inclusive).
 - 3. Payment Bond (pages 1 to 3, inclusive).
 - 4. General Conditions (pages 1 to 72, inclusive).
 - 5. Supplementary Conditions (pages 1 to 14, inclusive), and the following:
 - a. Wage Determination Schedule, comprised of a cover sheet and 15 pages.
 - 6. Specifications, as listed in the table of contents of the Project Manual.
 - 7. Drawings (not attached but incorporated by reference) consisting of 49 sheets, bearing the following general title: Wastewater Treatment Plant (WWTP) Admin Building Renovation, dated May 2024.
 - 8. Addenda consisting of Numbers ____ to ____, inclusive.
 - 9. Exhibits to this Agreement enumerated as follows:
 - a. Exhibit 1, pricing schedule from Contractor's Bid (pages ____ to ____, inclusive).
 - 10. The following, which may be delivered or issued on or after the Effective Date of the Contract, and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directive(s).
 - c. Change Order(s).
 - d. Field Order(s).
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above). Documents not attached are incorporated by reference.
- C. There are no Contract Documents other than those listed above in this Article 9.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions, as may be modified by the Supplementary Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

- A. Terms used in this Agreement will have the meanings indicated in the General Conditions and the Supplementary Conditions.

10.02 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 *Successors and Assigns*

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

- A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 - 1. “corrupt practice” means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 - 2. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-

competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
4. “coercive practice” means harming or threatening to harm directly or indirectly persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.06 *Other Provisions*

- A. The waiver by the Owner of any breach or violation of any term, covenant, or condition of this Agreement or of any Law or Regulation shall not be deemed to be a waiver of any other term, covenant, condition, or Law or Regulation, or of any subsequent breach or violation of the same or of any other term, covenant, condition, or Law or regulation. The subsequent payment of any monies or fee by the Owner which may become due hereunder shall not be deemed to be a waiver of any preceding breach or violation by Contractor of any term, covenant, condition of this Agreement or of any applicable Law or regulation.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____, 20____ (which is the Effective Date of the Contract).

1. *Contract.*

OWNER: _____

CONTRACTOR: _____

By: _____

By: _____

Title: _____

Title: _____

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____

Attest: _____

Title: _____

Title: _____

Address for giving notices:

Address for giving notices:

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

(If Contractor is a corporation, partnership, or limited liability company, attach evidence of authority to sign.)

+ + END OF AGREEMENT + +

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PERFORMANCE BOND

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

CONSTRUCTION CONTRACT

Effective Date of the Contract:

Amount:

Description *(name and location):*

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Contract):*

Amount:

Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal

Surety's Name and Corporate Seal

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence,

to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims

for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

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PAYMENT BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

CONSTRUCTION CONTRACT

Effective Date of the Contract:

Amount:

Description *(name and location)*:

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Contract)*:

Amount:

Modifications to this Bond Form: ☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

(seal)

Contractor's Name and Corporate Seal

By: _____

Signature

Print Name

Title

Attest: _____

Signature

Title

(seal)

Surety's Name and Corporate Seal

By: _____

Signature *(attach power of attorney)*

Print Name

Title

Attest: _____

Signature

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond shall arise after the following:
 - 5.1 Claimants who do not have a direct contract with the Contractor,
 - 5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2 Pay or arrange for payment of any undisputed amounts.
 - 7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.
8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.
11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.
16. **Definitions**
- 16.1 **Claim:** A written statement by the Claimant including at a minimum:
1. The name of the Claimant;
 2. The name of the person for whom the labor was done, or materials or equipment furnished;
 3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
 4. A brief description of the labor, materials, or equipment furnished;
 5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
 7. The total amount of previous payments received by the Claimant; and
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
- 16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
- 16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
- 16.4 **Owner Default:** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
- 16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.
18. Modifications to this Bond are as follows:

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This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by



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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer

has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. (“CERCLA”); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5101 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. (“RCRA”); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Engineer*—The individual or entity named as such in the Agreement.
21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.
23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.
26. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.
33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.
35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.
38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.
45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
46. *Unit Price Work*—Work to be paid for on the basis of unit prices.
47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:*
1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:*
1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:*
1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).
- E. *Furnish, Install, Perform, Provide:*
1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

- A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Contractor's Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.
- C. *Evidence of Owner's Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.
- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or

computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

- A. Standards Specifications, Codes, Laws and Regulations
 - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 - 2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

- A. *Reporting Discrepancies:*
 - 1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict,

error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

4.03 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 2. abnormal weather conditions;
 3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
 4. acts of war or terrorism.
- D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.
- E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.
- F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

- G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas:*

- 1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
- 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part

by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
 - 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
 - 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or
 2. is of such a nature as to require a change in the Drawings or Specifications; or
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Possible Price and Times Adjustments:*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

- c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- 2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
 - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 5.04.A.
- 3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
- 4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
 - 1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and
 - 2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 - d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after

becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

- C. *Engineer's Review:* Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Possible Price and Times Adjustments:*
 - 1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and
 - d. Contractor gave the notice required in Paragraph 5.05.B.
 - 2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
 - 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
 2. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.
- H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.
- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.
- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.
- E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.
- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is

maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

- D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.
- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 *Contractor's Insurance*

- A. *Workers' Compensation:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
 - 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
 - 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

4. Foreign voluntary worker compensation (if applicable).
- B. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:
1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
 2. claims for damages insured by reasonably available personal injury liability coverage.
 3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- C. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage:
 - a. Such insurance shall be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Broad form property damage coverage.
 4. Severability of interest.
 5. Underground, explosion, and collapse coverage.
 6. Personal injury coverage.
 7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
 8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- D. *Automobile liability:* Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.
- E. *Umbrella or excess liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
- F. *Contractor's pollution liability insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result

of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

- G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
- H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:
 - 1. include at least the specific coverages provided in this Article.
 - 2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.
 - 3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
 - 4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
 - 5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.
- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.
- B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 *Property Insurance*

- A. *Builder's Risk:* Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 - 1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
 - 2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.
 - 3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 - 4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).

5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
 6. extend to cover damage or loss to insured property while in transit.
 7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
 8. allow for the waiver of the insurer's subrogation rights, as set forth below.
 9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
 10. not include a co-insurance clause.
 11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
 12. include performance/hot testing and start-up.
 13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.
- B. *Notice of Cancellation or Change:* All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.
- C. *Deductibles:* The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- D. *Partial Occupancy or Use by Owner:* If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
- E. *Additional Insurance:* If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.
- F. *Insurance of Other Property:* If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

- A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:
 - 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 - 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.
- D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the

policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and

guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.04 "Or Equals"

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) it has a proven record of performance and availability of responsive service; and
 - 4) it is not objectionable to Owner.
 - b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense:* Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

- D. *Effect of Engineer's Determination:* Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.
- E. *Treatment as a Substitution Request:* If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 Substitutes

- A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.
 - 1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.
 - 2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
 - 3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - a. shall certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design,
 - 2) be similar in substance to that specified, and
 - 3) be suited to the same use as that specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from that specified, and

- 2) available engineering, sales, maintenance, repair, and replacement services.
- d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- E. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination:* If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.
- F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.
- J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
- K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.
- L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
- N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

O. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor
2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

7.09 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.10 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.12 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
 - C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
 - D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
 - E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
 - F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).
 - G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or

exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements:*

1. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

- a. Contractor shall submit the number of copies required in the Specifications.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to

provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

2. *Samples:*

- a. Contractor shall submit the number of Samples required in the Specifications.
- b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Other Submittals:* Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.
5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal;
 6. the issuance of a notice of acceptability by Engineer;
 7. any inspection, test, or approval by others; or
 8. any correction of defective Work by Owner.

- D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop

Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
 - 1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 - 2. an itemization of the specific matters to be covered by such authority and responsibility; and
 - 3. the extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

- A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner for whom the Owner is responsible causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.
- C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

- D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during

or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 *Rejecting Defective Work*

- A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

- A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.
- B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.07 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
 - 1. *Change Orders:*
 - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
 - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.
 - 2. *Work Change Directives:* A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an

adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
 1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on

the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

C. *Contractor's Fee:* When applicable, the Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or
2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.04.C.2.a and 11.04.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under

the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures:* Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.
 2. *Engineer's Action:* Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.
 3. *Binding Decision:* Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- B. *Resolution of Certain Change Proposals:* If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
 4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12 – CLAIMS

12.01 *Claims*

- A. *Claims Process:* The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
 - 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 - 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 - 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.
- B. *Submittal of Claim:* The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. *Review and Resolution:* The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation:*
 - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim

submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:
 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable

thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes

other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
- 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
- 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee:* When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.

E. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

- B. *Cash Allowances*: Contractor agrees that:
 - 1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 *Unit Price Work*

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:
 - 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;
 - 2. there is no corresponding adjustment with respect to any other item of Work; and
 - 3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
 - 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 - 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 - 3. by manufacturers of equipment furnished under the Contract Documents;
 - 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 - 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to

cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will

include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments:*
1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
 2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
 3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.
- C. *Review of Applications:*
1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
 2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

- a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

- e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due:*

- 1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner:*

- 1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. the Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. the Contract Price has been reduced by Change Orders;
 - i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
 - j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - l. there are other items entitling Owner to a set off against the amount recommended.
- 2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount

remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.
 - 2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
 - 4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

- A. *Application for Payment:*
 - 1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of

inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all disputes that Contractor believes are unsettled; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. Engineer's Review of Application and Acceptance:

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

- C. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.
- D. *Payment Becomes Due:* Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation,

including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such other adjacent areas;
 - 2. correct such defective Work;
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

- E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses,

and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for

expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this Article:
 - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
 - 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this Article, Owner or Contractor may:
 - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
 - 2. agree with the other party to submit the dispute to another dispute resolution process; or
 - 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
 - 1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
 - 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SUPPLEMENTARY CONDITIONS

SCOPE

These Supplementary Conditions amend or supplement EJCDC® C-700, Standard General Conditions of the Construction Contract (2013 edition) (hereinafter, “General Conditions”). All provisions of the General Conditions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions which are defined in the General Conditions have the meanings assigned to them in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to the singular and plural thereof.

The address system used in these Supplementary Conditions conforms to the address system used in the General Conditions, with the prefix "SC" added thereto.

SC-1.01.A.11 Add the following new sentence to Paragraph 1.01.A.11 of the General Conditions:

Lead-based paint shall be as defined in HUD’s publication, “Guidelines for the Evaluation and Control of Lead-Based Paint in Housing” (e.g., paint containing a lead concentration in excess of 1.0 mg/sq. cm or 0.5 percent lead by weight), or as otherwise prescribed in Laws or Regulations.

SC-1.01.A.16 Add the following to Paragraph 1.01.A.16 of the General Conditions:

Whenever the Project is to be constructed under multiple direct Contracts, the term “Contractor” shall mean the appropriate prime Contractor. Whenever a specific prime Contractor is referred to, terms such as “General Contractor”, “Electrical Contractor”, “Plumbing Contractor”, “HVAC Contractor”, or other appropriate Contract-indicating term will be used. The terms “Contractor” and “CONTRACTOR” have the same meaning.

SC-1.01.A.20 Add the following to Paragraph 1.01.A.20 of the General Conditions:

The terms “Engineer” and “ENGINEER” have the same meaning.

SC-1.01.A.28 Add a new sentence to Paragraph 1.01.A.28 that is to read as follows:

The terms “Owner” and “OWNER” have the same meaning.

SC-1.01.A.39 Add the following to Paragraph 1.01.A.39 of the General Conditions:

Trucking, shipping, and delivery firms, consultants, and entities performing testing or inspection retained by Contractor or any Subcontractor are considered to be Subcontractors.

SC-1.01.A.43 Add the following to Paragraph 1.01.A.43 of the General Conditions:

Entities that rent construction equipment or machinery, but are not incorporated into the Work, are considered to be Suppliers. If such rental entity furnishes both equipment and one or more personnel to operate and maintain the equipment, such entity is a Subcontractor.

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.B of the General Conditions:

- C. The following drawings of physical conditions relating to existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities) are known to Owner:
 - 1. Drawings dated August 2012 of Newburgh's Water Pollution Control Plan Improvements prepared by Arcadis CE, Inc., Clifton Park, NY, entitled "Water Pollution Control Plant Improvements", consisting of 64 sheets numbered 1 to 64, inclusive.
 - a. All of the information in such drawings constitutes Technical Data on whose accuracy Contractor may rely.
- D. Contractor may request electronic (PDF) copies from Engineer.

SC-5.06 Add the following paragraphs after Paragraph 5.06.A.2 of the General Conditions:

- 3. The following reports regarding Hazardous Environmental Conditions at the Site are known to Owner:
 - a. Report dated April 2, 2021, prepared by Stearns and Wheler Companies, Summary of Findings, Newburgh WWTF Subsurface Investigation, S&W No L10030.0 regarding an environmental assessment, consisting of 39 pages. Technical Data contained in such report upon whose accuracy Contractor may rely are the testing methods, the locations and logs of the sampling and testing, the laboratory test methods and results, and similar factual data. Sampling and testing information represent characteristics to the extent indicated, only for the point location of the associated sample or test. Contractor shall make its own interpretations of the conditions to be encountered between sampling and testing points. Contractor shall note the limitations, if any, on the results, and understands that the report(s) listed above were prepared for the sole use of Engineer and Owner relative to the Project's design phase. Use of the

results and reports for other purposes is not warranted by Owner or Engineer, except for Technical Data upon which Contractor may rely.

SC-6.01.B Modify Paragraph 6.01.B of the General Conditions by adding, after the words “the form prescribed by the Contract”, the words, “on the specimen bond forms bound in the Project Manual”.

SC 6.03.I.3 Delete Paragraph 6.03.I.3 of the General Conditions and replace with the following:

3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy. The endorsement shall read: “No cancellation of or change in this policy shall become effective until after thirty (30) days’ notice by issuing company.”

SC 6.03.I Add the following new paragraph immediately after Paragraph 6.03.I.5 of the General Conditions:

6. OWNER shall be named as Certificate holder as follows: City of Newburgh, Attn: Comptroller’s Office, 83 Broadway – 4th Floor, Newburgh, NY 12550. Renewals shall be mailed to said address annually until contract has been completed.

SC 6.03 Add the following new paragraph immediately after Paragraph 6.03.J of the General Conditions:

- K. The limits of liability for insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts, or greater where required by Laws and Regulations:

1. Workers’ Compensation, and related coverages under Paragraphs 6.03.A.1 and A.2 of the General Conditions:

State:	<u>Statutory</u>
--------	------------------

Federal, if applicable (e.g., Longshoreman’s):	<u>Statutory</u>
------------------------------------------------	------------------

Jones Act coverage, if applicable:

Bodily injury by accident, each accident	\$ <u>Not Required</u>
------------------------------------------	------------------------

Bodily injury by disease, aggregate	\$ <u>Not Required</u>
-------------------------------------	------------------------

Employer’s Liability:

Bodily injury, each accident	\$ <u>1,000,000</u>
------------------------------	---------------------

Bodily injury by disease, each employee	\$ <u>1,000,000</u>
-----------------------------------------	---------------------

Bodily injury/disease aggregate	\$ <u>2,000,000</u>
---------------------------------	---------------------

Foreign voluntary worker compensation Statutory

The policy shall include an All States Coverage Endorsement. Where applicable, the U.S. Longshore and Harbor Worker's Compensation Act Endorsement shall be attached to the policy. Where applicable, the Maritime Coverage Endorsement shall be attached to the policy. Where applicable, the Stop Gap Endorsement shall be attached to the policy. Proof of coverage shall be provided on Form C-105.2, GSI-105.2, SI-12, or U-26.3.

2. Contractor's Commercial General Liability under Paragraphs 6.03.B and 6.03.C of the General Conditions:

General Aggregate	\$ <u>3,000,000</u>
Each Occurrence (Bodily Injury and Property Damage)	\$ <u>1,000,000</u>
Products/Completed Operations	\$ <u>2,000,000</u>
Advertising/Personal Injury	\$ <u>1,000,000</u>
Premises Medical Payments	\$ <u>10,000</u>

3. Automobile Liability under Paragraph 6.03.D of the General Conditions:

Bodily Injury:

Each person	\$ <u>1,000,000</u>
Each accident	\$ <u>2,000,000</u>

Property Damage:

Each accident	\$ <u>1,000,000</u>
Combined Single Limit of	\$ <u>2,000,000</u>

Coverage for the additional insured shall apply as primary and non-contributing insurance before any insurance maintained by the additional insureds.

4. Excess or Umbrella Liability:

Per Occurrence	\$ <u>1,000,000</u>
General Aggregate	\$ <u>5,000,000</u>

5. Contractor's Pollution Liability:

Each Occurrence	\$ <u>1,000,000</u>
General Aggregate	\$ <u>2,000,000</u>

☐ If box is checked, Contractor is not required to furnish Contractor's Pollution Liability insurance under this Contract.

6. Additional Insureds: In addition to Owner and Engineer, include as additional insureds on Contractor-furnished insurance (except Workers' Compensation and Professional Liability insurance) the following:
 - a. Inframark.
8. Disability Benefits: Where and as required by law, Contractor shall provide disability benefits during the duration of the Contract for the employees required to be covered. Proof of such coverage shall be provided on Form D-120.1, DB-820/829, or DB-155. Renewals shall be mailed to Certificate Holder annually until Contract has been completed.

SC 6.07 Add the following new paragraph immediately after Paragraph 6.07 of the General Conditions:

6.08 Acceptance of Bonds and Insurance; Option to Replace

- A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 6 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

SC 7.01.B Amend Paragraph 7.01.B of the General Conditions by adding the following sentence:

Unless the Owner otherwise agrees in writing, the superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

SC-7.02.B Add the following new subparagraphs immediately after Paragraph 7.02.B of the General Conditions:

- 1 Except where otherwise prohibited by Laws or Regulations, regular working hours at the Site are defined as up to eight hours per day, beginning not earlier than 7:00 a.m. and ending not later than 7:00 p.m., local time.
2. Project's legal holidays are: New Year's Day, Martin Luther King Jr. Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas.
- 3 Maintenance and cleanup activities may be performed during hours other than regular working hours provided that such activities do not require the startup or operation of construction equipment.
- 4 If it becomes absolutely necessary to perform Work at night or on Saturdays, Sundays, or legal holidays, written notice shall be submitted to Owner and Engineer not less than three days in advance of the need for such Work. Owner will only consider the performance of such Work as can be performed satisfactorily under the conditions. Good lighting and all other necessary facilities for carrying out and observing the Work shall be provided and maintained where such Work is being performed at night.

SC-7.09 Add the following new paragraphs immediately after Paragraph 7.09.A of the General Conditions:

- B. Owner is exempt from payment of sales and compensating use taxes of the State of New York and of cities and counties thereof on all materials to be incorporated into the Work.
 1. Owner will furnish the required certificates of tax exemption to Contractor for use in the purchase of supplies and materials to be incorporated into the Work.
 2. Owner's exemption does not apply to construction tools, machinery, equipment, or other property purchased by or leased by Contractor, or to supplies or materials not incorporated into the Work.

SC-7.10 Add the following new paragraph immediately after Paragraph 7.10.C of the General Conditions:

- D. Refer to Article SC-19 for Laws and Regulations that, by terms of said Laws and Regulations, are to be included in the Contract Documents. The failure to include in Article SC-19 any Law or Regulation applicable to the performance of the Work does not diminish Contractor's responsibility to comply with all Laws and Regulations applicable to the performance of the Work.

SC-7.14 Add the following new paragraph immediately after Paragraph 7.14.A of the General Conditions:

- B. *Multiple Prime Contracts:* General Contractor shall be responsible for coordinating exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with all Laws and Regulations. General Contractor shall provide a centralized location for the maintenance of the material safety data sheets or other hazard communication information required to be made available by any employer on the Site. Location of the material safety data sheets or other hazard communication information shall be readily accessible to the employees of employers on the Site. Each other Contractor or employer shall furnish to the General Contractor material safety data sheets and other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with all Laws and Regulations.

SC-7.18 Delete in its entirety Paragraph 7.18 of the General Conditions and replace with the following:

SC-7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage:
1. is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of real or personal property (other than the Work itself), including the loss of use resulting therefrom; and
 2. is caused by any act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by an individual or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws or Regulations.
- B. In any and all claims against Owner or Engineer or any of their , officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any

Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph SC-7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

- C. The indemnification obligations of Contractor under Paragraph SC-7.18.A shall not be limited in any way by the amount or types of insurance provided by Contractor under Article 6 of the General Conditions and the Supplementary Conditions.
- D. The indemnification obligations of Contractor under Paragraph SC-7.18.A shall not extend to the sole negligence or willful misconduct of Owner or Engineer or of the officers, directors, members, partners, employees, agents, and consultants and subcontractors of each and any of them.

SC-8.02 Delete Paragraph 8.02.A of the General Conditions in its entirety and replace with the following:

- A. Owner intends to contract with others for the performance of other work at or adjacent to the Site, as indicated in Specifications Section 01 12 13, Summary of Work.
 - 1. Owner shall have authority and responsibility for coordination of the various contractors and work forces at the Site.

SC-10.03 Add new paragraphs immediately after Paragraph 10.03.A of the General Conditions that are to read as follows:

- B. The Resident Project Representative (RPR) will be Engineer's representative at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions.
 - 1. General: RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner only with the knowledge of and under the direction of Engineer.
 - 2. Schedules: Review the Progress Schedule, Schedule of Submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning their acceptability.
 - 3. Conferences and Meetings: Attend meetings with Contractor, such as pre-construction conferences, progress meetings, pre-installation

meetings, and other Project-related meetings, and prepare and circulate copies of minutes thereof (unless other entity is required to do so under the Contract Documents).

4. Liaison:
 - a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
 - b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's onsite operations.
 - c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.
5. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.
6. Shop Drawings, Samples, and Other Contractor Submittals:
 - a. Record date of receipt of Samples and Contractor-approved Shop Drawings and other submittals.
 - b. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.
 - c. Advise Engineer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing, Sample, or other submittal for which RPR believes that the submittal has not been approved or accepted (as applicable) by Engineer.
7. Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, if any, to Engineer. Transmit to Contractor in writing decisions as issued by Engineer.
8. Review of Work and Rejection of Defective Work:
 - a. Conduct onsite observations of Contractor's work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Report to Engineer whenever RPR believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
9. Inspections, Tests, and System Start-ups:

- a. Verify that tests, equipment, and systems start-ups and operating and maintenance training are performed in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.
 - b. Observe, record, and report to Engineer appropriate details relative to the test procedures and systems start-ups.
- 10. Records:
 - a. Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.
 - b. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all prime Contractors, Subcontractors, and major Suppliers of materials and equipment.
 - c. Maintain records for use in preparing Project documentation.
- 11. Reports:
 - a. Furnish to Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and Schedule of Submittals.
 - b. Draft and recommend to the Engineer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.
 - c. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.
- 12. Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site (or otherwise suitably stored) but not incorporated in the Work.
- 13. Certificates, Operation and Maintenance Manuals: During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.

14. Completion:
 - a. Participate in Engineer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a "punch list" of items to be completed or corrected.
 - b. Participate in Engineer's final visit to the Site to determine completion of the Work, in the company of Owner and Contractor, and prepare a final "punch list" of items to be completed and deficiencies to be remedied (if any).
 - c. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the Work.

C. The RPR shall not:

1. Authorize any deviation from the Contract Documents, or use of "or-equal" or substitute materials, equipment, or procedures.
2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences, or procedures of Contractor's work.
5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Accept Shop Drawings, Samples, or other submittals from anyone other than Contractor.
8. Authorize Owner to occupy the Project in whole or in part.

SC 15.01.D.1 Delete paragraph in its entirety and replace with the following:

1. Thirty days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

SC 15.03.B Add the following new subparagraph to Paragraph 15.03.B of the General Conditions:

1. If some or all the inspected Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection, re-testing, or

both, including the cost of time, travel, and other expenses, shall be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15 of the General Conditions.

SC-19 Add new Article immediately after Article 18 of the General Conditions, which is to read as follows:

ARTICLE SC-19 – STATUTORY REQUIREMENTS

SC-19.01 This Article contains portions of certain Laws or Regulations which, by provision of Laws or Regulations, are required to be included in the Contract Documents. The material included in this Article may not be complete or current. Contractor's obligation to comply with all Laws and Regulations applicable to the Work is set forth in Paragraph 7.10 of the General Conditions.

SC-19.04 Prevailing Rate Schedule:

- A. The labor on this contract shall be performed in accordance with the requirements of Article 8 (Sections 220-223) of the New York State Labor Law and the federal requirements on the Davis-Bacon Act. The supplements to be provided and wages to be paid to workers, laborers and mechanics employed on this contract are set forth in the schedules attached to and hereby made a part of these Supplementary Conditions.
- B. CONTRACTOR shall note that the wage rates and supplemental benefits shown in the attached schedules are subject to change. The wage rates and supplemental benefits to be paid and provided shall be those prevailing at the time the contract is being performed.

SC-19.05 Payments to Subcontractors:

- A. In accordance with N.Y. State General Municipal Law, Section 106-b, CONTRACTOR shall:
 - 1. Within seven calendar days of the receipt of any payment from the OWNER, the CONTRACTOR shall pay each of his Subcontractors and materialmen the proceeds from the payment representing the value of the work performed and/or materials furnished by the Subcontractor and/or materialman and reflecting the percentage of the Subcontractor's work completed or the materialman's material supplied in the requisition approved by the OWNER and based upon the actual value of the subcontract or purchase order less an amount necessary to satisfy any claims, liens or judgments against the Subcontractor or materialman which have not been suitably discharged and less any retained amount as hereafter described. The

CONTRACTOR shall retain not more than five per centum of each payment to the Subcontractor and/or materialman except that the CONTRACTOR may retain in excess of five per centum but not more than ten per centum of each payment to the Subcontractor provided that prior to entering into a subcontract with the CONTRACTOR, the Subcontractor is unable or unwilling to provide a Performance bond and a Labor and Material bond both in the full amount of the subcontract at the request of the CONTRACTOR. However, the CONTRACTOR shall retain nothing from those payments representing proceeds owed the Subcontractor and/or materialman from OWNER'S payments to the CONTRACTOR for the remaining amounts of the contract balance after the work or portions thereof are substantially complete. Within seven calendar days of the receipt of payment from the CONTRACTOR, the Subcontractor and/or materialman shall pay each of his Subcontractors and materialmen in the same manner as the CONTRACTOR has paid the Subcontractor. Nothing provided herein shall create any obligation on the part of the OWNER to pay or to see to the payment of any moneys to any Subcontractor or materialman from any CONTRACTOR nor shall anything provided herein serve to create any relationship in contract or otherwise, implied or expressed, between the Subcontractor or materialman and the OWNER.

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WAGE DETERMINATION SCHEDULE

New York State Department of Labor
Prevailing Wages – Project Rates

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Kathy Hochul, Governor

Roberta Reardon, Commissioner

City of Newburgh

Miranda Cordiale, Staff Engineer
201 Fuller Road
Suite 201
Albany NY 12203

Schedule Year 2023 through 2024
Date Requested 05/24/2024
PRC# 2024006197

Location Admin Building
Project ID# 7.24
Project Type Rehabilitation of the existing City of Newburgh Wastewater Treatment Plant Admin Building

PREVAILING WAGE SCHEDULE FOR ARTICLE 8 PUBLIC WORK PROJECT

Attached is the current schedule(s) of the prevailing wage rates and prevailing hourly supplements for the project referenced above. A unique Prevailing Wage Case Number (PRC#) has been assigned to the schedule(s) for your project.

The schedule is effective from July 2023 through June 2024. All updates, corrections, posted on the 1st business day of each month, and future copies of the annual determination are available on the Department's website www.labor.ny.gov. Updated PDF copies of your schedule can be accessed by entering your assigned PRC# at the proper location on the website.

It is the responsibility of the contracting agency or its agent to annex and make part, the attached schedule, to the specifications for this project, when it is advertised for bids and /or to forward said schedules to the successful bidder(s), immediately upon receipt, in order to insure the proper payment of wages.

Please refer to the "General Provisions of Laws Covering Workers on Public Work Contracts" provided with this schedule, for the specific details relating to other responsibilities of the Department of Jurisdiction.

Upon completion or cancellation of this project, enter the required information and mail **OR** fax this form to the office shown at the bottom of this notice, **OR** fill out the electronic version via the NYSDOL website.

NOTICE OF COMPLETION / CANCELLATION OF PROJECT

Date Completed: _____ Date Cancelled: _____

Name & Title of Representative: _____

Phone: (518) 457-5589 Fax: (518) 485-1870
W. Averell Harriman State Office Campus, Bldg. 12, Room 130, Albany, NY 12226

General Provisions of Laws Covering Workers on Article 8 Public Work Contracts

Introduction

The Labor Law requires public work contractors and subcontractors to pay laborers, workers, or mechanics employed in the performance of a public work contract not less than the prevailing rate of wage and supplements (fringe benefits) in the locality where the work is performed.

Responsibilities of the Department of Jurisdiction

A Department of Jurisdiction (Contracting Agency) includes a state department, agency, board or commission; a county, city, town or village; a school district, board of education or board of cooperative educational services; a sewer, water, fire, improvement and other district corporation; a public benefit corporation; and a public authority awarding a public work contract.

The Department of Jurisdiction (Contracting Agency) awarding a public work contract **MUST** obtain a Prevailing Rate Schedule listing the hourly rates of wages and supplements due the workers to be employed on a public work project. This schedule may be obtained by completing and forwarding a "Request for wage and Supplement Information" form (PW 39) to the Bureau of Public Work. The Prevailing Rate Schedule **MUST** be included in the specifications for the contract to be awarded and is deemed part of the public work contract.

Upon the awarding of the contract, the law requires that the Department of Jurisdiction (Contracting Agency) furnish the following information to the Bureau: the name and address of the contractor, the date the contract was let and the approximate dollar value of the contract. To facilitate compliance with this provision of the Labor Law, a copy of the Department's "Notice of Contract Award" form (PW 16) is provided with the original Prevailing Rate Schedule.

The Department of Jurisdiction (Contracting Agency) is required to notify the Bureau of the completion or cancellation of any public work project. The Department's PW 200 form is provided for that purpose.

Both the PW 16 and PW 200 forms are available for completion [online](#).

Hours

No laborer, worker, or mechanic in the employ of a contractor or subcontractor engaged in the performance of any public work project shall be permitted to work more than eight hours in any day or more than five days in any week, except in cases of extraordinary emergency. The contractor and the Department of Jurisdiction (Contracting Agency) may apply to the Bureau of Public Work for a dispensation permitting workers to work additional hours or days per week on a particular public work project.

Wages and Supplements

The wages and supplements to be paid and/or provided to laborers, workers, and mechanics employed on a public work project shall be not less than those listed in the current Prevailing Rate Schedule for the locality where the work is performed. If a prime contractor on a public work project has not been provided with a Prevailing Rate Schedule, the contractor must notify the Department of Jurisdiction (Contracting Agency) who in turn must request an original Prevailing Rate Schedule from the Bureau of Public Work. Requests may be submitted by: mail to NYSDOL, Bureau of Public Work, State Office Bldg. Campus, Bldg. 12, Rm. 130, Albany, NY 12226; Fax to Bureau of Public Work (518) 485-1870; or electronically at the NYSDOL website www.labor.ny.gov.

Upon receiving the original schedule, the Department of Jurisdiction (Contracting Agency) is **REQUIRED** to provide complete copies to all prime contractors who in turn **MUST**, by law, provide copies of all applicable county schedules to each subcontractor and obtain from each subcontractor, an affidavit certifying such schedules were received. If the original schedule expired, the contractor may obtain a copy of the new annual determination from the NYSDOL website www.labor.ny.gov.

The Commissioner of Labor makes an annual determination of the prevailing rates. This determination is in effect from July 1st through June 30th of the following year. The annual determination is available on the NYSDOL website www.labor.ny.gov.

Payrolls and Payroll Records

Every contractor and subcontractor **MUST** keep original payrolls or transcripts subscribed and affirmed as true under penalty of perjury. As per Article 6 of the Labor law, contractors and subcontractors are required to establish, maintain, and preserve for not less than six (6) years, contemporaneous, true, and accurate payroll records. At a minimum, payrolls must show the following information for each person employed on a public work project: Name, Address, Last 4 Digits of Social Security Number, Classification(s) in which the worker was employed, Hourly wage rate(s) paid, Supplements paid or provided, and Daily and weekly number of hours worked in each classification.

The filing of payrolls to the Department of Jurisdiction is a condition of payment. Every contractor and subcontractor shall submit to the Department of Jurisdiction (Contracting Agency), within thirty (30) days after issuance of its first payroll and every thirty (30) days thereafter, a transcript of the original payrolls, subscribed and affirmed as true under penalty of perjury. The Department of Jurisdiction (Contracting Agency) shall collect, review for facial validity, and maintain such payrolls.

In addition, the Commissioner of Labor may require contractors to furnish, with ten (10) days of a request, payroll records sworn to as their validity and accuracy for public work and private work. Payroll records include, but are not limited to time cards, work description sheets, proof that supplements were provided, cancelled payroll checks and payrolls. Failure to provide the requested information within the allotted ten (10) days will result in the withholding of up to 25% of the contract, not to exceed \$100,000.00. If the contractor or subcontractor does not maintain a place of business in New York State and the amount of the contract exceeds \$25,000.00, payroll records and certifications must be kept on the project worksite.

The prime contractor is responsible for any underpayments of prevailing wages or supplements by any subcontractor.

All contractors or their subcontractors shall provide to their subcontractors a copy of the Prevailing Rate Schedule specified in the public work contract as well as any subsequently issued schedules. A failure to provide these schedules by a contractor or subcontractor is a violation of Article 8, Section 220-a of the Labor Law.

All subcontractors engaged by a public work project contractor or its subcontractor, upon receipt of the original schedule and any subsequently issued schedules, shall provide to such contractor a verified statement attesting that the subcontractor has received the Prevailing Rate Schedule and will pay or provide the applicable rates of wages and supplements specified therein. (See NYS Labor Laws, Article 8 . Section 220-a).

Determination of Prevailing Wage and Supplement Rate Updates Applicable to All Counties

The wages and supplements contained in the annual determination become effective July 1st whether or not the new determination has been received by a given contractor. Care should be taken to review the rates for obvious errors. Any corrections should be brought to the Department's attention immediately. It is the responsibility of the public work contractor to use the proper rates. If there is a question on the proper classification to be used, please call the district office located nearest the project. Any errors in the annual determination will be corrected and posted to the NYSDOL website on the first business day of each month. Contractors are responsible for paying these updated rates as well, retroactive to July 1st.

When you review the schedule for a particular occupation, your attention should be directed to the dates above the column of rates. These are the dates for which a given set of rates is effective. To the extent possible, the Department posts rates in its possession that cover periods of time beyond the July 1st to June 30th time frame covered by a particular annual determination. Rates that extend beyond that instant time period are informational ONLY and may be updated in future annual determinations that actually cover the then appropriate July 1st to June 30th time period.

Withholding of Payments

When a complaint is filed with the Commissioner of Labor alleging the failure of a contractor or subcontractor to pay or provide the prevailing wages or supplements, or when the Commissioner of Labor believes that unpaid wages or supplements may be due, payments on the public work contract shall be withheld from the prime contractor in a sufficient amount to satisfy the alleged unpaid wages and supplements, including interest and civil penalty, pending a final determination.

When the Bureau of Public Work finds that a contractor or subcontractor on a public work project failed to pay or provide the requisite prevailing wages or supplements, the Bureau is authorized by Sections 220-b and 235.2 of the Labor Law to so notify the financial officer of the Department of Jurisdiction (Contracting Agency) that awarded the public work contract. Such officer MUST then withhold or cause to be withheld from any payment due the prime contractor on account of such contract the amount indicated by the Bureau as sufficient to satisfy the unpaid wages and supplements, including interest and any civil penalty that may be assessed by the Commissioner of Labor. The withholding continues until there is a final determination of the underpayment by the Commissioner of Labor or by the court in the event a legal proceeding is instituted for review of the determination of the Commissioner of Labor.

The Department of Jurisdiction (Contracting Agency) shall comply with this order of the Commissioner of Labor or of the court with respect to the release of the funds so withheld.

Summary of Notice Posting Requirements

The current Prevailing Rate Schedule must be posted in a prominent and accessible place on the site of the public work project. The prevailing wage schedule must be encased in, or constructed of, materials capable of withstanding adverse weather conditions and be titled "PREVAILING RATE OF WAGES" in letters no smaller than two (2) inches by two (2) inches.

The ["Public Work Project"](#) notice must be posted at the beginning of the performance of every public work contract, on each job site.

Every employer providing workers. compensation insurance and disability benefits must post notices of such coverage in the format prescribed by the Workers. Compensation Board in a conspicuous place on the jobsite.

Every employer subject to the NYS Human Rights Law must conspicuously post at its offices, places of employment, or employment training centers, notices furnished by the State Division of Human Rights.

Employers liable for contributions under the Unemployment Insurance Law must conspicuously post on the jobsite notices furnished by the NYS Department of Labor.

Apprentices

Employees cannot be paid apprentice rates unless they are individually registered in a program registered with the NYS Commissioner of Labor. The allowable ratio of apprentices to journeyworkers in any craft classification can be no greater than the statewide building trade ratios promulgated by the Department of Labor and included with the Prevailing Rate Schedule. An employee listed on a payroll as an apprentice who is not registered as above or is performing work outside the classification of work for which the apprentice is indentured, must be paid the prevailing journeyworker's wage rate for the classification of work the employee is actually performing.

NYSDOL Labor Law, Article 8, Section 220-3, require that only apprentices individually registered with the NYS Department of Labor may be paid apprenticeship rates on a public work project. No other Federal or State Agency of office registers apprentices in New York State.

Persons wishing to verify the apprentice registration of any person must do so in writing by mail, to the NYSDOL Office of Employability Development / Apprenticeship Training, State Office Bldg. Campus, Bldg. 12, Albany, NY 12226 or by Fax to NYSDOL Apprenticeship Training (518) 457-7154. All requests for verification must include the name and social security number of the person for whom the information is requested.

The only conclusive proof of individual apprentice registration is written verification from the NYSDOL Apprenticeship Training Albany Central office. Neither Federal nor State Apprenticeship Training offices outside of Albany can provide conclusive registration information.

It should be noted that the existence of a registered apprenticeship program is not conclusive proof that any person is registered in that program. Furthermore, the existence or possession of wallet cards, identification cards, or copies of state forms is not conclusive proof of the registration of any person as an apprentice.

Interest and Penalties

In the event that an underpayment of wages and/or supplements is found:

- Interest shall be assessed at the rate then in effect as prescribed by the Superintendent of Banks pursuant to section 14-a of the Banking Law, per annum from the date of underpayment to the date restitution is made.
- A Civil Penalty may also be assessed, not to exceed 25% of the total of wages, supplements, and interest due.

Debarment

Any contractor or subcontractor and/or its successor shall be ineligible to submit a bid on or be awarded any public work contract or subcontract with any state, municipal corporation or public body for a period of five (5) years when:

- Two (2) willful determinations have been rendered against that contractor or subcontractor and/or its successor within any consecutive six (6) year period.
- There is any willful determination that involves the falsification of payroll records or the kickback of wages or supplements.

Criminal Sanctions

Willful violations of the Prevailing Wage Law (Article 8 of the Labor Law) may be a felony punishable by fine or imprisonment of up to 15 years, or both.

Discrimination

No employee or applicant for employment may be discriminated against on account of age, race, creed, color, national origin, sex, disability or marital status.

No contractor, subcontractor nor any person acting on its behalf, shall by reason of race, creed, color, disability, sex or national origin discriminate against any citizen of the State of New York who is qualified and available to perform the work to which the employment relates (NYS Labor Law, Article 8, Section 220-e(a)).

No contractor, subcontractor, nor any person acting on its behalf, shall in any manner, discriminate against or intimidate any employee on account of race, creed, color, disability, sex, or national origin (NYS Labor Law, Article 8, Section 220-e(b)).

The Human Rights Law also prohibits discrimination in employment because of age, marital status, or religion.

There may be deducted from the amount payable to the contractor under the contract a penalty of \$50.00 for each calendar day during which such person was discriminated against or intimidated in violation of the provision of the contract (NYS Labor Law, Article 8, Section 220-e(c)).

The contract may be cancelled or terminated by the State or municipality. All monies due or to become due thereunder may be forfeited for a second or any subsequent violation of the terms or conditions of the anti-discrimination sections of the contract (NYS Labor Law, Article 8, Section 220-e(d)).

Every employer subject to the New York State Human Rights Law must conspicuously post at its offices, places of employment, or employment training centers notices furnished by the State Division of Human Rights.

Workers' Compensation

In accordance with Section 142 of the State Finance Law, the contractor shall maintain coverage during the life of the contract for the benefit of such employees as required by the provisions of the New York State Workers' Compensation Law.

A contractor who is awarded a public work contract must provide proof of workers' compensation coverage prior to being allowed to begin work.

The insurance policy must be issued by a company authorized to provide workers' compensation coverage in New York State. Proof of coverage must be on form C-105.2 (Certificate of Workers' Compensation Insurance) and must name this agency as a certificate holder.

If New York State coverage is added to an existing out-of-state policy, it can only be added to a policy from a company authorized to write workers' compensation coverage in this state. The coverage must be listed under item 3A of the information page.

The contractor must maintain proof that subcontractors doing work covered under this contract secured and maintained a workers' compensation policy for all employees working in New York State.

Every employer providing worker's compensation insurance and disability benefits must post notices of such coverage in the format prescribed by the Workers' Compensation Board in a conspicuous place on the jobsite.

Unemployment Insurance

Employers liable for contributions under the Unemployment Insurance Law must conspicuously post on the jobsite notices furnished by the New York State Department of Labor.



Kathy Hochul, Governor

Roberta Reardon, Commissioner

City of Newburgh

Miranda Cordiale, Staff Engineer
201 Fuller Road
Suite 201
Albany NY 12203

Schedule Year 2023 through 2024
Date Requested 05/24/2024
PRC# 2024006197

Location Admin Building
Project ID# 7.24
Project Type Rehabilitation of the existing City of Newburgh Wastewater Treatment Plant Admin Building

Notice of Contract Award

New York State Labor Law, Article 8, Section 220.3a requires that certain information regarding the awarding of public work contracts, be furnished to the Commissioner of Labor. One "Notice of Contract Award" (PW 16, which may be photocopied), **MUST** be completed for **EACH** prime contractor on the above referenced project.

Upon notifying the successful bidder(s) of this contract, enter the required information and mail **OR** fax this form to the office shown at the bottom of this notice, **OR** fill out the electronic version via the NYSDOL website.

Contractor Information

All information must be supplied

Federal Employer Identification Number: _____		
Name: _____		
Address: _____ _____		
City: _____	State: _____	Zip: _____
Amount of Contract: \$ _____	Contract Type:	
Approximate Starting Date: ____/____/____	<input type="checkbox"/> (01) General Construction	
Approximate Completion Date: ____/____/____	<input type="checkbox"/> (02) Heating/Ventilation	
	<input type="checkbox"/> (03) Electrical	
	<input type="checkbox"/> (04) Plumbing	
	<input type="checkbox"/> (05) Other : _____	

Phone: (518) 457-5589 Fax: (518) 485-1870
W. Averell Harriman State Office Campus, Bldg. 12, Room 130, Albany, NY 12226

Social Security Numbers on Certified Payrolls:

The Department of Labor is cognizant of the concerns of the potential for misuse or inadvertent disclosure of social security numbers. Identity theft is a growing problem and we are sympathetic to contractors' concern regarding inclusion of this information on payrolls if another identifier will suffice.

For these reasons, the substitution of the use of the last four digits of the social security number on certified payrolls submitted to contracting agencies on public work projects is now acceptable to the Department of Labor. This change does not affect the Department's ability to request and receive the entire social security number from employers during its public work/ prevailing wage investigations.

Construction Industry Fair Play Act: Required Posting for Labor Law Article 25-B § 861-d

Construction industry employers must post the "Construction Industry Fair Play Act" notice in a prominent and accessible place on the job site. Failure to post the notice can result in penalties of up to \$1,500 for a first offense and up to \$5,000 for a second offense. The posting is included as part of this wage schedule. Additional copies may be obtained from the NYS DOL website, <https://dol.ny.gov/public-work-and-prevailing-wage>

If you have any questions concerning the Fair Play Act, please call the State Labor Department toll-free at 1-866-435-1499 or email us at: dol.misclassified@labor.ny.gov .

Worker Notification: (Labor Law §220, paragraph a of subdivision 3-a)

Effective June 23, 2020

This provision is an addition to the existing wage rate law, Labor Law §220, paragraph a of subdivision 3-a. It requires contractors and subcontractors to provide written notice to all laborers, workers or mechanics of the *prevailing wage and supplement rate* for their particular job classification *on each pay stub**. It also requires contractors and subcontractors to *post a notice* at the beginning of the performance of every public work contract *on each job site* that includes the telephone number and address for the Department of Labor and a statement informing laborers, workers or mechanics of their right to contact the Department of Labor if he/she is not receiving the proper prevailing rate of wages and/or supplements for his/her job classification. The required notification will be provided with each wage schedule, may be downloaded from our website www.labor.ny.gov or be made available upon request by contacting the Bureau of Public Work at 518-457-5589. *In the event the required information will not fit on the pay stub, an accompanying sheet or attachment of the information will suffice.

**To all State Departments, Agency Heads and Public Benefit Corporations
IMPORTANT NOTICE REGARDING PUBLIC WORK ENFORCEMENT FUND**

Budget Policy & Reporting Manual

B-610

Public Work Enforcement Fund

effective date December 7, 2005

1. Purpose and Scope:

This Item describes the Public Work Enforcement Fund (the Fund, PWEF) and its relevance to State agencies and public benefit corporations engaged in construction or reconstruction contracts, maintenance and repair, and announces the recently-enacted increase to the percentage of the dollar value of such contracts that must be deposited into the Fund. This item also describes the roles of the following entities with respect to the Fund:

- New York State Department of Labor (DOL),
- The Office of the State of Comptroller (OSC), and
- State agencies and public benefit corporations.

2. Background and Statutory References:

DOL uses the Fund to enforce the State's Labor Law as it relates to contracts for construction or reconstruction, maintenance and repair, as defined in subdivision two of Section 220 of the Labor Law. State agencies and public benefit corporations participating in such contracts are required to make payments to the Fund.

Chapter 511 of the Laws of 1995 (as amended by Chapter 513 of the Laws of 1997, Chapter 655 of the Laws of 1999, Chapter 376 of the Laws of 2003 and Chapter 407 of the Laws of 2005) established the Fund.

3. Procedures and Agency Responsibilities:

The Fund is supported by transfers and deposits based on the value of contracts for construction and reconstruction, maintenance and repair, as defined in subdivision two of Section 220 of the Labor Law, into which all State agencies and public benefit corporations enter.

Chapter 407 of the Laws of 2005 increased the amount required to be provided to this fund to .10 of one-percent of the total cost of each such contract, to be calculated at the time agencies or public benefit corporations enter into a new contract or if a contract is amended. The provisions of this bill became effective August 2, 2005.

To all State Departments, Agency Heads and Public Benefit Corporations
IMPORTANT NOTICE REGARDING PUBLIC WORK ENFORCEMENT FUND

OSC will report to DOL on all construction-related ("D") contracts approved during the month, including contract amendments, and then DOL will bill agencies the appropriate assessment monthly. An agency may then make a determination if any of the billed contracts are exempt and so note on the bill submitted back to DOL. For any instance where an agency is unsure if a contract is or is not exempt, they can call the Bureau of Public Work at the number noted below for a determination. Payment by check or journal voucher is due to DOL within thirty days from the date of the billing. DOL will verify the amounts and forward them to OSC for processing.

For those contracts which are not approved or administered by the Comptroller, monthly reports and payments for deposit into the Public Work Enforcement Fund must be provided to the Administrative Finance Bureau at the DOL within 30 days of the end of each month or on a payment schedule mutually agreed upon with DOL.

Reports should contain the following information:

- Name and billing address of State agency or public benefit corporation;
- State agency or public benefit corporation contact and phone number;
- Name and address of contractor receiving the award;
- Contract number and effective dates;
- Contract amount and PWEF assessment charge (if contract amount has been amended, reflect increase or decrease to original contract and the adjustment in the PWEF charge); and
- Brief description of the work to be performed under each contract.

Checks and Journal Vouchers, payable to the "New York State Department of Labor" should be sent to:

Department of Labor
Administrative Finance Bureau-PWEF Unit
Building 12, Room 464
State Office Campus
Albany, NY 12226

Any questions regarding billing should be directed to NYSDOL's Administrative Finance Bureau-PWEF Unit at (518) 457-3624 and any questions regarding Public Work Contracts should be directed to the Bureau of Public Work at (518) 457-5589.



Required Notice under Article 25-B of the Labor Law

**Attention All Employees, Contractors and Subcontractors:
You are Covered by the Construction Industry Fair Play Act**

The law says that you are an employee unless:

- You are free from direction and control in performing your job, **and**
- You perform work that is not part of the usual work done by the business that hired you, **and**
- You have an independently established business.

Your employer cannot consider you to be an independent contractor unless all three of these facts apply to your work.

It is against the law for an employer to misclassify employees as independent contractors or pay employees off the books.

Employee Rights: If you are an employee, you are entitled to state and federal worker protections. These include:

- Unemployment Insurance benefits, if you are unemployed through no fault of your own, able to work, and otherwise qualified,
- Workers' compensation benefits for on-the-job injuries,
- Payment for wages earned, minimum wage, and overtime (under certain conditions),
- Prevailing wages on public work projects,
- The provisions of the National Labor Relations Act, and
- A safe work environment.

It is a violation of this law for employers to retaliate against anyone who asserts their rights under the law. Retaliation subjects an employer to civil penalties, a private lawsuit or both.

Independent Contractors: If you are an independent contractor, **you must pay all taxes and Unemployment Insurance contributions required by New York State and Federal Law.**

Penalties for paying workers off the books or improperly treating employees as independent contractors:

- **Civil Penalty**
 - First offense: Up to \$2,500 per employee
 - Subsequent offense(s): Up to \$5,000 per employee
- **Criminal Penalty**
 - First offense: Misdemeanor - up to 30 days in jail, up to a \$25,000 fine and debarment from performing public work for up to one year.
 - Subsequent offense(s): Misdemeanor - up to 60 days in jail or up to a \$50,000 fine and debarment from performing public work for up to 5 years.

If you have questions about your employment status or believe that your employer may have violated your rights and you want to file a complaint, call the Department of Labor at (866) 435-1499 or send an email to dol.misclassified@labor.ny.gov. All complaints of fraud and violations are taken seriously. You can remain anonymous.

Employer Name:

IA 999 (09/16)



Attention Employees

THIS IS A: **PUBLIC WORK PROJECT**

If you are employed on this project as a **worker, laborer, or mechanic** you are entitled to receive the **prevailing wage and supplements rate** for the classification at which you are working.

Your pay stub and wage notice received upon hire must clearly state your wage rate and supplement rate.

Chapter 629 of
the Labor Laws
of 2007:

These wages are set by law and must be posted at the work site. They can also be found at:
<https://dol.ny.gov/bureau-public-work>



If you feel that you have not received proper wages or benefits, please call our nearest office.*

Albany	(518) 457-2744	Patchogue	(631) 687-4882
Binghamton	(607) 721-8005	Rochester	(585) 258-4505
Buffalo	(716) 847-7159	Syracuse	(315) 428-4056
Garden City	(516) 228-3915	Utica	(315) 793-2314
New York City	(212) 932-2419	White Plains	(914) 997-9507
Newburgh	(845) 568-5287		

* For New York City government agency construction projects, please contact the Office of the NYC Comptroller at (212) 669-4443, or www.comptroller.nyc.gov – click on Bureau of Labor Law.

Contractor Name: _____

Project Location: _____

Requirements for OSHA 10 Compliance

Article 8 §220-h requires that when the advertised specifications, for every contract for public work, is \$250,000.00 or more the contract must contain a provision requiring that every worker employed in the performance of a public work contract shall be certified as having completed an OSHA 10 safety training course. The clear intent of this provision is to require that all employees of public work contractors, required to be paid prevailing rates, receive such training "prior to the performing any work on the project."

The Bureau will enforce the statute as follows:

All contractors and sub contractors must attach a copy of proof of completion of the OSHA 10 course to the first certified payroll submitted to the contracting agency and on each succeeding payroll where any new or additional employee is first listed.

Proof of completion may include but is not limited to:

- Copies of bona fide course completion card (*Note: Completion cards do not have an expiration date.*)
- Training roster, attendance record or other documentation from the certified trainer pending the issuance of the card.
- Other valid proof

**A certification by the employer attesting that all employees have completed such a course is not sufficient proof that the course has been completed.

Any questions regarding this statute may be directed to the New York State Department of Labor, Bureau of Public Work at 518-457-5589.

WICKS

Public work projects are subject to the Wicks Law requiring separate specifications and bidding for the plumbing, heating and electrical work, when the total project's threshold is \$3 million in Bronx, Kings, New York, Queens and, Richmond counties; \$1.5 million in Nassau, Suffolk and Westchester counties; and \$500,000 in all other counties.

For projects below the monetary threshold, bidders must submit a sealed list naming each subcontractor for the plumbing, HVAC and electrical and the amount to be paid to each. The list may not be changed unless the public owner finds a legitimate construction need, including a change in specifications or costs or the use of a Project Labor Agreement (PLA), and must be open to public inspection.

Allows the state and local agencies and authorities to waive the Wicks Law and use a PLA if it will provide the best work at the lowest possible price. If a PLA is used, all contractors shall participate in apprentice training programs in the trades of work it employs that have been approved by the Department of Labor (DOL) for not less than three years. They shall also have at least one graduate in the last three years and use affirmative efforts to retain minority apprentices. PLA's would be exempt from Wicks, but deemed to be public work subject to prevailing wage enforcement.

The Commissioner of Labor shall have the power to enforce separate specification requirements on projects, and may issue stop-bid orders against public owners for non-compliance.

Other new monetary thresholds, and similar sealed bidding for non-Wicks projects, would apply to certain public authorities including municipal housing authorities, NYC Construction Fund, Yonkers Educational Construction Fund, NYC Municipal Water Finance Authority, Buffalo Municipal Water Finance Authority, Westchester County Health Care Association, Nassau County Health Care Corp., Clifton-Fine Health Care Corp., Erie County Medical Center Corp., NYC Solid Waste Management Facilities, and the Dormitory Authority.

Contractors must pay subcontractors within a 7 days period.

(07.19)

Introduction to the Prevailing Rate Schedule

Information About Prevailing Rate Schedule

This information is provided to assist you in the interpretation of particular requirements for each classification of worker contained in the attached Schedule of Prevailing Rates.

Classification

It is the duty of the Commissioner of Labor to make the proper classification of workers taking into account whether the work is heavy and highway, building, sewer and water, tunnel work, or residential, and to make a determination of wages and supplements to be paid or provided. It is the responsibility of the public work contractor to use the proper rate. If there is a question on the proper classification to be used, please call the district office located nearest the project. District office locations and phone numbers are listed below.

Prevailing Wage Schedules are issued separately for "General Construction Projects" and "Residential Construction Projects" on a county-by-county basis.

General Construction Rates apply to projects such as: Buildings, Heavy & Highway, and Tunnel and Water & Sewer rates.

Residential Construction Rates generally apply to construction, reconstruction, repair, alteration, or demolition of one family, two family, row housing, or rental type units intended for residential use.

Some rates listed in the Residential Construction Rate Schedule have a very limited applicability listed along with the rate. Rates for occupations or locations not shown on the residential schedule must be obtained from the General Construction Rate Schedule. Please contact the local Bureau of Public Work office before using Residential Rate Schedules, to ensure that the project meets the required criteria.

Payrolls and Payroll Records

Contractors and subcontractors are required to establish, maintain, and preserve for not less than six (6) years, contemporaneous, true, and accurate payroll records.

Every contractor and subcontractor shall submit to the Department of Jurisdiction (Contracting Agency), within thirty (30) days after issuance of its first payroll and every thirty (30) days thereafter, a transcript of the original payrolls, subscribed and affirmed as true under penalty of perjury.

Paid Holidays

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

Overtime

At a minimum, all work performed on a public work project in excess of eight hours in any one day or more than five days in any workweek is overtime. However, the specific overtime requirements for each trade or occupation on a public work project may differ. Specific overtime requirements for each trade or occupation are contained in the prevailing rate schedules.

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays.

The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

Supplemental Benefits

Particular attention should be given to the supplemental benefit requirements. Although in most cases the payment or provision of supplements is straight time for all hours worked, some classifications require the payment or provision of supplements, or a portion of the supplements, to be paid or provided at a premium rate for premium hours worked. Supplements may also be required to be paid or provided on paid holidays, regardless of whether the day is worked. The Overtime Codes and Notes listed on the particular wage classification will indicate these conditions as required.

Effective Dates

When you review the schedule for a particular occupation, your attention should be directed to the dates above the column of rates. These are the dates for which a given set of rates is effective. The rate listed is valid until the next effective rate change or until the new annual determination which takes effect on July 1 of each year. All contractors and subcontractors are required to pay the current prevailing rates of wages and supplements. If you have any questions please contact the Bureau of Public Work or visit the New York State Department of Labor website (www.labor.ny.gov) for current wage rate information.

Apprentice Training Ratios

The following are the allowable ratios of registered Apprentices to Journey-workers.

For example, the ratio 1:1,1:3 indicates the allowable initial ratio is one Apprentice to one Journeyworker. The Journeyworker must be in place on the project before an Apprentice is allowed. Then three additional Journeyworkers are needed before a second Apprentice is allowed. The last ratio repeats indefinitely. Therefore, three more Journeyworkers must be present before a third Apprentice can be hired, and so on.

Please call Apprentice Training Central Office at (518) 457-6820 if you have any questions.

Title (Trade)	Ratio
Boilermaker (Construction)	1:1,1:4
Boilermaker (Shop)	1:1,1:3
Carpenter (Bldg.,H&H, Pile Driver/Dockbuilder)	1:1,1:4
Carpenter (Residential)	1:1,1:3
Electrical (Outside) Lineman	1:1,1:2
Electrician (Inside)	1:1,1:3
Elevator/Escalator Construction & Modernizer	1:1,1:2
Glazier	1:1,1:3
Insulation & Asbestos Worker	1:1,1:3
Iron Worker	1:1,1:4
Laborer	1:1,1:3
Mason	1:1,1:4
Millwright	1:1,1:4
Op Engineer	1:1,1:5
Painter	1:1,1:3
Plumber & Steamfitter	1:1,1:3
Roofer	1:1,1:2
Sheet Metal Worker	1:1,1:3
Sprinkler Fitter	1:1,1:2

If you have any questions concerning the attached schedule or would like additional information, please contact the nearest BUREAU of PUBLIC WORK District Office or write to:

New York State Department of Labor
Bureau of Public Work
State Office Campus, Bldg. 12
Albany, NY 12226

District Office Locations:	Telephone #	FAX #
Bureau of Public Work - Albany	518-457-2744	518-485-0240
Bureau of Public Work - Binghamton	607-721-8005	607-721-8004
Bureau of Public Work - Buffalo	716-847-7159	716-847-7650
Bureau of Public Work - Garden City	516-228-3915	516-794-3518
Bureau of Public Work - Newburgh	845-568-5287	845-568-5332
Bureau of Public Work - New York City	212-932-2419	212-775-3579
Bureau of Public Work - Patchogue	631-687-4882	631-687-4902
Bureau of Public Work - Rochester	585-258-4505	585-258-4708
Bureau of Public Work - Syracuse	315-428-4056	315-428-4671
Bureau of Public Work - Utica	315-793-2314	315-793-2514
Bureau of Public Work - White Plains	914-997-9507	914-997-9523
Bureau of Public Work - Central Office	518-457-5589	518-485-1870

Orange County General Construction

Boilermaker

05/01/2024

JOB DESCRIPTION Boilermaker

DISTRICT 4

ENTIRE COUNTIES

Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

WAGES

Per Hour:	07/01/2023	01/01/2024
Boilermaker	\$ 65.88	\$ 67.38
Repairs & Renovations	65.88	67.38

Repairs & Renovation: Includes Repairing, Renovating replacement of parts to an existing unit(s).

SUPPLEMENTAL BENEFITS

Per Hour:

Boilermaker	33.5% of hourly	33.5% of Hourly
Repair \$ Renovations	Wage Paid	Wage Paid
	+ \$ 26.49	+ \$26.85

NOTE: "Hourly Wage Paid" shall include any and all premium(s) pay.

Repairs & Renovation Includes replacement of parts and repairs & renovation of existing unit.

OVERTIME PAY

See (*B, O, **U) on OVERTIME PAGE

Note:* Includes 9th & 10th hours, double for 11th or more.

** Labor Day ONLY, if worked.

Repairs & Renovation see (B,E,Q) on OT Page

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 12, 15, 25, 26, 29) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wage per hour:

(1/2) Year Terms at the following percentage of Boilermaker's Wage

1st	2nd	3rd	4th	5th	6th	7th
65%	70%	75%	80%	85%	90%	95%

Supplemental Benefits Per Hour:

Apprentice(s)	33.5% of Hourly Wage Paid Plus Amount Below	33.5% of Hourly Wage Paid Plus Amount Below
1st Term	\$ 20.12	\$ 20.36
2nd Term	21.03	21.28
3rd Term	21.95	22.22
4th Term	22.83	23.12
5th Term	23.76	24.07
6th Term	24.67	25.00
7th Term	25.58	25.93

NOTE: "Hourly Wage Paid" shall include any and all premium(s)

4-5

Carpenter

05/01/2024

JOB DESCRIPTION Carpenter

DISTRICT 8

ENTIRE COUNTIES

Dutchess, Orange

WAGES

Per hour: 07/01/2023

Building:
Millwright \$ 46.00
+ 8.17*

*This portion is not subject to overtime premiums

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 34.31

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (18,19) on HOLIDAY PAGE.

Paid: See (5,6,11,13,16,18,19,25) for 1st & 2nd yr.Apprentices

Overtime: See (5,6,11,13,16,18,19,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES

Wages per hour:

One (1) year terms:

1st	2nd	3rd	4th
\$28.01	\$30.34	\$34.67	\$43.33
+ 4.27*	+ 5.06*	+ 5.81*	+ 7.31*

*This portion is not subject to overtime premiums

Supplemental benefits per hour:

1st	2nd	3rd	4th
\$22.55	\$24.34	\$26.45	\$29.18

8-740.2

Carpenter

05/01/2024

JOB DESCRIPTION Carpenter

DISTRICT 8

ENTIRE COUNTIES

Dutchess

PARTIAL COUNTIES

Orange: : The territory west demarcated by a line drawn from the Bear Mountain Bridge continuing east to the Bear Mountain Circle. The territory south demarcated by a line continuing north on 9W to the town of Cornwall where County Road 107 (also known as Quaker Rd) crosses under 9W to the centerline of Route 32, The territories south and east heading north on Route 32 to Orrs Mills Rd, then west on Orrs Mills Rd to Route 94, continue west and south on Route 94 to the Town of Chester, to the intersection of Kings Highway, continue south on Kings Highway to Bellvale Rd, west on Bellvale Rd to Bellvale Lakes Rd, then south on Bellvale Lakes Rd to Kain Rd, southeast on Kain Rd to Route 17A, then north and southeast along Route 17A to Route 210, then follow Route 210 to NJ Border.

WAGES

Per hour: 07/01/2023

Carpet/Resilient

Floor Coverer \$ 34.45
+ 3.25*

*This portion is not subject to overtime premiums

INCLUDES HANDLING & INSTALLATION OF ARTIFICIAL TURF AND SIMILAR TURF INDOORS/OUTDOORS.

SUPPLEMENTAL BENEFITS

Per hour:

\$ 28.33

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (18, 19) on HOLIDAY PAGE

Paid for 1st & 2nd yr.

Apprentices: See (5, 6, 11, 13, 16, 18, 19, 25)

Overtime: See (5, 6, 11, 13, 16, 18, 19, 25) on HOLIDAY PAGE.

REGISTERED APPRENTICES

Wage per hour - (1) year terms:

1st	2nd	3rd	4th
\$15.75	\$18.87	\$23.55	\$28.23
+ 2.48*	+ 2.48*	+ 2.48*	+ 2.48*

*This portion is not subject to overtime premiums

Supplemental Benefits per hour - All apprentice terms:

\$ 20.87

8-2287D&O

Carpenter

05/01/2024

JOB DESCRIPTION Carpenter

DISTRICT 8

ENTIRE COUNTIES

Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES

Per Hour: 07/01/2023

Marine Construction:

Marine Diver \$ 74.03
+ 9.79*

Marine Tender \$ 53.57
+ 9.79*

*This portion is not subject to overtime premiums

SUPPLEMENTAL BENEFITS

Per Hour:

Journeyworker \$ 45.34

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (18, 19) on HOLIDAY PAGE

Overtime: See (5, 6, 11, 13, 16, 18, 19, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour:

One (1) year terms.

1st year	\$ 25.60 + 5.30*
2nd year	31.20 + 5.30*
3rd year	39.58 + 5.30*
4th year	47.97 + 5.05*

*This portion is not subject to overtime premiums

Supplemental Benefits

Per Hour:

All terms \$ 31.83

8-1456MC

Carpenter

05/01/2024

JOB DESCRIPTION Carpenter

DISTRICT 8

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Westchester

PARTIAL COUNTIES

Orange: South of but including the following, Waterloo Mills, Slate Hill, New Hampton, Goshen, Blooming Grove, Mountainville, east to the Hudson River.

Putnam: South of but including the following, Cold Spring, Tompkins Corner, Mahopac, Croton Falls, east to Connecticut border.

Suffolk: West of Port Jefferson and Patchogue Road to Route 112 to the Atlantic Ocean.

WAGES

Per hour: 07/01/2023

Core Drilling:

Driller \$ 43.88
+ 2.50*

Driller Helper

\$ 34.47
+ 2.50*

Note: Hazardous Waste Pay Differential:

For Level C, an additional 15% above wage rate per hour

For Level B, an additional 15% above wage rate per hour

For Level A, an additional 15% above wage rate per hour

Note: When required to work on water: an additional \$ 3.00 per hour.

*This portion is not subject to overtime premiums

SUPPLEMENTAL BENEFITS

Per hour:

Driller and Helper \$ 28.85

OVERTIME PAY

See (B, G, P) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

8-1536-CoreDriller

Carpenter - Building / Heavy&Highway

05/01/2024

JOB DESCRIPTION Carpenter - Building / Heavy&Highway

DISTRICT 2

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Wyoming, Yates

PARTIAL COUNTIES

Orange: The area lying on Northern side of Orange County demarcated by a line drawn from the Bear Mountain Bridge continuing west to the Bear Mountain Circle, continue North on 9W to the town of Cornwall where County Road 107 (also known as Quaker Rd) crosses under 9W, then east on County Road 107 to Route 32, then north on Route 32 to Orrs Mills Rd, then west on Orrs Mills Rd to Route 94, continue west and south on Route 94 to the Town of Chester, to the intersection of Kings Highway, continue south on Kings Highway to Bellvale Rd, west on Bellvale Rd to Bellvale Lakes Rd, then south on Bellvale Lakes Rd to Kain Rd, southeast on Kain Rd to Route 17A, then north and southeast along Route 17A to Route 210, then follow Route 210 to NJ Border.

WAGES

Wages per hour: 07/01/2023 07/01/2024
Additional

Carpenter - ONLY for

Artificial Turf/Synthetic

Sport Surface \$ 34.48 \$ 2.25*

*To be allocated at a later date

Note - Does not include the operation of equipment. Please see Operating Engineers rates.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 26.30

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE

HOLIDAY

Paid: See (5) on HOLIDAY PAGE

Overtime: See (5, 6, 16) on HOLIDAY PAGE

Notes:

When a holiday falls upon a Saturday, it shall be observed on the preceding Friday. When a holiday falls upon a Sunday, it shall be observed on the following Monday.

An employee taking an unexcused day off the regularly scheduled day before or after a paid Holiday shall not receive Holiday pay.

REGISTERED APPRENTICES

Wages per hour (1300 hour terms at the following percentage of Journeyman's wage):

1st	2nd	3rd	4th
65%	70%	75%	80%

Supplemental Benefits per hour:

1st term	\$ 17.56
2nd term	18.04
3rd term	20.06
4th term	20.54

2-42AtSS

Carpenter - Building / Heavy&Highway

05/01/2024

JOB DESCRIPTION Carpenter - Building / Heavy&Highway

DISTRICT 11

ENTIRE COUNTIES

Columbia, Dutchess, Orange, Sullivan, Ulster

WAGES

WAGES (per hour)

Applies to Carpenter (Building/Heavy & Highway/Tunnel), Dockbuilder, Piledriver, Dive Tender, and Diver (Dry):

	07/01/2023	07/01/2024	07/01/2025	07/01/2026
		Additional	Additional	Additional
Base Wage	\$ 35.81	\$ 2.16**	\$ 2.23**	\$ 2.30**
	+ 4.88*			

Applies to Diver (Wet):

Base Wage	\$ 50.00
	+ 4.88*

*For all hours paid straight or premium.

**To be allocated at a later date.

SHIFT DIFFERENTIAL: When mandated by a Government Agency irregular or off shift can be worked. The Carpenter shall receive an additional fifteen percent (15%) of the base wage.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker	\$ 31.30
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OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

BUILDING:

Paid: See (1) on HOLIDAY PAGE.

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE.

- Holidays that fall on Sunday will be observed Monday.

HEAVY&HIGHWAY/TUNNEL:

Paid: See (5, 6, 25) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

- Holidays that fall on Sunday will be observed Monday

- Must be employed during the five (5) work days immediately preceding a holiday or during the five (5) work days following the paid holiday to receive holiday pay

- If Employee is entitled to a paid holiday, the Employee is paid the Holiday wage and supplemental benefits whether they work or not. If Employee works the Holiday, the Employee will receive holiday pay (including supplemental benefits), plus the applicable premium wage for working the Holiday. If Employee works in excess of 8 hours on Holiday, then benefits will be paid for any hours in excess of 8 hours.

REGISTERED APPRENTICES

1 Year terms at the following wage rates.

1st	2nd	3rd	4th	5th
-----	-----	-----	-----	-----

\$ 17.91	\$ 21.49	\$ 23.28	\$ 25.07	\$ 28.65
+2.58*	+2.58*	+2.58*	+2.58*	+2.58*

*For all hours paid straight or premium

SUPPLEMENTAL BENEFITS per hour:

All Terms \$ 16.32

11-279.2B/H&H

Carpenter - Floor Coverer

05/01/2024

JOB DESCRIPTION Carpenter - Floor Coverer

DISTRICT 11

ENTIRE COUNTIES

Columbia, Sullivan, Ulster

PARTIAL COUNTIES

Orange: The area lying on Northern side of Orange County demarcated by a line drawn from the Bear Mountain Bridge continuing west to the Bear Mountain Circle, continue North on 9W to the town of Cornwall where County Road 107 (also known as Quaker Rd) crosses under 9W, then east on County Road 107 to Route 32, then north on Route 32 to Orrs Mills Rd, then west on Orrs Mills Rd to Route 94, continue west and south on Route 94 to the Town of Chester, to the intersection of Kings Highway, continue south on Kings Highway to Bellvale Rd, west on Bellvale Rd to Bellvale Lakes Rd, then south on Bellvale Lakes Rd to Kain Rd, southeast on Kain Rd to Route 17A, then north and southeast along Route 17A to Route 210, then follow Route 210 to NJ Border.

WAGES

WAGES:(per hour)

	07/01/2023	07/01/2024	07/01/2025
		Additional	Additional
Carpet/Resilient Floor Coverer	\$ 35.81	\$ 2.16**	\$ 2.23**
	+4.88*		

* For all hours paid straight or premium

** To be allocated at a later date.

SHIFT DIFFERENTIAL: When mandated by a Government Agency irregular or off shift can be worked. The Carpenter shall receive an additional fifteen (15) percent of wage plus applicable benefits.

SUPPLEMENTAL BENEFITS

Per hour:

Journey worker \$ 31.30

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

BUILDING:

Paid: See (1) on HOLIDAY PAGE.

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE.

- Holidays that fall on Sunday will be observed Monday.

HEAVY&HIGHWAY/TUNNEL:

Paid: See (5, 6, 25) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

- Holidays that fall on Sunday will be observed Monday

- Must be employed during the five (5) work days immediately preceding a holiday or during the five (5) work days following the paid holiday to receive holiday pay

- If Employee is entitled to a paid holiday, the Employee is paid the Holiday wage and supplemental benefits whether they work or not. If Employee works the Holiday, the Employee will receive holiday pay (including supplemental benefits), plus the applicable premium wage for working the Holiday. If Employee works in excess of 8 hours on Holiday, then benefits will be paid for any hours in excess of 8 hours.

REGISTERED APPRENTICES

1 Year terms at the following wage rates.

1st	2nd	3rd	4th	5th
\$ 17.91	\$ 21.49	\$ 23.28	\$ 25.07	\$ 28.65
+2.58*	+2.58*	+2.58*	+2.58*	+2.58*

*For all hours paid straight or premium

SUPPLEMENTAL BENEFITS per hour:

All terms \$ 16.32

11-279.2Floor

Electrician

05/01/2024

JOB DESCRIPTION Electrician

DISTRICT 11

ENTIRE COUNTIES

Orange, Putnam, Rockland

PARTIAL COUNTIES

Dutchess: Towns of Fishkill, East Fishkill, and Beacon.

WAGES

Per hour:

	07/01/2023	04/01/2024
Electrician Wireman/Technician	\$ 49.50	\$ 50.50
	+9.00*	+ 9.50*

SHIFT DIFFERENTIAL: On Public Work in New York State when shift work is mandated either in the job specifications or by the contracting agency, the following rates apply when shift is worked:

Between 4:30pm & 12:30am	\$ 58.08	\$ 59.30
	+ 9.00*	+ 9.50*
Between 12:30am & 8:30am	\$ 65.06	\$66.35
	+ 9.00*	+ 9.50*

*For all hours paid straight or premium, not to be included in 3% calculation for supplemental benefits.

NOTE ADDITIONAL AMOUNTS PAID FOR THE FOLLOWING WORK LISTED BELOW (subject to overtime premiums):

- On jobs where employees are required to work from boatswain chairs, swinging scaffolds, etc., forty (40) feet or more above the ground, or under compressed air, using Scottair packs, or gas masks, they shall receive an additional \$2.00 per hour above the regular straight time rate.
- Journeyman Wireman working in Shafts, Tunnels or on Barges: \$5.00 above the Journeyman Wireman rate of pay
- Journeyman Wireman when performing welding or cable splicing: \$3.00 above the Journeyman Wireman rate of pay
- Journeyman Wireman required to have a NYS Asbestos Certificate: \$3.00 above the Journeyman Wireman rate of pay
- Journeyman Wireman required to have a CDL: \$3.00 above the Journeyman Wireman rate of pay.

SUPPLEMENTAL BENEFITS

Per hour:

	07/01/2023	04/01/2024
Journeyman	\$ 28.68 plus	\$ 29.68 plus
	3% of straight	3% of straight
	or premium wage	or premium wage

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 13, 15, 16, 25) on HOLIDAY PAGE

When the holiday falls on a Saturday it is observed the Friday before. When the holiday falls on a Sunday it is observed on the Monday after.

REGISTERED APPRENTICES

WAGES:

(1)year terms at the following rates

	1st	2nd	3rd	4th	5th	6th
07/01/2023						
1st Shift	\$ 14.25	\$ 19.00	\$ 23.75	\$ 28.50	\$ 33.25	\$ 35.63
	+1.00*	+1.00*	+1.50*	+2.00*	+2.50*	+2.50*
2nd Shift	16.72	22.29	27.86	33.43	39.00	41.79
	+1.00*	+1.00*	+1.50*	+2.00*	+2.50*	+2.50*
3rd Shift	18.72	24.97	31.21	37.45	43.69	46.82
	+1.00*	+1.00*	+1.50*	+2.00*	+2.50*	+2.50*
09/01/2023						
1st Shift	\$ 15.68	\$ 19.00	\$ 23.75	\$ 28.50	\$ 33.25	\$ 35.63
	+1.00*	+1.00*	+1.50*	+2.00*	+2.50*	+2.50*
2nd Shift	18.39	22.29	27.86	33.43	39.00	41.79
	+1.00*	+1.00*	+1.50*	+2.00*	+2.50*	+2.50*
3rd Shift	20.60	24.97	31.21	47.45	43.69	46.82
	+1.00*	+1.00*	+1.50*	+2.00*	+2.50*	+2.50*
04/01/2024						
1st Shift	\$ 16.01	\$ 19.40	\$ 24.25	\$ 29.10	\$ 33.95	\$ 36.38
	+1.00*	+1.00*	+1.50*	+2.00*	+2.50*	+2.50*

2nd Shift	18.78	22.76	28.45	34.13	39.82	42.67
	+1.00*	+1.00*	+1.50*	+2.00*	+2.50*	+2.50*
3rd Shift	21.04	25.49	31.86	38.24	44.61	47.80
	+1.00*	+1.00*	+1.50*	+2.00*	+2.50*	+2.50*
09/01/2024	1st	2nd	3rd	4th	5th	6th
1st Shift	\$ 16.01	\$ 19.40	\$ 24.25	\$ 29.10	\$ 33.95	\$ 36.38
	+1.00*	+1.00*	+1.00*	+2.00*	+2.50*	+2.50*
2nd Shift	18.78	22.76	28.45	34.13	39.82	42.67
	+1.00*	+1.00*	+1.00*	+2.00*	+2.50*	+2.50*
3rd Shift	21.04	25.49	31.86	38.24	44.61	47.80
	+1.00*	+1.00*	+1.00*	+2.00*	+2.50*	+2.50*
04/01/2025	1st	2nd	3rd	4th	5th	6th
1st Shift	\$ 16.34	\$ 19.80	\$ 24.75	\$ 29.70	\$ 34.65	\$ 37.13
	+1.00*	+1.00*	+1.00*	+2.00*	+2.50*	+2.50*
2nd Shift	19.17	23.23	29.03	34.84	40.64	43.55
	+1.00*	+1.00*	+1.00*	+2.00*	+2.50*	+2.50*
3rd Shift	21.47	26.02	32.52	39.03	45.53	48.79
	+1.00*	+1.00*	+1.00*	+2.00*	+2.50*	+2.50*

*For all hours paid straight or premium, not to be included in 3% calculation for supplemental benefits.

SUPPLEMENTAL BENEFITS per hour:

07/01/2023

1st term	\$ 16.28 plus 3% of straight or premium wage
2nd term	\$ 16.28 plus 3% of straight or premium wage
3rd term	\$ 18.28 plus 3% of straight or premium wage
4th term	\$ 18.78 plus 3% of straight or premium wage
5th term	\$ 20.28 plus 3% of straight or premium wage
6th term	\$ 20.28 plus 3% of straight or premium wage

09/01/2024

1st term	\$ 16.28 plus 3% of straight or premium wage
2nd term	\$ 17.78 plus 3% of straight or premium wage
3rd term	\$ 18.78 plus 3% of straight or premium wage
4th term	\$ 19.78 plus 3% of straight or premium wage
5th term	\$ 21.28 plus 3% of straight or premium wage
6th term	\$ 21.28 plus 3% of straight or premium wage

11-363/1

Elevator Constructor

05/01/2024

JOB DESCRIPTION Elevator Constructor

DISTRICT 1

ENTIRE COUNTIES

Columbia, Dutchess, Greene, Orange, Putnam, Sullivan, Ulster

PARTIAL COUNTIES

Delaware: Towns of Andes, Bovina, Colchester, Davenport, Delhi, Harpersfield, Hemdon, Kortright, Meredith, Middletown, Roxbury, Hancock & Stamford

Rockland: Only the Township of Stony Point.

Westchester: Only the Townships of Bedford, Lewisboro, Cortland, Mt. Kisco, North Salem, Pound Ridge, Somers and Yorktown.

WAGES

Per Hour	07/01/2023	01/01/2024
Mechanic	\$ 67.35	\$ 70.15
Helper	70% of Mechanic Wage Rate	70% of Mechanic Wage Rate

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour	07/01/2023	01/01/2024
Journey person/Helper	\$ 37.335*	\$ 37.885*

(*)Plus 6% of regular hourly if less than 5 years of service. Plus 8% of regular hourly rate if more than 5 years of service.

OVERTIME PAY

See (D, O) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 15, 16) on HOLIDAY PAGE

Overtime: See (5, 6, 15, 16) on HOLIDAY PAGE

Note: When a paid holiday falls on Saturday, it shall be observed on Friday. When a paid holiday falls on Sunday, it shall be observed on Monday.

REGISTERED APPRENTICES

Wages per hour:

0-6 mo*	6-12 mo	2nd yr	3rd yr	4th yr
50 %	55 %	65 %	70 %	80 %

(*)Plus 6% of the hourly rate, no additional supplemental benefits.

Supplemental Benefits per hour worked:

Same as Journey person/Helper

1-138

Glazier	05/01/2024
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JOB DESCRIPTION Glazier

DISTRICT 8

ENTIRE COUNTIES

Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

WAGES

Per hour: 7/01/2023

Glazier & Glass Tinting \$ 61.64

and Window Film

*Scaffolding 65.64

**Repair & Maintenance 30.76

*Scaffolding includes swing scaffold, mechanical equipment, scissor jacks, man lifts, booms & buckets 30' or more, but not pipe scaffolding.

**Repair & Maintenance- All repair & maintenance work on a particular building whenever performed, where the total cumulative Repair & Maintenance contract value is under \$184,000.

SUPPLEMENTAL BENEFITS

Per hour: 7/01/2023

Glazier & Glass Tinting \$ 40.20

and Window Film

Repair & Maintenance 23.19

OVERTIME PAY

See (B, E, Q, V) on OVERTIME PAGE

For 'Repair & Maintenance' see (B, B2, I, S) on overtime page.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (4, 6, 16, 25) on HOLIDAY PAGE

For 'Repair & Maintenance'

Paid: See(5, 6, 16, 25)

Overtime: See(5, 6, 16, 25)

REGISTERED APPRENTICES

Wage per hour:

(1) year terms at the following wage rates:

7/01/2023

1st term	\$ 21.93
2nd term	30.05
3rd term	39.95
4th term	48.97

Supplemental Benefits:

(Per hour)

1st term	\$ 18.25
2nd term	25.97
3rd term	31.27
4th term	34.32

8-1087 (DC9 NYC)

Insulator - Heat & Frost

05/01/2024

JOB DESCRIPTION Insulator - Heat & Frost

DISTRICT 8

ENTIRE COUNTIES

Dutchess, Orange, Putnam, Rockland, Westchester

WAGES

Per hour:	07/01/2023	06/01/2024
Insulator	\$ 59.25	+ \$ 2.50
Discomfort & Additional Training**	62.31	+ \$ 2.50
Fire Stop Work*	31.77	+ \$ 2.50

* Applies on all exclusive Fire Stop Work (When contract is for Fire Stop work only). No apprentices on these contracts only.

**Applies to work requiring: garb or equipment worn against the body not customarily worn by insulators; psychological evaluation ;special training, including but not limited to "Yellow Badge" radiation training

Note: Additional \$0.50 per hour for work 30 feet or more above floor or ground level.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker	\$ 37.35
Discomfort & Additional Training	39.39
Fire Stop Work: Journeyworker	19.03

OVERTIME PAY

See (B, E, E2, Q, *T) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Note: Last working day preceding Christmas and New Years day, workers shall work no later than 12:00 noon and shall receive 8 hrs pay.

Overtime: See (2*, 4, 6, 16, 25) on HOLIDAY PAGE.

*Note: Labor Day triple time if worked.

REGISTERED APPRENTICES

(1) year terms:

Insulator Apprentices:

1st	2nd	3rd	4th
\$ 31.77	\$ 37.26	\$ 42.76	\$ 48.26

Discomfort & Additional Training Apprentices:

1st	2nd	3rd	4th
\$ 33.30	\$ 39.09	\$ 44.90	\$ 50.71

Supplemental Benefits paid per hour:

Insulator Apprentices:

1st term	\$ 19.03
2nd term	22.69
3rd term	26.36
4th term	30.03

Discomfort & Additional Training Apprentices:

1st term	\$ 20.06
2nd term	23.92
3rd term	27.78
4th term	31.66

8-91

Ironworker

05/01/2024

JOB DESCRIPTION Ironworker

DISTRICT 11

ENTIRE COUNTIES

Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster

WAGES

Per hour:

	07/01/2023	07/01/2024 Additional	07/01/2025 Additional	07/01/2026 Additional
Structural	\$ 52.63	\$ 2.00*	\$ 2.00*	\$2.00*
Reinforcing*	52.63	2.00*	2.00*	2.00*
Ornamental	52.63	2.00*	2.00*	2.00*
Chain Link Fence	52.63	2.00*	2.00*	2.00*

* To be allocated at a later date.

NOTE: For Reinforcing classification ONLY, Ironworker 4-46Reinf rates apply in Rockland County's southern section (south of Convent Road and east of Blue Hills Road).

On Government Mandated Irregular Work Days or Shift Work, the following wage will be paid:

1st Shift	\$ 52.63
2nd Shift	67.34
3rd Shift	72.24

**Note- Any shift that works past 12:00 midnight shall receive the 3rd shift differential.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman	\$ 43.47
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OVERTIME PAY

See (B1, Q, V) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 16) on HOLIDAY PAGE

If a holiday falls on Saturday, it will be observed Friday. If a holiday falls on Sunday, it will be observed Monday.

REGISTERED APPRENTICES

Wages:

(1) year terms at the following wage:

	1st yr	2nd yr	3rd yr	4th yr
1st Shift	\$ 26.32	\$ 31.58	\$ 36.85	\$ 42.10
2nd Shift	36.16	42.40	48.64	54.86
3rd Shift	39.45	46.00	52.57	59.12

Supplemental Benefits per hour:

1st year	\$ 37.35
2nd year	38.57
3rd year	39.80
4th year	41.02

11-417

Laborer - Building

05/01/2024

JOB DESCRIPTION Laborer - Building

DISTRICT 11

ENTIRE COUNTIES

Orange, Sullivan, Ulster

PARTIAL COUNTIES

Delaware: Only the Townships of Andes, Bovina, Davenport, Delhi, Franklin, Hamden, Harpersfield, Kortright, Meredith, Middletown, Roxbury, and Stamford.

Greene: Only the Township of Catskill.

WAGES

Class 1: Custodial and janitorial work, general cleanup, and flag person.

Class 2: Concrete laborer, mason tending, hod carrier, signal person, pressure blasting and washing, chainsaw, demo saw, jackhammers, general labor.

Class 3: Jumping jack, air track drills, grading, explosive handler and blaster, grade checker. When OSHA requires negative pressure respirator.

Class 4: Environmental work including but not limited to asbestos abatement, toxic and hazardous abatement, lead abatement work, mold remediation and biohazards.

WAGES: (per hour)	07/01/2023	06/01/2024	06/01/2025 Additional	06/01/2026 Additional
Class 1	\$ 41.65	\$ 43.15	\$ 2.69*	\$ 2.79*
Class 2	42.40	43.95	2.72*	2.82*
Class 3	44.30	45.90	2.79*	2.89*
Class 4	47.30	49.00	2.90*	3.00*

*To be allocated at a later date.

These rates will cover all work within five feet of the building foundation line.

Shift Differential: On all Governmental mandated irregular or off shift work, an additional 25% of wage is required. The 25% shift differential will be paid on public works contract for shifts or irregular workdays outside the normal working hours for 2nd and 3rd shifts or irregular work day or when mandated or required by state, federal, county, local or other governmental agency contracts.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman	\$ 32.40	\$ 33.50
Shift	39.46	40.84

OVERTIME PAY

See (B, *E, E5, **Q) on OVERTIME PAGE

*For first 8 hours on Saturday

**When an employee is required to work on a holiday which falls on a Sunday the employee shall be paid three (3) times the hourly rate and one (1) hour benefits for every hour worked. When an employee is required to work on a holiday which falls on a Saturday the employee shall be paid two and a half (2.5) times the hourly rate and one hour benefits for every hour worked.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

Holidays that fall on Saturday shall be observed on Friday, when holidays fall on Sunday they shall be observed on Monday.

REGISTERED APPRENTICES

(1000) hour terms at the following wages.

	07/01/2023	06/01/2024
1st term	\$ 27.05	\$ 28.05
2nd term	31.25	32.35
3rd term	35.40	36.70
4th term	39.55	41.00

Supplemental Benefits per hour:

All Terms Regular	\$ 28.33	\$ 29.23
All Terms Shift Rate	34.27	TBD

11-17.BA

Laborer - Heavy&Highway

05/01/2024

JOB DESCRIPTION Laborer - Heavy&Highway

DISTRICT 11

ENTIRE COUNTIES

Orange, Sullivan, Ulster

PARTIAL COUNTIES

Delaware: Only the Townships of Andes, Bovina, Middletown, Roxbury, Franklin, Hamden, Stamford, Delhi, Kortright, Harpersfield, Meredith, and Davenport.

Greene: Only the Township of Catskill.

WAGES

CLASS 1: Flagperson, gateperson.

CLASS 2: General laborer, chuck tender, nipper, powder carrier, magazine tender, concrete men, vibrator men, mason tender, mortar men, traffic control, custodial work, temporary heat, pump men, pit men, dump men, asphalt men, joint setter, signalman, pipe men, riprap, dry stone layers, jack hammer, bush hammer, pavement breaker, men on mulching & seeding machines, all seeding & sod laying, landscape work, walk behind self-propelled power saws, grinder, walk behind rollers and tampers of all types, burner men, filling and wiring of baskets for gabion walls, chain saw operator, railroad track laborers, power buggy, plaster & acoustic pump, power brush cutter, retention liners, walk behind surface planer, chipping hammer, manhole, catch basin or inlet installing, mortar mixer, laser men. *Micropaving and crack sealing.

CLASS 3: Asbestos, toxic, bio remediation and phyto-remediation, lead or hazardous materials abatement when certification or license is required, Drilling Equipment Only Where a Separate Air Compressor Unit Supplies Power.

CLASS 4: Asphalt screedman, blaster, all laborers involved in pipejacking and boring operations not exceeding more than 10 feet into pipe, boring or drilled area.

WAGES: (per hour)	07/01/2023	06/01/2024 Additional
Class 1	\$ 40.80	\$ 2.65**
Class 2	44.80	2.35**
Class 3	49.40	2.45**
Class 4	54.70	2.20**

* When laborers are performing micro paving, crack sealing or slurry application when not part of asphalt prep operations laborers shall receive an additional \$2.50 per hour over rate.

**To be allocated at a later date.

SHIFT DIFFERENTIAL: Night work and irregular shift require 20% increase on wages for all Government mandated night and irregular shift work.

NOTE - The 'Employer Registration' (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman	\$ 32.28
Shift	37.96

OVERTIME PAY

See (B, E, P, *R, **S, ***T, X) on OVERTIME PAGE

*For Mon-Fri Holidays, Double Benefits to be paid for all hours worked.

**For Saturday Holidays, Two and one Half Benefits for all hours worked.

***For Sunday Holidays, Triple Benefits for all hours worked.

HOLIDAY

Paid: See (5, 6, 15, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 15, 25) on HOLIDAY PAGE

To be eligible for a paid holiday, an employee must work at least two (2) days in the calendar week or payroll week in which the holiday falls.

REGISTERED APPRENTICES

(1000) hour terms at the following wages.

	07/01/2023	06/01/2024
1st term	\$ 27.05	\$ 28.05
2nd term	31.25	32.35
3rd term	35.40	36.70
4th term	39.55	41.00

Supplemental Benefits per hour:

All Terms Regular	\$ 28.33	\$ 29.23
All Terms Shift Rate	33.08	TBD

11-17.1H/H

Laborer - Tunnel

05/01/2024

JOB DESCRIPTION Laborer - Tunnel

DISTRICT 11

ENTIRE COUNTIES

Columbia, Dutchess, Greene, Orange, Otsego, Putnam, Rockland, Sullivan, Ulster, Westchester

PARTIAL COUNTIES

Chenango: Townships of Columbus, Sherburne and New Berlin.

Delaware: Townships of Andes, Bovina, Middletown, Roxbury, Franklin, Hamden, Stamford, Delhi, Kortright, Harpersfield, Merideth and Davenport.

WAGES

Class 1: All support laborers/sandhogs working above the shaft or tunnel.

Class 2: All laborers/sandhogs working in the shaft or tunnel.

Class 4: Safety Miners

Class 5: Site work related to Shaft/Tunnel

WAGES: (per hour)

	07/01/2023	06/01/2024	06/01/2025
Class 1	\$ 55.55	\$ 57.05	\$ 58.55
Class 2	57.70	59.20	60.70
Class 4	64.10	65.60	67.10
Class 5	47.65	49.90	51.40

Toxic and hazardous waste, lead abatement and asbestos abatement work will be paid an additional \$ 3.00 an hour.

SHIFT DIFFERENTIAL...On all Government mandated irregular shift work:

- Employee shall be paid at time and one half the regular rate Monday through Friday.
- Saturday shall be paid at 1.65 times the regular rate.
- Sunday shall be paid at 2.15 times the regular rate.

SUPPLEMENTAL BENEFITS

Per hour:

Benefit 1	\$ 35.73	\$ 36.98	\$ 38.23
Benefit 2	51.01	TBD	TBD
Benefit 3	71.28	TBD	TBD

Benefit 1 applies to straight time hours, paid holidays not worked.

Benefit 2 applies to over 8 hours in a day (M-F), irregular shift work hours worked, and Saturday hours worked.

Benefit 3 applies to Sunday and Holiday hours worked.

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 15, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 15, 16, 25) on HOLIDAY PAGE

When a recognized Holidays falls on Saturday or Sunday, holidays falling on Saturday shall be recognized or observed on Friday and holidays falling on Sunday shall be recognized or observed on Monday. Employees ordered to work on the Saturday or Sunday of the holiday or on the recognized or the observed Friday or Monday for those holidays falling on Saturday or Sunday shall receive double time the established rate and benefits for the holiday.

REGISTERED APPRENTICES

FOR APPRENTICE RATES, refer to the appropriate Laborer Heavy & Highway wage rate contained in the wage schedule for the County and location where the work is to be performed.

11-17/60/235/754Tun

Lineman Electrician

05/01/2024

JOB DESCRIPTION Lineman Electrician

DISTRICT 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Wyoming, Yates

WAGES

A Lineman/Technician shall perform all overhead aerial work. A Lineman/Technician on the ground will install all electrical panels, connect all grounds, install and connect all electrical conductors, assembly of all electrical materials, conduit, pipe, or raceway; placing of fish wire; pulling of cables, wires or fiber optic cable through such raceways; splicing of conductors; dismantling of such structures, lines or equipment.

A Groundman/Truck Driver shall: Build and set concrete forms, handle steel mesh, set footer cages, transport concrete in a wheelbarrow, hand or machine concrete vibrator, finish concrete footers, mix mortar, grout pole bases, cover and maintain footers while curing in cold weather, operate jack hammer, operate hand pavement breaker, tamper, concrete and other motorized saws, as a drill helper, operate and maintain generators, water pumps, chainsaws, sand blasting, operate mulching and seeding machine, air tools, electric tools, gas tools, load and unload materials, hand shovel and/or broom, prepare and pour mastic and other fillers, assist digger operator/equipment operator in ground excavation and restoration, landscape work and painting. Only when assisting a lineman technician, a groundman/truck driver may assist in installing conduit, pipe, cables and equipment.

NOTE: Includes Teledata Work within ten (10) feet of High Voltage Transmission Lines. Also includes digging of holes for poles, anchors, footer, and foundations for electrical equipment.

Below rates applicable on all overhead and underground distribution and maintenance work, and all overhead and underground transmission line work and the installation of fiber optic cable where no other construction trades are or have been involved. (Ref #14.01.01)

Per hour:	07/01/2023	05/06/2024
Group A:		
Lineman, Technician	\$ 57.40	\$ 58.90
Crane, Crawler Backhoe	57.40	58.90
Welder, Cable Splicer	57.40	58.90
Group B:		
Digging Mach. Operator	51.66	53.01
Tractor Trailer Driver	48.79	50.07
Groundman, Truck Driver	45.92	47.12
Equipment Mechanic	45.92	47.12
Flagman	34.44	35.34

Additional \$1.00 per hour for entire crew when a helicopter is used.

Below rates applicable on all electrical sub-stations, switching structures, fiber optic cable and all other work not defined as "Utility outside electrical work". (Ref #14.02.01-A)

Group A:		
Lineman, Technician	\$ 57.40	\$ 58.90
Crane, Crawler Backhoe	57.40	58.90
Cable Splicer	63.14	64.79
Certified Welder, Pipe Type Cable	60.27	61.85
Group B:		
Digging Mach. Operator	51.66	53.01
Tractor Trailer Driver	48.79	50.07
Groundman, Truck Driver	45.92	47.12
Equipment Mechanic	45.92	47.12
Flagman	34.44	35.34

Additional \$1.00 per hour for entire crew when a helicopter is used.

Below rates apply on switching structures, maintenance projects, railroad catenary install/maintenance third rail installation, bonding of rails and pipe type cable and installation of fiber optic cable. (Ref #14.02.01-B)

Group A:		
Lineman, Tech, Welder	\$ 58.72	\$ 60.22
Crane, Crawler Backhoe	58.72	60.22
Cable Splicer	64.59	66.24
Certified Welder, Pipe Type Cable	61.66	63.23
Group B:		
Digging Mach. Operator	52.85	54.20
Tractor Trailer Driver	49.91	51.19
Groundman, Truck Driver	46.98	48.18

Equipment Mechanic	46.98	48.18
Flagman	35.23	36.13

Additional \$1.00 per hour for entire crew when a helicopter is used.

Below rates applicable on all overhead and underground transmission line work & fiber optic cable where other construction trades are or have been involved. This applies to transmission line work only, not other construction. (Ref #14.03.01)

Group A:		
Lineman, Tech, Welder	\$ 59.91	\$ 61.41
Crane, Crawler Backhoe	59.91	61.41
Cable Splicer	59.91	61.41

Group B:		
Digging Mach. Operator	53.92	55.27
Tractor Trailer Driver	50.92	52.20
Groundman, Truck Driver	47.93	49.13
Equipment Mechanic	47.93	49.13
Flagman	35.95	36.85

Additional \$1.00 per hour for entire crew when a helicopter is used.

NOTE: THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION WORKED BETWEEN THE HOURS LISTED BELOW:

1ST SHIFT	8:00 AM to 4:30 PM REGULAR RATE
2ND SHIFT	4:30 PM to 1:00 AM REGULAR RATE PLUS 17.3 %
3RD SHIFT	12:30 AM to 9:00 AM REGULAR RATE PLUS 31.4 %

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

	07/01/2023	05/06/2024
Group A	\$ 29.40	\$ 30.90
	*plus 7% of the hourly wage paid	*plus 7% of the hourly wage paid
Group B	\$ 26.40	\$ 26.90
	*plus 7% of the hourly wage paid	*plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE. *Note* Double time for all emergency work designated by the Dept. of Jurisdiction.

NOTE: WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid	See (5, 6, 8, 13, 25) on HOLIDAY PAGE plus Governor of NYS Election Day.
Overtime	See (5, 6, 8, 13, 25) on HOLIDAY PAGE plus Governor of NYS Election Day.

NOTE: All paid holidays falling on Saturday shall be observed on the preceding Friday. All paid holidays falling on Sunday shall be observed on the following Monday. Supplements for holidays paid at straight time.

REGISTERED APPRENTICES

WAGES per hour: 1000 hour terms at the following percentage of the applicable Journeyman Lineman wage.

1st	2nd	3rd	4th	5th	6th	7th
-----	-----	-----	-----	-----	-----	-----

60% 65% 70% 75% 80% 85% 90%

SUPPLEMENTAL BENEFITS per hour:

07/01/2023	05/06/2024
\$ 26.40	\$ 26.90
*plus 7% of the hourly wage paid	*plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

6-1249a

Lineman Electrician - Teledata

05/01/2024

JOB DESCRIPTION Lineman Electrician - Teledata

DISTRICT 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

Per hour:

For outside work, stopping at first point of attachment (demarcation).

	07/01/2023	01/01/2024	01/01/2025
Cable Splicer	\$ 37.73	\$ 39.24	\$ 40.81
Installer, Repairman	\$ 35.81	\$ 37.24	\$ 38.73
Teledata Lineman	\$ 35.81	\$ 37.24	\$ 38.73
Tech., Equip. Operator	\$ 35.81	\$ 37.24	\$ 38.73
Groundman	\$ 18.98	\$ 19.74	\$ 20.53

NOTE: EXCLUDES Teledata work within ten (10) feet of High Voltage (600 volts and over) transmission lines. For this work please see LINEMAN.

NOTE: THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION WORKED:

1ST SHIFT	REGULAR RATE
2ND SHIFT	REGULAR RATE PLUS 10%
3RD SHIFT	REGULAR RATE PLUS 15%

SUPPLEMENTAL BENEFITS

Per hour:	07/01/2023	01/01/2024	01/01/2025
Journeyman	\$ 5.70	\$ 5.70	\$ 5.70
	*plus 3% of the hourly wage paid	*plus 3% of the hourly wage paid	*plus 3% of the hourly wage paid

*The 3% is based on the hourly wage paid, straight time rate or premium rate.

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

NOTE: WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 16) on HOLIDAY PAGE

6-1249LT - Teledata

Lineman Electrician - Traffic Signal, Lighting

05/01/2024

JOB DESCRIPTION Lineman Electrician - Traffic Signal, Lighting

DISTRICT 6

ENTIRE COUNTIES

Columbia, Dutchess, Orange, Putnam, Rockland, Ulster

WAGES

Lineman/Technician shall perform all overhead aerial work. A Lineman/Technician on the ground will install all electrical panels, connect all grounds, install and connect all electrical conductors which includes, but is not limited to road loop wires; conduit and plastic or other type pipes that carry conductors, flex cables and connectors, and to oversee the encasement or burial of such conduits or pipes.

A Groundman/Truck Driver shall: Build and set concrete forms, handle steel mesh, set footer cages, transport concrete in a wheelbarrow, hand or machine concrete vibrator, finish concrete footers, mix mortar, grout pole bases, cover and maintain footers while curing in cold weather, operate jack hammer, operate hand pavement breaker, tamper, concrete and other motorized saws, as a drill helper, operate and maintain generators, water pumps, chainsaws, sand blasting, operate mulching and seeding machine, air tools, electric tools, gas tools, load and unload materials, hand shovel and/or broom, prepare and pour mastic and other fillers, assist digger operator/equipment operator in ground excavation and restoration, landscape work and painting. Only when assisting a lineman technician, a groundman/truck driver may assist in installing conduit, pipe, cables and equipment.

A flagger's duties shall consist of traffic control only.
(Ref #14.01.02)

Per hour:	07/01/2023	05/06/2024
Group A:		
Lineman, Technician	\$ 50.60	\$ 51.82
Crane, Crawler Backhoe	50.60	51.82
Certified Welder	53.13	54.41
Group B:		
Digging Machine	45.54	46.64
Tractor Trailer Driver	43.01	44.05
Groundman, Truck Driver	40.48	41.46
Equipment Mechanic	40.48	41.46
Flagman	30.36	31.09

Above rates are applicable for installation, testing, operation, maintenance and repair on all Traffic Control (Signal) and Illumination (Lighting) projects, Traffic Monitoring Systems, and Road Weather Information Systems. Includes digging of holes for poles, anchors, footer foundations for electrical equipment; assembly of all electrical materials or raceway; placing of fish wire; pulling of cables, wires or fiber optic cable through such raceways; splicing of conductors; dismantling of such structures, lines or equipment.

NOTE: THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION WORKED BETWEEN THE HOURS LISTED BELOW:

1ST SHIFT	8:00 AM TO 4:30 PM REGULAR RATE
2ND SHIFT	4:30 PM TO 1:00 AM REGULAR RATE PLUS 17.3%
3RD SHIFT	12:30 AM TO 9:00 AM REGULAR RATE PLUS 31.4%

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour worked (but also required on non-worked holidays):

	07/01/2023	05/06/2024
Group A:	\$ 29.40	\$ 30.90
	*plus 7% of the hourly wage paid	*plus 7% of the hourly wage paid
Group B	\$ 26.40	\$ 26.90
	*plus 7% of the hourly wage paid	*plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE. *Note* Double time for all emergency work designated by the Dept. of Jurisdiction.

NOTE: WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (5, 6, 8, 13, 25) on HOLIDAY PAGE and Governor of NYS Election Day.
Overtime: See (5, 6, 8, 13, 25) on HOLIDAY PAGE and Governor of NYS Election Day.

NOTE: All paid holidays falling on Saturday shall be observed on the preceding Friday. All paid holidays falling on Sunday shall be observed on the following Monday. Supplements for holidays paid at straight time.

REGISTERED APPRENTICES

WAGES per hour: 1000 hour terms at the following percentage of the applicable Journeyman Lineman wage.

1st	2nd	3rd	4th	5th	6th	7th
60%	65%	70%	75%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

07/01/2023	05/06/2024
\$ 26.40	\$ 26.90
*plus 7% of the hourly wage paid	*plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

6-1249aReg8LT

Lineman Electrician - Tree Trimmer

05/01/2024

JOB DESCRIPTION Lineman Electrician - Tree Trimmer

DISTRICT 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Wyoming, Yates

WAGES

Applies to line clearance, tree work and right-of-way preparation on all new or existing energized overhead or underground electrical, telephone and CATV lines. This also would include stump removal near underground energized electrical lines, including telephone and CATV lines.

Per hour:	07/01/2023	12/31/2023
Tree Trimmer	\$ 29.80	\$ 31.44
Equipment Operator	26.35	27.80
Equipment Mechanic	26.35	27.80
Truck Driver	21.95	23.15
Groundman	18.07	19.07
Flag person	14.20	14.20*

*NOTE- Rate effective on 01/01/2024 - \$15.00 due to minimum wage increase

SUPPLEMENTAL BENEFITS

Per hour:

	07/01/2023	12/31/2023
Journeyman	\$ 10.48	\$ 10.48
	*plus 4.5% of the hourly wage paid	*plus 4.5% of the hourly wage paid

* The 4.5% is based on the hourly wage paid, straight time rate or premium rate.

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE

NOTE: WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (5, 6, 8, 15) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 15, 16, 25) on HOLIDAY PAGE

NOTE: All paid holidays falling on a Saturday shall be observed on the preceding Friday.
All paid holidays falling on a Sunday shall be observed on the following Monday.

6-1249TT

Mason - Building

05/01/2024

JOB DESCRIPTION Mason - Building

DISTRICT 11

ENTIRE COUNTIES
Dutchess, Sullivan, Ulster

PARTIAL COUNTIES
Orange: Entire county except the Township of Tuxedo.

WAGES
Per hour:

07/01/2023

Bricklayer	\$ 45.00
Cement Mason	45.00
Plasterer/Stone Mason	45.00
Pointer/Caulker	45.00

Additional \$1.00 per hour for power saw work
Additional \$0.50 per hour for swing scaffold or staging work

SHIFT WORK: When shift work or an irregular workday is mandated or required by state, federal, county, local or other governmental agency contracts, the following premiums apply:

Irregular workday requires 15% premium
Second shift an additional 15% of wage plus benefits to be paid
Third shift an additional 25% of wage plus benefits to be paid

SUPPLEMENTAL BENEFITS
Per hour:

Journeyman \$ 37.39

OVERTIME PAY
Cement Mason See (B, E, Q, W) on OVERTIME PAGE.
All Others See (B, E, Q) on OVERTIME PAGE.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE
Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.

REGISTERED APPRENTICES
Wages per hour:

750 hour terms at the following percentage of Journeyman's wage

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Supplemental Benefits per hour

750 hour terms at the following percentage of journeyman supplements

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Apprentices indentured before June 1st, 2011 receive full journeyman benefits

11-5du-b

Mason - Building

05/01/2024

JOB DESCRIPTION Mason - Building

DISTRICT 9

ENTIRE COUNTIES
Dutchess, Orange, Putnam, Sullivan, Ulster

WAGES
Per hour:

07/01/202312/04/202306/03/2024

Building:	Additional		
Tile, Marble,& Terrazzo Mechanic/Setter	\$ 57.29	\$ 57.72	\$ 0.64

SUPPLEMENTAL BENEFITS

Per Hour:			
Journeyworker:	\$ 23.06*	\$ 23.26*	
	+ \$7.68	+\$7.69	

* This portion of benefits subject to same premium rate as shown for overtime wages.

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE
Double time rate applies after 10 hours

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 15, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wage per hour:
(Counties of Orange & Putnam)

750 hour terms at the following wage rate:

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
	1-	751-	1501-	2251-	3001-	3751-	4501-	5251-	6001-	6751-
	750	1500	2250	3000	3750	4500	5250	6000	6750	7500
07/01/2023	\$21.70	\$26.66	\$33.75	\$38.69	\$42.25	\$45.70	\$49.29	\$54.23	\$57.09	\$61.25
12/04/2023	\$21.96	\$26.95	\$34.10	\$39.08	\$42.68	\$46.16	\$49.79	\$54.77	\$57.66	\$61.90

Supplemental Benefits per hour:
(Counties of Orange & Putnam)

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
07/01/2023	\$12.55*	\$12.55*	\$15.36*	\$15.36*	\$16.36*	\$17.86*	\$18.86*	\$18.86*	\$16.86*	\$22.11*
	+\$0.73	+\$0.78	+\$0.88	+\$0.88	+\$1.37	+\$1.42	+\$1.83	+\$1.88	+\$6.03	+\$6.61
12/04/2023	\$12.55*	\$12.55*	\$15.36*	\$15.36*	\$16.36*	\$17.86*	\$18.86*	\$18.86*	\$16.86*	\$22.11*
	+\$0.73	+\$0.78	+\$0.89	+\$0.94	+\$1.38	+\$1.43	+\$1.84	+\$1.89	+\$6.04	+\$6.62

Wages per hour:
(Counties of Dutchess, Sullivan, Ulster)

750 hour terms at the following wage rate:

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
	1-	751-	1501-	2251-	3001-	3751-	4501-	5251-	6001-	6751-
	750	1500	2250	3000	3750	4500	5250	6000	6750	7500
07/01/2023	\$19.83	\$23.92	\$25.89	\$29.98	\$32.74	\$36.32	\$39.61	\$42.71	\$44.31	\$47.73

Supplemental Benefits per hour:
(Counties of Dutchess, Sullivan, Ulster)

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
07/01/2023									
\$12.55*	\$12.55*	\$14.66*	\$14.66*	\$15.60*	\$16.16*	\$16.66*	\$17.66*	\$15.66*	\$20.41*
+\$0.65	+\$0.69	+\$0.74	+\$0.78	+\$1.15	+\$1.19	+\$1.53	+\$1.57	+\$6.09	+\$6.18

* This portion of benefits subject to same premium rate as shown for overtime wages.

9-7/52B

Mason - Building	05/01/2024
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JOB DESCRIPTION Mason - Building **DISTRICT** 9

ENTIRE COUNTIES

Dutchess, Orange, Putnam, Sullivan, Ulster

WAGES

Per hour: 07/01/2023 12/04/2023 06/03/2024

Building Additional

Tile, Marble, &
Terrazzo Finisher \$ 47.06 \$ 47.51 \$ 0.54

SUPPLEMENTAL BENEFITS

Journeyworker:

Per Hour \$ 20.16* \$ 20.26*
+ \$ 7.55 + \$ 7.55

*This portion of benefits subject to same premium rate as shown for overtime wages

OVERTIME PAY

See (A, *E, Q) on OVERTIME PAGE

Double time rate applies after 10 hours on Saturdays.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 15, 16, 25) on HOLIDAY PAGE

9-7/88B-tf

Mason - Building	05/01/2024
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JOB DESCRIPTION Mason - Building **DISTRICT** 11

ENTIRE COUNTIES

Putnam, Rockland, Westchester

PARTIAL COUNTIES

Orange: Only the Township of Tuxedo.

WAGES

Per hour: 07/01/2023

Bricklayer \$ 45.89
Cement Mason 45.89
Plasterer/Stone Mason 45.89
Pointer/Caulker 45.89

Additional \$1.00 per hour for power saw work

Additional \$0.50 per hour for swing scaffold or staging work

SHIFT WORK: When shift work or an irregular workday is mandated or required by state, federal, county, local or other governmental agency contracts, the following premiums apply:

Irregular workday requires 15% premium

Second shift an additional 15% of wage plus benefits to be paid

Third shift an additional 25% of wage plus benefits to be paid

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 37.95

OVERTIME PAY

OVERTIME:

Cement Mason See (B, E, Q, W) on OVERTIME PAGE.

All Others See (B, E, Q) on OVERTIME PAGE.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.

REGISTERED APPRENTICES

Wages per hour:

750 hour terms at the following percentage of Journeyman's wage

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Supplemental Benefits per hour

750 hour terms at the following percentage of journeyman supplements

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Apprentices indentured before June 1st, 2011 receive full journeyman benefits

11-5wp-b

Mason - Building

05/01/2024

JOB DESCRIPTION Mason - Building

DISTRICT 9

ENTIRE COUNTIES

Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

WAGES

Per Hour:

07/01/2023 7/03/2023

Marble Cutters & Setters \$ 62.82 \$ 63.12

SUPPLEMENTAL BENEFITS

Per Hour:

Journeyworker \$ 39.03 \$ 39.34

OVERTIME PAY

See (B, E, Q, V) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wage Per Hour:

07/01/2023

750 hour terms at the following wage

1st	2nd	3rd	4th	5th	6th	7th	8th
0- 3000	3001- 3750	3751- 4500	4501- 5250	5251- 6000	6001- 6750	6751- 7500	7500+
\$ 26.42	\$ 39.62	\$ 42.91	\$ 46.22	\$ 49.52	\$ 53.38	\$ 59.67	\$ 62.82

Supplemental Benefits per hour:

07/01/2023

1st	2nd	3rd	4th	5th	6th	7th	8th
\$ 25.38	\$ 28.86	\$ 29.74	\$ 30.60	\$ 31.48	\$ 36.44	\$ 38.17	\$ 39.03

07/03/2023

Wage Per Hour:

750 hour terms at the following wage.

1st	2nd	3rd	4th	5th	6th	7th	8th
0-3000	3001-3750	3751-4500	4501-5250	5251-6000	6001-6750	6751-7500	7500+
\$ 26.60	\$ 39.82	\$ 43.13	\$ 46.45	\$ 49.78	\$ 53.64	\$ 59.95	\$ 63.12

Supplemental Benefits Per Hour:

1st	2nd	3rd	4th	5th	6th	7th	8th
\$ 25.54	\$ 29.09	\$ 29.97	\$ 30.84	\$ 31.72	\$ 36.73	\$ 38.48	\$ 39.34

9-7/4

Mason - Heavy&Highway

05/01/2024

JOB DESCRIPTION Mason - Heavy&Highway

DISTRICT 11

ENTIRE COUNTIES

Dutchess, Sullivan, Ulster

PARTIAL COUNTIES

Orange: Entire county except the Township of Tuxedo.

WAGES

Per hour:

07/01/2023

Bricklayer	\$ 45.50
Cement Mason	45.50
Marble/Stone Mason	45.50
Plasterer	45.50
Pointer/Caulker	45.50

Additional \$1.00 per hour for power saw work

Additional \$0.50 per hour for swing scaffold or staging work

SHIFT WORK: When shift work or an irregular workday is mandated or required by state, federal, county, local or other governmental contracts, the following rates apply:

Irregular workday requires 15% premium

Second shift an additional 15% of wage plus benefits to be paid

Third shift an additional 25% of wage plus benefits to be paid

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 37.39

OVERTIME PAY

Cement Mason See (B, E, Q, W)

All Others See (B, E, Q)

HOLIDAY

Paid: See (5, 6, 16, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

- Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.

- Supplemental Benefits are not paid for paid Holiday

- If Holiday is worked, Supplemental Benefits are paid for hours worked.

- Whenever an Employee works within three (3) calendar days before a holiday, the Employee shall be paid for the Holiday.

REGISTERED APPRENTICES

Wages per hour:

750 hour terms at the following percentage of Journeyman's wage

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Supplemental Benefits per hour

750 hour terms at the following percentage of journeyman supplements

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Apprentices indentured before June 1st, 2011 receive full journeyman benefits

11-5du-H/H

Mason - Heavy&Highway

05/01/2024

JOB DESCRIPTION Mason - Heavy&Highway

DISTRICT 11

ENTIRE COUNTIES

Putnam, Rockland, Westchester

PARTIAL COUNTIES

Orange: Only the Township of Tuxedo.

WAGES

Per hour:

07/01/2023

Bricklayer	\$ 46.39
Cement Mason	46.39
Marble/Stone Mason	46.39
Plasterer	46.39
Pointer/Caulker	46.39

Additional \$1.00 per hour for power saw work

Additional \$0.50 per hour for swing scaffold or staging work

SHIFT WORK: When shift work or an irregular workday is mandated or required by state, federal, county, local or other governmental contracts, the following rates apply:

Irregular workday requires 15% premium

Second shift an additional 15% of wage plus benefits to be paid

Third shift an additional 25% of wage plus benefits to be paid

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman	\$ 37.95
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OVERTIME PAY

Cement Mason See (B, E, Q, W)

All Others See (B, E, Q,)

HOLIDAY

Paid: See (5, 6, 16, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

- Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.

- Supplemental Benefits are not paid for paid Holiday

- If Holiday is worked, Supplemental Benefits are paid for hours worked.

- Whenever an Employee works within three (3) calendar days before a holiday, the Employee shall be paid for the Holiday.

REGISTERED APPRENTICES

Wages per hour:

750 hour terms at the following percentage of Journeyman's wage

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Supplemental Benefits per hour

750 hour terms at the following percentage of journeyman supplements

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Apprentices indentured before June 1st, 2011 receive full journeyman benefits

11-5WP-H/H

Operating Engineer - Building / Heavy&Highway

05/01/2024

JOB DESCRIPTION Operating Engineer - Building / Heavy&Highway

DISTRICT 11

ENTIRE COUNTIES

Delaware, Orange, Rockland, Sullivan, Ulster

WAGES

CLASS A5: Cranes, Derricks and Pile Drivers 100 tons or more and Tower Cranes, with 140ft boom and over.

CLASS A4: Cranes, Derricks and Pile Drivers 100 tons or more and Tower Cranes, with 100ft to 139ft boom.

CLASS A3: Cranes, Derricks and Pile Drivers 100 tons or more and Tower Cranes with a boom under 100ft.

CLASS A2: Cranes, Derricks and Pile Drivers less than 100 tons with 140ft boom and over.

CLASS A1: Cranes, Derricks and Pile Drivers less than 100 tons with a 100ft to 139ft boom.

CLASS A: Cranes, Derricks and Pile Drivers less than 100 tons with a boom under 100ft.; Autograde Combination Subgrader, Base Material Spreader and Base Trimmer (CMI and Similar Types); Autograde Pavement profiler (CMI and Similar Types); Autograde Pavement Profiler and Recycle type (CMI and Similar Type); Autograde Placer-Trimmer-Spreader Comb. (CMI & Similar types); Autograde Slipform Paver (CMI & Similar Types); Central Power Plants (all types); Chief of Party; Concrete Paving Machines; Drill (Bauer, AML and Similar Types); Drillmaster, Quarrymaster (Down the Hole Drill), Rotary Drill, Self-Propelled Hydraulic Drill, Self-Powered Drill; Draglines; Elevator Graders; Excavator; Front End Loaders (5 yds. and over); Gradalls; Grader-Rago; Helicopters (Co-Pilot); Helicopters (Communications Engineer);Juntann Pile Driver; Locomotive (Large); Mucking Machines; Pavement & Concrete Breaker, i.e., Superhammer & Hoe Ram; Roadway Surface Grinder; Prentice Truck; Scooper (Loader and Shovel); Shovels; Tree Chopper with Boom; Trench Machines (Cable Plow); Tunnel Boring Machine; Vacuum Truck

CLASS B: "A" Frame; Backhoe (Combination); Boom Attachment on Loaders (Rate based on size of Bucket) not applicable to Pipehook; Boring and Drilling Machines; Brush Chopper, Shredder and Tree Shredder, Tree Shearer; Bulldozer(Fine Grade); Cableways; Carryalls; Concrete Pump; Concrete Pumping System, Pump Concrete and Similar Types; Conveyors (125 ft. and over); Drill Doctor (duties incl. Dust Collector Maintenance); Front End Loaders (2 yds. but less than 5 yds.); Graders (Finish); Groove Cutting Machine (Ride on Type); Heater Planer; Hoists (all type Hoists, 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 Machines, portable or stationary, except Chicago Boom Type); Long Boom Rate to be applied if Hoist is "Outside Material Tower Hoist"***; Hydraulic Cranes-10 tons and under; Hydraulic Dredge; Hydro-Axe; Hydro Blaster; Jacks-Screw Air Hydraulic Power Operated Unit or Console Type (not hand Jack or Pile Load Test Type); Log Skidder; Pans; Pavers (all) concrete; Plate and Frame Filter Press; Pumpcrete Machines, Squeezcrete & Concrete Pumping (regardless of size); Scrapers; Side Booms; "Straddle"Carrier-Ross and similar types; Winch Trucks (Hoisting); Whip Hammer

CLASS C: Asphalt Curbing Machine; Asphalt Plant Engineer; Asphalt Spreader; Autograde Tube Finisher and Texturing Machine (CMI & Similar types); Autograde Curecrete Machine (CMI & Similar Types); Autograde Curb Trimmer & Sidewalk, Shoulder, Slipform (CMI & Similar Types); Bar Bending Machines (Power); Barrier Moving Machine-Zipper; Batchers, Batching Plant and Crusher on Site; Belt Conveyor Systems; Boom Type Skimmer Machines; Bridge Deck Finisher; Bulldozer(except fine grade); Car Dumpers (Railroad); Compressor and Blower Type Units (used independently or mounted on dual purpose Trucks, on Job Site or in conjunction with jobsite, in Loading and Unloading of Concrete, Cement, Fly Ash, Instantcrete, or Similar Type Materials); Compressors (2 or 3 in Battery); Concrete Finishing Machines; Concrete cleaning decontamination machine operator; Concrete Saws and Cutters (Ride-on type); Concrete Spreaders (Hetzel, Rexomatic and Similar Types); Concrete Vibrators; Conveyors (under 125 feet); Crushing Machines; Directional Boring Machines; Ditching Machine-small (Ditch-witch, Vermeer, or Similar type); Dope Pots (Mechanical with or without pump); Dumpsters; Elevator; Fireman; Fork Lifts (Econobile, Lull and Similar Types of Equipment); Front End Loaders (1 yd. and over but under 2 yds.); Generators (2 or 3 in Battery); Giraffe Grinders; Grout Pump; Gunnite Machines (excluding nozzle); Hammer Vibrator (in conjunction with Generator); Heavy Equipment Robotics Operator Technician; Hoists-Roof, Tugger, Aerial Platform Hoist & House Cars; Hoppers; Hopper Doors (power operated); Hydro Blaster; Hydraulic Jacking Trailer; Ladders (motorized); Laddervator; Locomotive-dinky type; Maintenance -Utility Man; Master Environmental Maintenance Technician; Mechanics; Mixers (Excepting Paving Mixers); Motor Patrols; Pavement Breakers (small self - propelled ride on type-also maintains compressor hydraulic unit); Pavement Breaker-truck mounted; Pipe Bending Machine (Power); Pitch Pump; Plaster Pump (regardless of size); Post Hole Digger (Post Pounder & Auger); Pot Hole Killer Trucks or equivalent; Rod Bending Machines (Power); Roller-Black Top; Scales (Power); Seaman pulverizing mixer; Shoulder widener; Silos; Skidsteer (all attachments); Skimmer Machines (boom-type); Steel Cutting Machine (service & maintain); Tam Rock Drill; Tractors; Transfer Machine; Captain (Power Boats); Tug Master (powerboats); Ultra High Pressure Waterjet Cutting Tool System operator/maintenance technician; Vacuum Blasting Machine; Vibrating Plants (used in conjunction with unloading); Welder and Repair Mechanics

CLASS D: Brooms and Sweepers; Chippers; Compressor (single); Concrete Spreaders (small type); Conveyor Loaders (not including Elevator Graders); Engines-large diesel (1620 HP) and Staging Pump; Farm Tractors; Fertilizing Equipment (Operation & Maintenance of); Fine Grade Machine (small type); Form Line Graders (small type); Front End Loader (under 1 yard); Generator (single); Grease, Gas, Fuel and Oil supply trucks; Heaters (Nelson or other type incl. Propane, Natural Gas or Flowtype Units); Lights, Portable Generating Light Plants; Mixers (Concrete, small); Mulching Equipment (Operation and Maintenance of); Pumps (2 or less than 4 inch suction); Pumps (4 inch suction and over incl. submersible pumps); Pumps (Diesel Engine and Hydraulic-immaterial of power); Road Finishing Machines (small type); Rollers-grade, fill or stone base; Seeding Equip. (Operation and Maintenance of); Sprinkler & Water Pump Trucks (used on jobsite or in conjunction with jobsite); Steam Jennies and Boilers-irrespective of use; Stone Spreader; Tamping Machines, Vibrating Ride-on; Temporary Heating Plant (Nelson or other type, incl. Propane, Natural Gas or Flow Type Units); Water & Sprinkler Trucks (used on or in conjunction with jobsite); Welding Machines (Gas, Diesel, and/or Electric Converters of any type, single, two, or three in a battery); Wellpoint Systems (including installation by Bull Gang and Maintenance of)

CLASS E: Assistant Engineer/Oiler; Drillers Helper; Maintenance Apprentice (Deck Hand); Maintenance Apprentice (Oiler); Mechanics' Helper; Tire Repair and Maintenance; Transit/Instrument Man

WAGES:(per hour)

	07/01/2023	07/01/2024 Additional	07/01/2025 Additional
Class A5	\$ 65.72 plus 4.00*	\$ 2.75***	\$ 2.50***
Class A4	64.72 plus 4.00*	2.75***	2.50***
Class A3	63.72 plus 4.00*	2.75***	2.50***
Class A2	61.22 plus 4.00*	2.75***	2.50***
Class A1	60.22 plus 4.00*	2.75***	2.50***
Class A	59.22 plus 4.00*	2.75***	2.50***
Class B	57.63 plus 4.00*	2.75***	2.50***
Class C	55.72 plus 4.00*	2.75***	2.50***
Class D	54.09 plus 4.00*	2.75***	2.50***
Class E	50.38 plus 4.00*	2.75***	2.50***
Safety Engineer	59.96 plus 4.00*	2.75***	2.50***
Helicopter:			
Pilot/Engineer	61.04 plus 4.00*	2.75***	2.50***
Co Pilot	59.22 plus 4.00*	2.75***	2.50***
Communications Engineer	59.22 plus 4.00*	2.75***	2.50***

Surveying:

Chief of Party	59.22 plus 4.00*	2.75***	2.50***
Transit/Instrument Man	50.38 plus 4.00*	2.75***	2.50***
Rod/Chainman	49.80 plus 4.00*	2.75***	2.50***

Additional \$0.75 for Survey work Tunnel under compressed air.

Additional \$0.50 for Hydrographic work.

*The \$4.00 is added to the Class Base Wage for all hours worked. Additionally, the \$4.00 is subject to the V-Code listed on the OVERTIME CODE Sheet.

**Outside Material Hoist (Class B) receives additional \$ 1.00 per hour on 110 feet up to 199 feet total height, \$ 2.00 per hour on 200 feet and over total height.

***To be allocated at a later date

- SHIFT WORK: On all Government mandated irregular or off shift work, an additional 15% on straight time hours.

- On HAZARDOUS WASTE REMOVAL or ASBESTOS REMOVAL work, or any state or federally DESIGNATED HAZARDOUS WASTE SITE:

For projects bid on or before April 1, 2020...Where the Operating Engineer is in direct contact with hazardous material and when personal protective equipment is required for respiratory, skin and eye protection, the Operating Engineer shall receive the hourly wage plus an additional twenty percent (20%) of that wage for the entire shift.

For projects bid after April 1, 2020...On hazardous waste removal work of any kind, including state or federally designated site where the operating engineer is required to wear level A, B, or C personal protection the operating engineer shall receive an hourly wage rate of his regular hourly wage plus \$5.00 per hour. An operating engineer working at a hazardous waste removal project or site at a task requiring hazardous waste related certification, but who is not working in a zone requiring level A, B, or C personal protection, shall receive an hourly wage rate of his regular rate plus \$ 1.00 per hour. This shall also apply to sites where the level D personal protection is required.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 33.50

SHIFT WORK: On all Government mandated irregular or off shift work, an additional 15% on straight time hours.

OVERTIME PAY

See (B, E, Q, *V, X) on OVERTIME PAGE

*15% premium is also required on shift work benefits

HOLIDAY

Paid: See (5, 6, 10, 13, 15) on HOLIDAY PAGE

Overtime: See (5, 6, 10, 13, 15) on HOLIDAY PAGE

Holidays falling on Sunday will be celebrated on Monday.

REGISTERED APPRENTICES

(1) year terms at the following percentage of journeyman's wage:

1st year 60% of Class base wage plus \$4.00*

2nd year	70% of Class base wage plus \$4.00*
3rd year	80% of Class base wage plus \$4.00*
4th year	90% of Class base wage plus \$4.00*

*The \$4.00 is added to the Class Base Wage for all hours worked. Additionally, the \$4.00 is subject to the V-Code listed on the OVERTIME CODE Sheet.

Supplemental Benefits per hour:

Apprentices	\$ 33.50
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11-825

Operating Engineer - Marine Dredging

05/01/2024

JOB DESCRIPTION Operating Engineer - Marine Dredging

DISTRICT 4

ENTIRE COUNTIES

Albany, Bronx, Cayuga, Clinton, Columbia, Dutchess, Essex, Franklin, Greene, Jefferson, Kings, Monroe, Nassau, New York, Orange, Oswego, Putnam, Queens, Rensselaer, Richmond, Rockland, St. Lawrence, Suffolk, Ulster, Washington, Wayne, Westchester

WAGES

These wages do not apply to Operating Engineers on land based construction projects. For those projects, please see the Operating Engineer Heavy/Highway Rates. The wage rates below for all equipment and operators are only for marine dredging work in navigable waters found in the counties listed above.

Per Hour:	07/01/2023	10/01/2023
CLASS A1 Deck Captain, Leverman Mechanical Dredge Operator Licensed Tug Operator 1000HP or more.	\$ 43.94	\$ 45.26
CLASS A2 Crane Operator (360 swing)	39.16	40.33
CLASS B Dozer, Front Loader Operator on Land	To conform to Operating Engineer Prevailing Wage in locality where work is being performed including benefits.	
CLASS B1 Derrick Operator (180 swing) Spider/Spill Barge Operator Operator II, Fill Placer, Engineer, Chief Mate, Electrician, Chief Welder, Maintenance Engineer Licensed Boat, Crew Boat Operator	38.00	39.14
CLASS B2 Certified Welder	35.77	36.84
CLASS C1 Drag Barge Operator, Steward, Mate, Assistant Fill Placer	34.79	35.83
CLASS C2 Boat Operator	33.67	34.68
CLASS D Shoreman, Deckhand, Oiler, Rodman, Scowman, Cook, Messman, Porter/Janitor	27.97	28.81

SUPPLEMENTAL BENEFITS

Per Hour:

THE FOLLOWING SUPPLEMENTAL BENEFITS APPLY TO ALL CATEGORIES

All Classes A & B	\$ 11.85 plus 6% of straight time	\$ 12.00 plus 6% of straight time
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	wage, Overtime hours add \$ 0.63	wage, Overtime hours add \$ 0.63
All Class C	\$ 11.60 plus 6% of straight time wage, Overtime hours add \$ 0.50	\$ 11.75 plus 6% of straight time wage, Overtime hours add \$ 0.50
All Class D	\$ 11.35 plus 6% of straight time wage, Overtime hours add \$ 0.38	\$ 11.60 plus 6% of straight time wage, Overtime hours add \$ 0.50

OVERTIME PAY

See (B2, F, R) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 15, 26) on HOLIDAY PAGE

4-25a-MarDredge

Operating Engineer - Steel Erectors

05/01/2024

JOB DESCRIPTION Operating Engineer - Steel Erectors

DISTRICT 11

ENTIRE COUNTIES

Delaware, Orange, Rockland, Sullivan, Ulster

WAGES

CLASS A3: Cranes, Derricks and Pile Drivers 100 tons or more and Tower Cranes, with a 140 ft. boom and over.

CLASS A2: Cranes, Derricks and Pile Drivers 100 tons or more and Tower Cranes, with up to a 139 ft. boom and under.

CLASS A1: Cranes, Derricks and Pile Drivers less than 100 tons with a 140 ft. boom and over.

CLASS A: Cranes, Derricks and Pile Drivers less than 100 tons with up to a 139 ft. boom and under.

CLASS B: "A" Frame; Cherry Pickers(10 tons and under); Hoists (all type Hoists, 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 Machines, portable or stationary, except Chicago Boom Type); Jacks-Screw Air Hydraulic Power Operated Unit or Console Type (not hand Jack or Pile Load Test Type); Side Booms; Straddle Carrier

CLASS C: Aerial Platform used as Hoist; Compressors (2 or 3 in Battery); Concrete cleaning/ decontamination machine operator; Directional Boring Machines; Elevator or House Cars; Conveyers and Tugger Hoists; Fireman; Fork Lifts; Generators (2 or 3 in Battery); Heavy Equipment Robotics Operator/Technician; Master Environmental Maintenance Technician; Maintenance -Utility Man; Rod Bending Machines (Power); Captain(powerboat); Tug Master; Ultra High Pressure Waterjet Cutting Tool System; Vacuum Blasting Machine; Welding Machines(gas or electric,2 or 3 in battery, including diesels); Transfer Machine; Apprentice Engineer/Oiler with either one compressor or one welding machine when used for decontamination and remediation

CLASS D: Compressor (single); Welding Machines (Gas, Diesel, and/or Electric Converters of any type); Welding System Multiple (Rectifier Transformer type)

CLASS E: Assistant Engineer/Oiler; Maintenance Apprentice (Deck Hand);Drillers Helper; Maintenance Apprentice (Oiler); Mechanics' Helper; Transit/Instrument Man

WAGES:(per hour)

	07/01/2023	07/01/2024 Additional	07/01/2025 Additional
Class A3	\$ 67.74 plus 4.00*	\$ 2.75**	\$ 2.50**
Class A2	66.08 plus 4.00*	2.75**	2.50**
Class A1	63.24 plus 4.00*	2.75**	2.50**
Class A	61.58 plus 4.00*	2.75**	2.50**
Class B	58.79 plus 4.00*	2.75**	2.50**
Class C	56.13 plus 4.00*	2.75**	2.50**
Class D	54.60 plus 4.00*	2.75**	2.50**
Class E	50.84 plus 4.00*	2.75**	2.50**

Vacuum Truck	59.55 plus 4.00*	2.75**	2.50**
Safety Engineer	60.41 plus 4.00*	2.75**	2.50**
Helicopter:			
Pilot/Engineer	63.24 plus 4.00*	2.75**	2.50**
Co Pilot	62.85 plus 4.00*	2.75**	2.50**
Communications Engineer	62.85 plus 4.00*	2.75**	2.50**
Surveying:			
Chief of Party	59.55 plus 4.00*	2.75**	2.50**
Transit/Instrument man	50.84 plus 4.00*	2.75**	2.50**
Rod/Chainman	49.80 plus 4.00*	2.75**	2.50**
Additional \$0.75 for Survey work Tunnels under compressed air.			
Additional \$0.50 for Hydrographic work.			

*The \$4.00 is added to the Class Base Wage for all hours worked. Additionally, the \$4.00 is subject to the V-Code listed on the OVERTIME CODE Sheet.

**To be allocated at a later date

- SHIFT WORK: On all Government mandated irregular or off shift work, an additional 15% on straight time hours.
- On HAZARDOUS WASTE REMOVAL or ASBESTOS REMOVAL work, or any state or federally DESIGNATED HAZARDOUS WASTE SITE:

For projects bid on or before April 1, 2020...Where the Operating Engineer is in direct contact with hazardous material and when personal protective equipment is required for respiratory, skin and eye protection, the Operating Engineer shall receive the hourly wage plus an additional twenty percent (20%) of that wage for the entire shift.

For projects bid after April 1, 2020...On hazardous waste removal work of any kind, including state or federally designated site where the operating engineer is required to wear level A, B, or C personal protection the operating engineer shall receive an hourly wage rate of his regular hourly wage plus \$5.00 per hour. An operating engineer working at a hazardous waste removal project or site at a task requiring hazardous waste related certification, but who is not working in a zone requiring level A, B, or C personal protection, shall receive an hourly wage rate of his regular rate plus \$ 1.00 per hour. This shall also apply to sites where the level D personal protection is required.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 33.50

OVERTIME PAY

See (B, E, Q, *V, X) on OVERTIME PAGE

*15% premium is also required on shift work benefits

HOLIDAY

Paid: See (5, 6, 10, 13, 15) on HOLIDAY PAGE

Overtime: See (5, 6, 10, 13, 15) on HOLIDAY PAGE

Holidays falling on Sunday will be celebrated on Monday.

REGISTERED APPRENTICES

(1) year terms at the following percentage of journeyman's wage.

1st year	60% of Class base wage plus \$4.00*
2nd year	70% of Class base wage plus \$4.00*
3rd year	80% of Class base wage plus \$4.00*
4th year	90% of Class base wage plus \$4.00*

*The \$4.00 is added to the Class Base Wage for all hours worked. Additionally, the \$4.00 is subject to the V-Code listed on the OVERTIME CODE Sheet.

Supplemental Benefits per hour:

Apprentices \$ 33.50

11-825SE

Painter

05/01/2024

JOB DESCRIPTION Painter

DISTRICT 1

ENTIRE COUNTIES

Columbia, Dutchess, Greene, Orange, Sullivan, Ulster

WAGES

Per hour	07/01/2023	07/01/2024 Additional
Brush/Paper Hanger	\$ 37.97	+ \$1.93*
Dry Wall Finisher	37.97	+ \$1.93*
Lead Abatement	37.97	+ \$1.93*
Sandblaster-Painter	37.97	+ \$1.93*
Spray Rate	38.97	+ \$1.93*

(*) To be allocated at later date.

See Bridge Painting rates for the following work:

Structural Steel, all work performed on tanks, ALL BRIDGES, towers, smoke stacks, flag poles. Rate shall apply to all of said areas from the ground up.

SUPPLEMENTAL BENEFITS

Per hour

Journey person \$ 26.28

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour

Six (6) month terms at the following percentage of Journey person's wage

1st	2nd	3rd	4th	5th	6th
50%	55%	65%	75%	85%	95%

Supplemental Benefits per hour worked

1st term	\$ 11.14
All others	26.28

1-155

Painter - Bridge & Structural Steel

05/01/2024

JOB DESCRIPTION Painter - Bridge & Structural Steel

DISTRICT 8

ENTIRE COUNTIES

Albany, Bronx, Clinton, Columbia, Dutchess, Essex, Franklin, Fulton, Greene, Hamilton, Kings, Montgomery, Nassau, New York, Orange, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Suffolk, Sullivan, Ulster, Warren, Washington, Westchester

WAGES

Per Hour:

STEEL:

Bridge Painting:	07/01/2023	10/01/2023
	\$ 54.50	\$ 56.00
	+ 10.10*	+ 10.35*

ADDITIONAL \$6.50 per hour for POWER TOOL/SPRAY, whether straight time or overtime.

NOTE: All premium wages are to be calculated on base rate per hour only.

* For the period of May 1st to November 15th, this amount is payable up to 40 hours. For the period of Nov 16th to April 30th, this amount is payable up to 50 hours. EXCEPTION: First and last week of employment, and for the weeks of Memorial Day, Independence Day and Labor Day, where the amount is paid for the actual number of hours worked (no cap).

NOTE: Generally, for Bridge Painting Contracts, ALL WORKERS on and off the bridge (including Flagmen) are to be paid Painter's Rate; the contract must be ONLY for Bridge Painting.

SHIFT WORK:

When directly specified in public agency or authority contract documents for an employer to work a second shift and works the second shift with employees other than from the first shift, all employees who work the second shift will be paid 10% of the base wage shift differential in lieu of overtime for the first eight (8) hours worked after which the employees shall be paid at time and one half of the regular wage rate. When a single irregular work shift is mandated in the job specifications or by the contracting agency, wages shall be paid at time and one half for single shifts between the hours of 3pm-11pm or 11pm-7am.

SUPPLEMENTAL BENEFITS

Per Hour:

Journeyworker:

\$ 11.78	\$ 12.43
+ 30.85*	+ 31.55*

* For the period of May 1st to November 15th, this amount is payable up to 40 hours. For the period of Nov 16th to April 30th, this amount is payable up to 50 hours. EXCEPTION: First and last week of employment, and for the weeks of Memorial Day, Independence Day and Labor Day, where the amount is paid for the actual number of hours worked (no cap).

OVERTIME PAY

See (B, F, R) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (4, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wage - Per hour:

Apprentices: (1) year terms.

1st year	\$ 21.80 + 4.04	\$ 22.40 + 4.14
2nd year	\$ 32.70 + 6.06	\$ 33.60 + 6.21
3rd year	\$ 43.60 + 8.08	\$ 44.80 + 8.28
Supplemental Benefits - Per hour:		
1st year	\$.90 + 12.34	\$ 1.16 + 12.62
2nd year	\$ 7.07 + 18.51	\$ 7.46 + 18.93
3rd year	\$ 9.42 + 24.68	\$ 9.94 + 25.24

NOTE: All premium wages are to be calculated on base rate per hour only.

8-DC-9/806/155-BrSS

Painter - Line Striping

05/01/2024

JOB DESCRIPTION Painter - Line Striping

DISTRICT 8

ENTIRE COUNTIES

Albany, Clinton, Columbia, Dutchess, Essex, Franklin, Fulton, Greene, Hamilton, Montgomery, Nassau, Orange, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Suffolk, Sullivan, Ulster, Warren, Washington, Westchester

WAGES

Per hour:

Painter (Striping-Highway):	07/01/2023	01/01/2024	07/01/2024
Striping-Machine Operator*	\$ 31.53	\$ 31.53	\$ 34.12
Linerman Thermoplastic	38.34	38.34	41.12

Note: * Includes but is not limited to: Positioning of cones and directing of traffic using hand held devices. Excludes the Driver/Operator of equipment used in the maintenance and protection of traffic safety.

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30,2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour paid:

Journeyworker:

Striping Machine Operator:	\$ 10.03	\$ 22.24	\$ 23.65
Linerman Thermoplastic:	10.03	22.24	23.65

OVERTIME PAY

See (B, B2, E2, F, S) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 20) on HOLIDAY PAGE

Overtime: See (5, 20) on HOLIDAY PAGE

REGISTERED APPRENTICES

One (1) year terms at the following wage rates:

1st Term:	\$ 15.00	\$ 15.00	\$ 15.00
2nd Term:	18.92	18.92	20.47
3rd Term:	25.22	25.22	27.30

Supplemental Benefits per hour:

1st term:	\$ 9.16	\$ 22.24	\$ 23.65
2nd Term:	10.03	22.24	23.65
3rd Term:	10.03	22.24	23.65

8-1456-LS

Painter - Metal Polisher

05/01/2024

JOB DESCRIPTION Painter - Metal Polisher

DISTRICT 8

ENTIRE COUNTIES

Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

07/01/2023

Metal Polisher	\$ 38.18
Metal Polisher*	39.28
Metal Polisher**	42.18

*Note: Applies on New Construction & complete renovation

** Note: Applies when working on scaffolds over 34 feet.

SUPPLEMENTAL BENEFITS

Per Hour: 07/01/2023

Journeyworker:

All classification \$ 12.34

OVERTIME PAY

See (B, E, P, T) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE

Overtime: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour:

One (1) year term at the following wage rates:

07/01/2023

1st year	\$ 16.00
2nd year	17.00

3rd year	18.00
1st year*	\$ 16.39
2nd year*	17.44
3rd year*	18.54
1st year**	\$ 18.50
2nd year**	19.50
3rd year**	20.50

*Note: Applies on New Construction & complete renovation

** Note: Applies when working on scaffolds over 34 feet.

Supplemental benefits:

Per hour:

1st year	\$ 8.69
2nd year	8.69
3rd year	8.69

8-8A/28A-MP

Plumber

05/01/2024

JOB DESCRIPTION Plumber

DISTRICT 11

ENTIRE COUNTIES

Orange, Rockland, Sullivan

PARTIAL COUNTIES

Ulster: Only the Townships of Plattekill, Marlboro, Wawarsing, and Shawangunk (except for Wallkill and Shawangunk Prisons).

WAGES

REFRIGERATION: For commercial and industrial refrigeration which means service, maintenance, and installation work where the combined compressor tonnage does not exceed 40 tons.

AIR CONDITIONING: Air conditioning to be installed that is water cooled shall not exceed 25 tons. This will include the piping of the component system and erection of water tower. Air conditioning that is air cooled shall not exceed 50 tons.

WAGES: (per hour)

	07/01/2023	05/01/2024	05/01/2025
		Additional	Additional
Plumber	\$ 38.59	\$ 2.25*	\$ 2.50*

*To be allocated at a later date

Star Certification: an additional \$ 1.00 per hour over scale will be paid to all those who have Star Certification.

Shift Differential: When mandated by the governmental agency, an additional 15% premium will be paid for irregular work day or for 2nd and 3rd shift.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman

\$ 36.07*

*For overtime or shift differential work, \$0.10 is paid at straight time, the remaining balance is paid at the same premium as the wages.

OVERTIME PAY

See (B, G, P, *V) on OVERTIME PAGE

* A portion of the benefit amount is subject to the V code for overtime and shift differential work.

HOLIDAY

Paid: See (5, 6, 13, 15, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 13, 15, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

(1)year terms at the following wage.

	07/01/2023
1st term	\$ 17.37
2nd term	21.23
3rd term	25.09
4th term	28.95
5th term	32.81

Supplemental Benefits per hour:
Apprentices

1st term	\$ 16.31*
2nd term	19.90*
3rd term	23.50*
4th term	27.10*
5th term	30.69*

*For overtime or shift differential work, \$0.10 is paid at straight time, the remaining balance is paid at the same premium as the wages.
11-373 Refrig

Plumber	05/01/2024
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JOB DESCRIPTION Plumber

DISTRICT 11

ENTIRE COUNTIES

Orange, Rockland, Sullivan

PARTIAL COUNTIES

Ulster: Only the Townships of Plattekill, Marlboro, Wawarsing, and Shawangunk (except for Wallkill and Shawangunk Prisons).

WAGES

WAGES:(per hour)	07/01/2023	05/01/2024
		Additional
Plumber/Steamfitter	\$ 49.95	\$ 2.25*

*to be allocated at a later date

Note: For all work 40-60 feet above ground add \$ 0.25 per hour, over 60 feet add \$ 0.50 per hour.

Shift Differential: When mandated by the governmental agency, an additional 15% premium will be paid for irregular work day or for 2nd and 3rd shift.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman	\$ 44.57
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*For overtime or shift differential work, \$0.10 is paid at straight time, the remaining balance is paid at the same premium as the wages.

OVERTIME PAY

See (B, E, Q, *V) on OVERTIME PAGE

* A portion of the benefit amount is subject to the V code for overtime and shift differential work.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 15, 16) on HOLIDAY PAGE

When a holiday falls on a Saturday, the day prior shall be considered and recognized as the holiday. When a holiday falls on a Sunday, the day proceeding shall be considered and recognized as the holiday to be observed.

REGISTERED APPRENTICES

(1) year terms at the following wages.

	07/01/2023
1st term	\$ 17.49
2nd term	22.48
3rd term	27.48
4th term	32.47
5th term	39.96

Supplemental Benefits per hour:

1st term	\$ 15.69*
2nd term	20.14*
3rd term	24.57*
4th term	29.03*
5th term	35.67*

*For overtime or shift differential work, \$0.10 is paid at straight time, the remaining balance is paid at the same premium as the wages.
11-373 SF

Roofer	05/01/2024
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JOB DESCRIPTION Roofer

DISTRICT 9

ENTIRE COUNTIES

Bronx, Dutchess, Kings, New York, Orange, Putnam, Queens, Richmond, Rockland, Sullivan, Ulster, Westchester

WAGES

Per Hour:	07/01/2023	05/01/2024
		Additional
Roofer/Waterproofer	\$ 46.50	\$2.50
	+ \$7.00*	

* This portion is not subjected to overtime premiums.

Note: Abatement/Removal of Asbestos containing roofs and roofing material is classified as Roofer.

SUPPLEMENTAL BENEFITS

Per Hour:	\$ 31.37
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OVERTIME PAY

See (B, H) on OVERTIME PAGE

Note: An observed holiday that falls on a Sunday will be observed the following Monday.

HOLIDAY

Paid:	See (1) on HOLIDAY PAGE
Overtime:	See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

(1) year term apprentices indentured prior to 01/01/2023

	1st	2nd	3rd	4th
	\$ 16.28	\$ 23.25	\$ 27.90	\$ 34.88
		+ 3.50*	+ 4.20*	+ 5.26*

Supplements:

	1st	2nd	3rd	4th
	\$ 4.03	\$ 15.85	\$ 18.95	\$ 23.61

* This portion is not subjected to overtime premiums.

(1) year term apprentices indentured after 01/01/2023

	1st	2nd	3rd	4th	5th
	\$ 17.67	\$ 20.93	\$ 23.25	\$ 27.90	\$ 34.88
		+ 3.16*	+ 3.50*	+ 4.20*	+ 5.26

Supplements:

	1st	2nd	3rd	4th	5th
	\$ 7.61	\$ 14.29	\$ 15.85	\$ 18.95	\$ 23.61

* This portion is not subjected to overtime premiums.

9-8R

Sheetmetal Worker

05/01/2024

JOB DESCRIPTION Sheetmetal Worker

DISTRICT 8

ENTIRE COUNTIES

Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster, Westchester

WAGES

	07/01/2023
SheetMetal Worker	\$ 47.00
	+ 3.60*

*This portion is not subject to overtime premiums.

SHIFT WORK

For all NYS D.O.T. and other Governmental mandated off-shift work:

10% increase for additional shifts for a minimum of five (5) days

SUPPLEMENTAL BENEFITS

Journeyworker	\$ 45.62
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OVERTIME PAY

OVERTIME:.. See (B, E, Q,) on OVERTIME PAGE.

HOLIDAY

Paid:	See (1) on HOLIDAY PAGE
Overtime:	See (5, 6, 8, 15, 16, 23) on HOLIDAY PAGE

REGISTERED APPRENTICES

1st	2nd	3rd	4th	5th	6th	7th	8th
\$ 17.50	\$ 19.67	\$ 21.87	\$ 24.05	\$ 26.24	\$ 28.44	\$ 31.10	\$ 33.75
+ 1.44*	+ 1.62*	+ 1.80*	+ 1.98*	+ 2.16*	+ 2.34*	+ 2.52*	+ 2.70*

*This portion is not subject to overtime premiums.

Supplemental Benefits per hour:

Apprentices

1st term	\$ 19.53
2nd term	21.99
3rd term	24.42
4th term	26.88
5th term	29.32
6th term	31.75
7th term	33.72
8th term	35.71

8-38

Sprinkler Fitter	05/01/2024
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JOB DESCRIPTION Sprinkler Fitter

DISTRICT 1

ENTIRE COUNTIES

Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster, Westchester

WAGES

Per hour 07/01/2023

Sprinkler \$ 50.86
Fitter

SUPPLEMENTAL BENEFITS

Per hour

Journey person \$ 30.19

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

Note: When a holiday falls on Sunday, the following Monday shall be considered a holiday and all work performed on either day shall be at the double time rate. When a holiday falls on Saturday, the preceding Friday shall be considered a holiday and all work performed on either day shall be at the double time rate.

REGISTERED APPRENTICES

Wages per hour

One Half Year terms at the following wage.

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
\$ 24.77	\$ 27.53	\$ 30.03	\$ 32.78	\$ 35.53	\$ 38.29	\$ 41.04	\$ 43.79	\$ 46.54	\$ 49.30

Supplemental Benefits per hour

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
\$ 8.74	\$ 8.74	\$ 20.32	\$ 20.32	\$ 20.57	\$ 20.57	\$ 20.57	\$ 20.57	\$ 20.57	\$ 20.57
									1-669.2

Teamster - Building / Heavy&Highway	05/01/2024
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JOB DESCRIPTION Teamster - Building / Heavy&Highway

DISTRICT 11

ENTIRE COUNTIES

Dutchess, Orange, Rockland, Sullivan, Ulster

WAGES

GROUP 1: LeTourneau Tractors, Double Barrel Euclids, Athney Wagons and similar equipment (except when hooked to scrapers), I-Beam and Pole Trailers, Tire Trucks, Tractor and Trailers with 5 axles and over, Articulated Back Dumps and Road Oil Distributors, Articulated Water Trucks and Fuel Trucks/Trailers, positions requiring a HAZMAT CDL endorsement.

GROUP 1A: Drivers on detachable Gooseneck Low Bed Trailers rated over 35 tons.

GROUP 2: All equipment 25 yards and up to and including 30 yard bodies and cable Dump Trailers and Powder and Dynamite Trucks.

GROUP 3: All Equipment up to and including 24-yard bodies, Mixer Trucks, Dump Crete Trucks and similar types of equipment, Fuel Trucks, Batch Trucks and all other Tractor Trailers, Hi-Rail Truck.

GROUP 4: Tri-Axles, Ten Wheelers, Grease Trucks, Tillerman, Pattern Trucks, Attenuator Trucks, Water Trucks, Bus.

GROUP 5: Straight Trucks.

GROUP 6: Pick-up Trucks for hauling materials and parts, and Escort Man over-the-road.

WAGES: (per hour) 07/01/2023

GROUP 1	\$ 34.58
GROUP 1A	35.72
GROUP 2	34.02
GROUP 3	33.80
GROUP 4	33.69
GROUP 5	33.57
GROUP 6	33.57

NOTE ADDITIONAL PREMIUMS:

- On projects requiring an irregular shift a premium of 10% will be paid on wages. The premium will be paid for off-shift or irregular shift work when mandated by Governmental Agency.

- Employees engaged in hazardous/toxic waste removal, on a State or Federally designated hazardous/toxic waste site, where the employee comes in contact with hazardous/toxic waste material and when personal protective equipment is required for respiratory, skin, or eye protection, the employee shall receive an additional 20% premium above the hourly wage.

NOTE - The 'Employer Registration' (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30,2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

First 40 hours	\$ 44.59
Over 40 hours	36.99

OVERTIME PAY

See (*B, E, **E2, ***P, X) on OVERTIME PAGE

*Holidays worked Monday through Friday receive Double Time (2x) after 8 hours.

**Makeup day limited to the employees who were working on the site that week.

***Sunday Holidays are paid at a rate of double time and one half (2.5x) for all hours worked.

HOLIDAY

Paid: See (5, 6, 15, 25) on HOLIDAY PAGE

Overtime: See (*1) on HOLIDAY PAGE

- Any employee working two (2) days in any calendar week during which a holiday occurs shall receive a days pay for each holiday occurring during said week. This provision shall also apply if a holiday falls on a Saturday or Sunday.

*See OVERTIME PAY section for when additional premium is applicable on Holiday hours worked.

11-445B/HH

Teamster - Delivery - Building / Heavy&Highway

05/01/2024

JOB DESCRIPTION Teamster - Delivery - Building / Heavy&Highway

DISTRICT 11

ENTIRE COUNTIES

Dutchess, Orange, Rockland, Sullivan, Ulster

WAGES

Group 1	Tractor Trailer Drivers
Group 2	Tri- Axle

Wages: 07/01/2023

Group 1	\$ 33.70
Group 2	29.70

Hazardous/Toxic Waste Removal additional 20% when personal protective equipment is required.

SUPPLEMENTAL BENEFITS

Per hour paid:

First 40 hours \$ 32.30

Over 40 hours 0.00

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 13, 15, 16, 20, 22, 25, 26) on HOLIDAY PAGE

Overtime: See (5, 13, 15, 16, 20, 22, 25, 26) on HOLIDAY PAGE

- Employee must work either the scheduled day of work before or the scheduled day of work after the holiday in the workweek.

- Any employee working one (1) day in the calendar week during which a holiday occurs shall receive a day's pay for each holiday occurring during said week. This provision shall also apply if a holiday falls on a Saturday.

- When any of the recognized holidays occur on Sunday and are celebrated any day before or after the holiday Sunday, such days shall be considered as the holiday and paid for as such.

11-445 B/HH Delivery

Welder

05/01/2024

JOB DESCRIPTION Welder

DISTRICT 1

ENTIRE COUNTIES

Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

Per hour 07/01/2023

Welder: To be paid the same rate of the mechanic performing the work.*

*EXCEPTION: If a specific welder certification is required, then the 'Certified Welder' rate in that trade tag will be paid.

OVERTIME PAY

HOLIDAY

1-As Per Trade

Overtime Codes

Following is an explanation of the code(s) listed in the OVERTIME section of each classification contained in the attached schedule. Additional requirements may also be listed in the HOLIDAY section.

NOTE: Supplemental Benefits are 'Per hour worked' (for each hour worked) unless otherwise noted

- (AA) Time and one half of the hourly rate after 7 and one half hours per day
- (A) Time and one half of the hourly rate after 7 hours per day
- (B) Time and one half of the hourly rate after 8 hours per day
- (B1) Time and one half of the hourly rate for the 9th & 10th hours week days and the 1st 8 hours on Saturday.
Double the hourly rate for all additional hours
- (B2) Time and one half of the hourly rate after 40 hours per week
- (C) Double the hourly rate after 7 hours per day
- (C1) Double the hourly rate after 7 and one half hours per day
- (D) Double the hourly rate after 8 hours per day
- (D1) Double the hourly rate after 9 hours per day
- (E) Time and one half of the hourly rate on Saturday
- (E1) Time and one half 1st 4 hours on Saturday; Double the hourly rate all additional Saturday hours
- (E2) Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
- (E3) Between November 1st and March 3rd Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather, provided a given employee has worked between 16 and 32 hours that week
- (E4) Saturday and Sunday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
- (E5) Double time after 8 hours on Saturdays
- (F) Time and one half of the hourly rate on Saturday and Sunday
- (G) Time and one half of the hourly rate on Saturday and Holidays
- (H) Time and one half of the hourly rate on Saturday, Sunday, and Holidays
- (I) Time and one half of the hourly rate on Sunday
- (J) Time and one half of the hourly rate on Sunday and Holidays
- (K) Time and one half of the hourly rate on Holidays
- (L) Double the hourly rate on Saturday
- (M) Double the hourly rate on Saturday and Sunday
- (N) Double the hourly rate on Saturday and Holidays
- (O) Double the hourly rate on Saturday, Sunday, and Holidays
- (P) Double the hourly rate on Sunday
- (Q) Double the hourly rate on Sunday and Holidays
- (R) Double the hourly rate on Holidays
- (S) Two and one half times the hourly rate for Holidays

- (S1) Two and one half times the hourly rate the first 8 hours on Sunday or Holidays One and one half times the hourly rate all additional hours.
- (T) Triple the hourly rate for Holidays
- (U) Four times the hourly rate for Holidays
- (V) Including benefits at SAME PREMIUM as shown for overtime
- (W) Time and one half for benefits on all overtime hours.
- (X) Benefits payable on Paid Holiday at straight time. If worked, additional benefit amount will be required for worked hours. (Refer to other codes listed.)

Holiday Codes

PAID Holidays:

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

OVERTIME Holiday Pay:

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays. The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

Following is an explanation of the code(s) listed in the HOLIDAY section of each classification contained in the attached schedule. The Holidays as listed below are to be paid at the wage rates at which the employee is normally classified.

- (1) None
- (2) Labor Day
- (3) Memorial Day and Labor Day
- (4) Memorial Day and July 4th
- (5) Memorial Day, July 4th, and Labor Day
- (6) New Year's, Thanksgiving, and Christmas
- (7) Lincoln's Birthday, Washington's Birthday, and Veterans Day
- (8) Good Friday
- (9) Lincoln's Birthday
- (10) Washington's Birthday
- (11) Columbus Day
- (12) Election Day
- (13) Presidential Election Day
- (14) 1/2 Day on Presidential Election Day
- (15) Veterans Day
- (16) Day after Thanksgiving
- (17) July 4th
- (18) 1/2 Day before Christmas
- (19) 1/2 Day before New Years
- (20) Thanksgiving
- (21) New Year's Day
- (22) Christmas
- (23) Day before Christmas
- (24) Day before New Year's
- (25) Presidents' Day
- (26) Martin Luther King, Jr. Day
- (27) Memorial Day
- (28) Easter Sunday

(29) Juneteenth

New York State Department of Labor - Bureau of Public Work
State Office Building Campus
Building 12 - Room 130
Albany, New York 12226

REQUEST FOR WAGE AND SUPPLEMENT INFORMATION

As Required by Articles 8 and 9 of the NYS Labor Law

Fax (518) 485-1870 or mail this form for new schedules or for determination for additional occupations.

This Form Must Be Typed

Submitted By:

(Check Only One) ☐ Contracting Agency ☐ Architect or Engineering Firm ☐ Public Work District Office Date:

A. Public Work Contract to be let by: (Enter Data Pertaining to Contracting/Public Agency)

1. Name and complete address ☐ (Check if new or change)

Telephone

Fax

E-Mail:

2. NY State Units (see Item 5).

☐ 01 DOT

☐ 02 OGS

☐ 03 Dormitory Authority

☐ 04 State University
Construction Fund

☐ 05 Mental Hygiene
Facilities Corp.

☐ 06 OTHER N.Y. STATE UNIT

☐ 07 City

☐ 08 Local School District

☐ 09 Special Local District, i.e.,
Fire, Sewer, Water District

☐ 10 Village

☐ 11 Town

☐ 12 County

☐ 13 Other Non-N.Y. State
(Describe)

3. SEND REPLY TO ☐ (check if new or change)
Name and complete address:

Telephone

Fax

E-Mail:

4. SERVICE REQUIRED. Check appropriate box and provide project information.

☐ New Schedule of Wages and Supplements.

APPROXIMATE BID DATE :

☐ Additional Occupation and/or Redetermination

PRC NUMBER ISSUED PREVIOUSLY FOR
THIS PROJECT :

OFFICE USE ONLY

B. PROJECT PARTICULARS

5. Project Title

Description of Work

Contract Identification Number

Note: For NYS units, the OSC Contract No.

6. Location of Project:

Location on Site

Route No/Street Address

Village or City

Town

County

7. Nature of Project - Check One:

☐

1. New Building

☐

2. Addition to Existing Structure

☐

3. Heavy and Highway Construction (New and Repair)

☐

4. New Sewer or Waterline

☐

5. Other New Construction (Explain)

☐

6. Other Reconstruction, Maintenance, Repair or Alteration

☐

7. Demolition

☐

8. Building Service Contract

8. OCCUPATION FOR PROJECT :

☐

Construction (Building, Heavy
Highway/Sewer/Water)

☐

Tunnel

☐

Residential

☐

Landscape Maintenance

☐

Elevator maintenance

☐

Exterminators, Fumigators

☐

Fire Safety Director, NYC Only

☐

Fuel Delivery

☐

Guards, Watchmen

☐

Janitors, Porters, Cleaners,
Elevator Operators

☐

Moving furniture and
equipment

☐

Trash and refuse removal

☐

Window cleaners

☐

Other (Describe)

9. Does this project comply with the Wicks Law involving separate bidding? YES ☐ NO ☐

10. Name and Title of Requester

Signature



NEW YORK STATE DEPARTMENT OF LABOR
Bureau of Public Work - Debarment List

**LIST OF EMPLOYERS INELIGIBLE TO BID ON OR BE
AWARDED ANY PUBLIC WORK CONTRACT**

Under Article 8 and Article 9 of the NYS Labor Law, a contractor, sub-contractor and/or its successor shall be debarred and ineligible to submit a bid on or be awarded any public work or public building service contract/sub-contract with the state, any municipal corporation or public body for a period of five (5) years from the date of debarment when:

- Two (2) final determinations have been rendered within any consecutive six-year (6) period determining that such contractor, sub-contractor and/or its successor has WILLFULLY failed to pay the prevailing wage and/or supplements;
- One (1) final determination involves falsification of payroll records or the kickback of wages and/or supplements.

The agency issuing the determination and providing the information, is denoted under the heading 'Fiscal Officer'. DOL = New York State Department of Labor; NYC = New York City Comptroller's Office; AG = New York State Attorney General's Office; DA = County District Attorney's Office.

Debarment Database: To search for contractors, sub-contractors and/or their successors debarred from bidding or being awarded any public work contract or subcontract under NYS Labor Law Articles 8 and 9, or under NYS Workers' Compensation Law Section 141-b, access the database at this link: <https://apps.labor.ny.gov/EDList/searchPage.do>

For inquiries where WCB is listed as the "Agency", please call 1-866-546-9322

NYSDOL Bureau of Public Work Debarment List 05/24/2024

Article 8

AGENCY	Fiscal Officer	FEIN	EMPLOYER NAME	EMPLOYER DBA NAME	ADDRESS	DEBARMENT START DATE	DEBARMENT END DATE
DOL	DOL	*****5754	0369 CONTRACTORS, LLC		515 WEST AVE UNIT PH 13NORWALK CT 06850	05/12/2021	05/12/2026
DOL	DOL	*****5784	A.J.M. TRUCKING, INC.		PO BOX 2064 MONROE NY 10950	02/12/2024	02/12/2029
DOL	AG	*****1812	ADVANCED BUILDERS & LAND DEVELOPMENT, INC.		400 OSER AVE #2300HAUPPAUGE NY 11788	09/11/2019	09/11/2024
DOL	DOL	*****1687	ADVANCED SAFETY SPRINKLER INC		261 MILL ROAD P.O BOX 296EAST AURORA NY 14052	05/29/2019	05/29/2024
DOL	NYC		ALL COUNTY SEWER & DRAIN, INC.		7 GREENFIELD DR WARWICK NY 10990	03/25/2022	03/25/2027
DOL	NYC		AMJED PARVEZ		401 HANOVER AVENUE STATEN ISLAND NY 10304	01/11/2021	01/11/2026
DOL	DOL		ANGELO F COKER		2610 SOUTH SALINA STREET SUITE 14SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL		ANGELO GARCIA		515 WEST AVE UNIT PH 13NORWALK CT 06850	05/12/2021	05/12/2026
DOL	DOL		ANGELO TONDO		449 WEST MOMBSHA ROAD MONROE NY 10950	06/06/2022	06/06/2027
DOL	DOL	*****4231	ANKER'S ELECTRIC SERVICE, INC.		10 SOUTH 5TH ST LOCUST VALLEY NY 11560	09/26/2022	09/26/2027
DOL	DOL		ANTHONY MONGELLI		PO BOX 2064 MONROE NY 10950	02/12/2024	02/12/2029
DOL	NYC		ARADCO CONSTRUCTION CORP		115-46 132RD ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	DOL		ARNOLD A. PAOLINI		1250 BROADWAY ST BUFFALO NY 14212	02/03/2020	02/03/2025
DOL	NYC		ARSHAD MEHMOOD		168-42 88TH AVENUE JAMAICA NY 11432	11/20/2019	11/20/2024
DOL	NYC		AVM CONSTRUCTION CORP		117-72 123RD ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	NYC		AZIDABEGUM		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	DOL	*****8421	B & B DRYWALL, INC		206 WARREN AVE APT 1WHITE PLAINS NY 10603	12/14/2021	12/14/2026
DOL	DOL		B&L RENOVATION CO.		618 OCEAN PARKWAY APT A6BROOKLYN NY 11230	09/17/2020	09/17/2025
DOL	DOL		BERNARD BEGLEY		38 LONG RIDGE ROAD BEDFORD NY 10506	12/18/2019	12/18/2024
DOL	NYC	*****2113	BHW CONTRACTING, INC.		401 HANOVER AVENUE STATEN ISLAND NY 10304	01/11/2021	01/11/2026
DOL	DOL	*****3627	BJB CONSTRUCTION CORP.		38 LONG RIDGE ROAD BEDFORD NY 10506	12/18/2019	12/18/2024
DOL	DOL	*****5078	BLACK RIVER TREE REMOVAL, LLC		29807 ANDREWS ROAD BLACK RIVER NY 13032	10/17/2023	10/17/2028
DOL	DOL	*****4512	BOB BRUNO EXCAVATING, INC		5 MORNINGSIDE DR AUBURN NY 13021	05/28/2019	05/28/2024
DOL	DOL		BRADLEY J SCHUKA		4 BROTHERS ROAD WAPPINGERS FALLS NY 12590	10/20/2020	10/20/2025
DOL	DOL	*****9383	C.C. PAVING AND EXCAVATING, INC.		2610 SOUTH SALINA ST SUITE 12SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL	*****4083	C.P.D. ENTERPRISES, INC		P.O BOX 281 WALDEN NY 12586	03/03/2020	03/03/2025
DOL	DOL	*****5161	CALADRI DEVELOPMENT CORP.		1223 PARK ST. PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	DOL	*****3391	CALI ENTERPRISES, INC.		1223 PARK STREET PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	NYC		CALVIN WALTERS		465 EAST THIRD ST MT. VERNON NY 10550	09/09/2019	09/09/2024
DOL	DOL	*****4155	CASA BUILDERS, INC.	FRIEDLANDER CONSTRUCTI ON	64 N PUTT CONNERS ROAD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	AG	*****7247	CENTURY CONCRETE CORP		2375 RAYNOR ST RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	*****0026	CHANTICLEER CONSTRUCTION LLC		4 BROTHERS ROAD WAPPINGERS FALLS NY 12590	10/20/2020	10/20/2025
DOL	NYC	*****2117	CHARAN ELECTRICAL ENTERPRISES		9-11 40TH AVENUE LONG ISLAND CITY NY 11101	09/26/2023	09/26/2028
DOL	NYC		CHARLES ZAHRADKA		863 WASHINGTON STREET FRANKLIN SQUARE NY 11010	03/10/2020	03/10/2025

NYSDOL Bureau of Public Work Debarment List 05/24/2024

Article 8

DOL	DOL		CHRISTOPHER GRECO		26 NORTH MYRTLE AVENUE SPRING VALLEY NY 10956	02/18/2021	02/18/2026
DOL	DOL		CHRISTOPHER PAPASTEFANOU A/K/A CHRIS PAPASTEFANOU		1445 COMMERCE AVE BRONX NY 10461	05/30/2019	05/30/2024
DOL	DOL		CRAIG JOHANSEN		10 SOUTH 5TH ST LOCUST VALLEY NY 11560	09/26/2022	09/26/2027
DOL	DOL	*****3228	CROSS-COUNTY LANDSCAPING AND TREE SERVICE, INC.	ROCKLAND TREE SERVICE	26 NORTH MYRTLE AVENUE SPRING VALLEY NY 10956	02/18/2021	02/18/2026
DOL	DOL	*****7619	DANCO CONSTRUCTION UNLIMITED INC.		485 RAFT AVENUE HOLBROOK NY 11741	10/19/2021	10/19/2026
DOL	DOL		DANIEL ROBERT MCNALLY		7 GREENFIELD DRIVE WARWICK NY 10990	03/25/2022	03/25/2027
DOL	DOL		DARIAN L COKER		2610 SOUTH SALINA ST SUITE 2CSYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL		DAVID FRIEDLANDER		64 NORTH PUTT CORNERS RD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	NYC		DAVID WEINER		14 NEW DROP LANE 2ND FLOORSTATEN ISLAND NY 10306	11/14/2019	11/14/2024
DOL	DOL		DELPHI PAINTING & DECORATING CO INC		1445 COMMERCE AVE BRONX NY 10461	05/30/2019	05/30/2024
DOL	DOL		DINA TAYLOR		64 N PUTT CONNERS RD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	DOL	*****5175	EAGLE MECHANICAL AND GENERAL CONSTRUCTION LLC		11371 RIDGE RD WOLCOTT NY 14590	02/03/2020	02/03/2025
DOL	AG		EDWIN HUTZLER		23 NORTH HOWELLS RD BELLPORT NY 11713	08/04/2021	08/04/2026
DOL	DA		EDWIN HUTZLER		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	*****0780	EMES HEATING & PLUMBING CONTR		5 EMES LANE MONSEY NY 10952	01/20/2002	01/20/3002
DOL	DOL		EUGENIUSZ "GINO" KUCHAR		195 KINGSLAND AVE BROOKLYN NY 11222	12/22/2023	12/22/2028
DOL	DA		FREDERICK HUTZLER		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	NYC	*****6616	G & G MECHANICAL ENTERPRISES, LLC.		1936 HEMPSTEAD TURNPIKE EAST MEDOW NY 11554	11/29/2019	11/29/2024
DOL	DOL	*****2998	G.E.M. AMERICAN CONSTRUCTION CORP.		195 KINGSLAND AVE BROOKLYN NY 11222	12/22/2023	12/22/2028
DOL	NYC		GAYATRI MANGRU		21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	DA		GEORGE LUCEY		150 KINGS STREET BROOKLYN NY 11231	01/19/1998	01/19/2998
DOL	DOL		GIGI SCHNECKENBURGER		261 MILL RD EAST AURORA NY 14052	05/29/2019	05/29/2024
DOL	DA		GIOVANNA TRAVAJA		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	DA	*****0213	GORILLA CONTRACTING GROUP, LLC		505 MANHATTAN AVE WEST BABYLON NY 11704	10/05/2023	10/05/2028
DOL	DOL		HANS RATH		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	DOL		HERBERT CLEMEN		42 FOWLER AVENUE CORTLAND MANOR NY 10567	01/24/2023	01/24/2028
DOL	DOL		HERBERT CLEMEN		42 FOWLER AVENUE CORTLAND MANOR NY 10567	10/25/2022	10/25/2027
DOL	DOL		IRENE KASELIS		32 PENNINGTON AVE WALDWICK NJ 07463	05/30/2019	05/30/2024
DOL	DOL	*****9211	J. WASE CONSTRUCTION CORP.		8545 RT 9W ATHENS NY 12015	03/09/2021	03/09/2026
DOL	DOL		J.M.J CONSTRUCTION		151 OSTRANDER AVENUE SYRACUSE NY 13205	11/21/2022	11/21/2027
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028

NYSDOL Bureau of Public Work Debarment List 05/24/2024

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DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	12/12/2022	12/12/2027
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		JAMES J. BAKER		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL	*****7993	JBS DIRT, INC.		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL	*****2435	JEFFEL D. JOHNSON	JMJ7 AND SON	5553 CAIRNSTRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JEFFEL JOHNSON ELITE CARPENTER REMODEL AND CONSTRUCTION		C2 EVERGREEN CIRCLE LIVERPOOL NY 13090	11/21/2022	11/21/2027
DOL	DOL	*****2435	JEFFREY M. JOHNSON	JMJ7 AND SON	5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	NYC		JENNIFER GUERRERO		1936 HEMPSTEAD TURNPIKE EAST MEADOW NY 11554	11/29/2019	11/29/2024
DOL	DOL		JIM PLAUGHER		17613 SANTE FE LINE ROAD WAYNEFIELD OH 45896	07/16/2021	07/16/2026
DOL	DOL		JMJ7 & SON CONSTRUCTION, LLC		5553 CAIRNS TRAIL LIVERPOOL NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 AND SONS CONTRACTORS		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS		7014 13TH AVENUE BROOKLYN NY 11228	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS AND SONS		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS, LLC		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JOHN GOCEK		14B COMMERCIAL AVE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL		JOHN MARKOVIC		47 MANDON TERRACE HAWTHORN NJ 07506	03/29/2021	03/29/2026
DOL	DOL		JOHN WASE		8545 RT 9W ATHENS NY 12015	03/09/2021	03/09/2026
DOL	DOL		JON E DEYOUNG		261 MILL RD P.O BOX 296EAST AURORA NY 14052	05/29/2019	05/29/2024
DOL	DOL		JORGE RAMOS		8970 MIKE GARCIA DR MANASSAS VA 20109	07/16/2021	07/16/2026
DOL	DOL		JOSEPH K. SALERNO		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL		JOSEPH K. SALERNO II		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL		JRN CONSTRUCTION CO, LLC		1024 BROADWAY ALBANY NY 12204	11/07/2023	11/07/2028

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DOL	DOL	*****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL	*****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL	*****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		JULIUS AND GITA BEHREND		5 EMES LANE MONSEY NY 10952	11/20/2002	11/20/3002
DOL	DOL		KARIN MANGIN		796 PHELPS ROAD FRANKLIN LAKES NJ 07417	12/01/2020	12/01/2025
DOL	DOL		KATE E. CONNOR		7088 INTERSTATE ISLAND RD SYRACUSE NY 13209	03/31/2021	03/31/2026
DOL	DOL		KEAN INDUSTRIES, LLC		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL	*****2959	KELC DEVELOPMENT, INC		7088 INTERSTATE ISLAND RD SYRACUSE NY 13209	03/31/2021	03/31/2026
DOL	DOL		KIMBERLY F. BAKER		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL		KMA GROUP II, INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL	*****1833	KMA GROUP INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL		KMA INSULATION, INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL		KRIN HEINEMANN		2345 ROUTE 52, SUITE 2N HOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	NYC		KULWANT S. DEOL		9-11 40TH AVENUE LONG ISLAND CITY NY 11101	09/26/2023	09/26/2028
DOL	DA	*****8816	LAKE CONSTRUCTION AND DEVELOPMENT CORPORATION		150 KINGS STREET BROOKLYN NY 11231	08/19/1998	08/19/2998
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	11/07/2023	11/07/2028
DOL	AG	*****3291	LINTECH ELECTRIC, INC.		3006 TILDEN AVE BROOKLYN NY 11226	02/16/2022	02/16/2027
DOL	DOL		LOUIS A. CALICCHIA		1223 PARK ST. PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	NYC		LUBOMIR PETER SVOBODA		27 HOUSMAN AVE STATEN ISLAND NY 10303	12/26/2019	12/26/2024
DOL	NYC		M & L STEEL & ORNAMENTAL IRON CORP.		27 HOUSMAN AVE STATEN ISLAND NY 10303	12/26/2019	12/26/2024
DOL	DOL	*****2196	MAINSTREAM SPECIALTIES, INC.		11 OLD TOWN RD SELKIRK NY 12158	02/02/2021	02/02/2026
DOL	DA		MANUEL P TOBIO		150 KINGS STREET BROOKLYN NY 14444	08/19/1998	08/19/2998
DOL	DA		MANUEL TOBIO		150 KINGS STREET BROOKLYN NY 11231	08/19/1998	08/19/2998
DOL	DOL		MAQSOOD AHMAD		618 OCEAN PKWY BROOKLYN NY 11230	09/17/2020	09/17/2025
DOL	NYC		MARIA NUBILE		84-22 GRAND AVENUE ELMHURST NY 11373	03/10/2020	03/10/2025
DOL	NYC	*****9926	MILLENNIUM FIRE PROTECTION, LLC		325 W. 38TH STREET SUITE 204NEW YORK NY 10018	11/14/2019	11/14/2024
DOL	NYC	*****0627	MILLENNIUM FIRE SERVICES, LLC		14 NEW DROP LNE 2ND FLOORSTATEN ISLAND NY 10306	11/14/2019	11/14/2024
DOL	DOL	*****1320	MJC MASON CONTRACTING, INC.		42 FOWLER AVENUE CORTLAND MANOR NY 10567	10/25/2022	10/25/2027
DOL	DOL	*****1320	MJC MASON CONTRACTING, INC.		42 FOWLER AVENUE CORTLAND MANOR NY 10567	01/24/2023	01/24/2028
DOL	NYC		MUHAMMED A. HASHEM		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025

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DOL	NYC		NAMOW, INC.		84-22 GRAND AVENUE ELMHURST NY 11373	03/10/2020	03/10/2025
DOL	DOL	*****7790	NATIONAL BUILDING & RESTORATION CORP		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL	*****1797	NATIONAL CONSTRUCTION SERVICES, INC		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	NYC		NAVIT SINGH		402 JERICHO TURNPIKE NEW HYDE PARK NY 11040	08/10/2022	08/10/2027
DOL	DOL		NELCO CONTRACTING, LLC		1024 BROADWAY ALBANY NY 12204	11/07/2023	11/07/2028
DOL	DA		NICHOLAS T. ANALITIS		505 MANHATTAN AVE WEST BABYLON NY 11704	10/05/2023	10/05/2028
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL	*****7429	NICOLAE I. BARBIR	BESTUCCO CONSTRUCTI ON, INC.	444 SCHANTZ ROAD ALLENTOWN PA 18104	09/17/2020	09/17/2025
DOL	NYC	*****5643	NYC LINE CONTRACTORS, INC.		402 JERICHO TURNPIKE NEW HYDE PARK NY 11040	08/10/2022	08/10/2027
DOL	DOL		PATRICK PENNACCHIO		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL		PATRICK PENNACCHIO		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL		PAULINE CHAHALES		935 S LAKE BLVD MAHOPAC NY 10541	03/02/2021	03/02/2026
DOL	DOL		PETER STEVENS		11 OLD TOWN ROAD SELKIRK NY 12158	02/02/2021	02/02/2026
DOL	DOL		PETER STEVENS		8269 21ST ST BELLEROSE NY 11426	12/22/2022	12/22/2027
DOL	DOL	*****0466	PRECISION BUILT FENCES, INC.		1617 MAIN ST PEEKSKILL NY 10566	03/03/2020	03/03/2025
DOL	NYC		RASHEL CONSTRUCTION CORP		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	DOL	*****1068	RATH MECHANICAL CONTRACTORS, INC.		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	DOL	*****2633	RAW POWER ELECTRIC CORP.		3 PARK CIRCLE MIDDLETOWN NY 10940	07/11/2022	07/11/2027
DOL	DA	*****7559	REGAL CONTRACTING INC.		24 WOODBINE AVE NORTHPORT NY 11768	10/01/2020	10/01/2025
DOL	DOL		RICHARD REGGIO		1617 MAIN ST PEEKSKILL NY 10566	03/03/2020	03/03/2025
DOL	DOL		ROBBYE BISSESAR		89-51 SPRINGFIELD BLVD QUEENS VILLAGE NY 11427	01/11/2003	01/11/3003
DOL	DOL		ROBERT A. VALERINO		3841 LANYARD COURT NEW PORT RICHEY FL 34652	07/09/2019	07/09/2024
DOL	DOL		ROBERT BRUNO		5 MORNINGSIDE DRIVE AUBURN NY 13021	05/28/2019	05/28/2024
DOL	DOL		ROMEO WARREN		161 ROBYN RD MONROE NY 10950	07/11/2022	07/11/2027
DOL	DOL		RONALD MESSEN		14B COMMERCIAL AVE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL	*****7172	RZ & AL INC.		198 RIDGE AVENUE VALLEY STREAM NY 11581	06/06/2022	06/06/2027
DOL	DOL		SAL FRESINA MASONRY CONTRACTORS, INC.		1935 TEALL AVENUE SYRACUSE NY 13206	07/16/2021	07/16/2026
DOL	DOL		SAL MASONRY CONTRACTORS, INC.		(SEE COMMENTS) SYRACUSE NY 13202	07/16/2021	07/16/2026
DOL	DOL	*****9874	SALFREE ENTERPRISES INC		P.O BOX 14 2821 GARDNER RDPOMPEI NY 13138	07/16/2021	07/16/2026
DOL	DOL		SALVATORE A FRESINA A/K/A SAM FRESINA		107 FACTORY AVE P.O BOX 11070SYRACUSE NY 13218	07/16/2021	07/16/2026
DOL	DOL		SAM FRESINA		107 FACTORY AVE P.O BOX 11070SYRACUSE NY 13218	07/16/2021	07/16/2026
DOL	NYC	*****0349	SAM WATERPROOFING INC		168-42 88TH AVENUE APT.1 AJAMAICA NY 11432	11/20/2019	11/20/2024

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DOL	DA	*****0476	SAMCO ELECTRIC CORP.		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	NYC	*****1130	SCANA CONSTRUCTION CORP.		863 WASHINGTON STREET FRANKLIN SQUARE NY 11010	03/10/2020	03/10/2025
DOL	DOL	*****2045	SCOTT DUFFIE	DUFFIE'S ELECTRIC, INC.	P.O BOX 111 CORNWALL NY 12518	03/03/2020	03/03/2025
DOL	DOL		SCOTT DUFFIE		P.O BOX 111 CORNWALL NY 12518	03/03/2020	03/03/2025
DOL	DA		SILVANO TRAVALJA		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	DOL	*****0440	SOLAR GUYS INC.		8970 MIKE GARCIA DR MANASSAS VA 20109	07/16/2021	07/16/2026
DOL	NYC		SOMATIE RAMSUNAHAI		115-46 132ND ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	DOL	*****2221	SOUTH BUFFALO ELECTRIC, INC.		1250 BROADWAY ST BUFFALO NY 14212	02/03/2020	02/03/2025
DOL	NYC	*****3661	SPANIER BUILDING MAINTENANCE CORP		200 OAK DRIVE SYOSSET NY 11791	03/14/2022	03/14/2027
DOL	DOL		STANADOS KALOGELAS		485 RAFT AVENUE HOLBROOK NY 11741	10/19/2021	10/19/2026
DOL	DOL	*****3496	STAR INTERNATIONAL INC		89-51 SPRINGFIELD BLVD QUEENS VILLAGE NY 11427	08/11/2003	08/11/3003
DOL	DOL	*****6844	STEAM PLANT AND CHX SYSTEMS INC.		14B COMMERCIAL AVENUE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL	*****9933	STEED GENERAL CONTRACTORS, INC.		1445 COMMERCE AVE BRONX NY 10461	05/30/2019	05/30/2024
DOL	DOL	*****9528	STEEL-IT, LLC.		17613 SANTE FE LINE ROAD WAYNESFIELD OH 45896	07/16/2021	07/16/2026
DOL	DOL		STEFANOS PAPASTEFANOU, JR. A/K/A STEVE PAPASTEFANOU, JR.		256 WEST SADDLE RIVER RD UPPER SADDLE RIVER NJ 07458	05/30/2019	05/30/2024
DOL	DOL	*****3800	SUBURBAN RESTORATION CO. INC.		5-10 BANTA PLACE FAIR LAWN PLACE NJ 07410	03/29/2021	03/29/2026
DOL	DOL	*****9150	SURGE INC.		8269 21ST STREET BELLEROSSE NY 11426	12/22/2022	12/22/2027
DOL	DOL		SYED RAZA		198 RIDGE AVENUE NY 11581	06/06/2022	06/06/2027
DOL	DOL		TERRY THOMPSON		11371 RIDGE RD WOLCOTT NY 14590	02/03/2020	02/03/2025
DOL	DOL	*****9733	TERSAL CONSTRUCTION SERVICES INC		107 FACTORY AVE P.O BOX 11070SYRACUSE NY 13208	07/16/2021	07/16/2026
DOL	DOL		TERSAL CONTRACTORS, INC.		221 GARDNER RD P.O BOX 14POMPEI NY 13138	07/16/2021	07/16/2026
DOL	DOL		TERSAL DEVELOPMENT CORP.		1935 TEALL AVENUE SYRACUSE NY 13206	07/16/2021	07/16/2026
DOL	DOL	*****5766	THE COKER CORPORATION	COKER CORPORATIO N	2610 SOUTH SALINA ST SUITE 14SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL		TIMOTHY PERCY		29807 ANDREWS ROAD BLACK RIVER NY 13612	10/17/2023	10/17/2028
DOL	DA	*****1050	TRI STATE CONSTRUCTION OF NY CORP.		50-39 175TH PLACE FRESH MEADOWS NY 11365	03/28/2022	03/28/2027
DOL	DA	*****4106	TRIPLE H CONCRETE CORP		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	*****8210	UPSTATE CONCRETE & MASONRY CONTRACTING CO INC		449 WEST MOMBSHA ROAD MONROE NY 10950	06/06/2022	06/06/2027
DOL	DOL	*****6418	VALHALLA CONSTRUCTION, LLC.		796 PHLEPS ROAD FRANKLIN LAKES NJ 07417	12/01/2020	12/01/2025
DOL	NYC	*****2426	VICKRAM MANGRU	VICK CONSTRUCTI ON	21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	NYC		VICKRAM MANGRU		21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	DOL		VIKTORIA RATH		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	NYC	*****3673	WALTERS AND WALTERS, INC.		465 EAST AND THIRD ST MT. VERNON NY 10550	09/09/2019	09/09/2024
DOL	DOL	*****3296	WESTERN NEW YORK CONTRACTORS, INC.		3841 LAYNARD COURT NEW PORT RICHEY FL 34652	07/09/2019	07/09/2024
DOL	DOL	*****8266	WILLIAM CHRIS MCCLENDON	MCCLENDON ASPHALT PAVING	1646 FALLS STREET NIAGARA FALLS NY 14303	05/01/2023	05/01/2028

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DOL	DOL		WILLIAM CHRIS MCCLENDON		1646 FALLS STREET NIAGARA FALLS NY 14303	05/01/2023	05/01/2028
DOL	DOL		WILLIAM G. PROERFRIEDT		85 SPRUCEWOOD ROAD WEST BABYLON NY 11704	01/19/2021	01/19/2026
DOL	DOL	*****5924	WILLIAM G. PROPHY, LLC	WGP CONTRACTIN G, INC.	54 PENTAQUIT AVE BAYSHORE NY 11706	01/19/2021	01/19/2026
DOL	DOL		XENOFON EFTHIMIADIS		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028

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SECTION 01 12 13

SUMMARY OF WORK

PART 1 – GENERAL

1.1 LOCATION AND DESCRIPTION OF WORK

- A. The Work is located at the City of Newburgh Wastewater Treatment Plant: 2 Renwick Street, Newburgh, New York.
- B. The Work to be performed under this Contract includes, but is not limited to, constructing the Work described below and all related appurtenances. The Work includes, but is not limited to, the following:
 - 1. Rehabilitation of the existing City of Newburgh Wastewater Treatment Plant Admin Building.
 - a. Repair of exterior brick and single tee roof structure ends.
 - b. Reconfiguration of interior partitions and refinishing of interior rooms.
 - c. Replacement of building doors and windows.
 - d. Adding accessible access to building via ramp.
 - e. Replacement of laboratory casework and equipment.
 - f. Replacement of under slab HVAC system with above HVAC systems.
 - g. Reconfiguration and replacement of plumbing fixtures and piping.
 - h. Replacement of electrical power and lighting panels, conduit and wiring to end devices.
- C. Contracting Method: The Project will be constructed under multiple prime contracts.
- D. Hazardous Environmental Conditions:
 - 1. To the best of Owner's knowledge, information, and belief, asbestos, lead and PCBs have been removed from the Wastewater Treatment Plant Admin Building by Others.

1.2 WORK BY OWNER

- A. OWNER will perform the following in connection with the Work:
 - 1. Operate all existing valves, gates, pumps, equipment, and appurtenances that will affect OWNER's operation, unless otherwise specified or indicated.

1.3 SEQUENCE AND PROGRESS OF WORK

- A. Sequencing:
 - 1. Incorporate sequencing of the Work into the Progress Schedule.

1.4 CONTRACTOR'S USE OF SITE

- A. CONTRACTORS shall share use of the Site with other contractors and others specified in Article 1.4 of this Section and others as specified in Article 1.5 of this Section.
- B. Move stored materials and equipment that interfere with operations of OWNER, other contractors, and others performing work for OWNER.
- C. Limits on CONTRACTOR's use of the Site are:
 - 1. As indicated in Section 01 14 19, Use of Site.
 - 2. Do not use the Site for operations other than those required for the Project.

1.5 EASEMENTS AND RIGHTS-OF-WAY

- A. General:
 - 1. Easements and rights-of-way required for the permanent improvements included in the Work will be provided by OWNER in accordance with the General Conditions and Supplementary Conditions.
 - 2. Confine construction operations within OWNER's property, public rights-of-way, easements obtained by OWNER, and limits shown, and property for which CONTRACTOR has made arrangements directly with property owner(s).
 - 3. Use care in placing construction tools, equipment, excavated materials, and materials and equipment to be incorporated into the Work to avoid damaging property and interfering with traffic.
 - 4. Do not enter private property outside the construction limits without permission from the owner of the property.

1.6 SALVAGE OF MATERIALS AND EQUIPMENT

- A. Existing materials and equipment removed and not shown or specified to be reused in the Work will become CONTRACTOR's property and shall be disposed of in accordance with the local, state and federal regulations.
- B. Existing materials and equipment removed by CONTRACTOR shall not be reused in the Work.
- C. Removal, Storage, Handling, Reinstallation:
 - 1. Carefully remove in manner to prevent damage all materials and equipment shown or indicated to be salvaged and reused or to remain property of OWNER.
 - 2. Store and protect salvaged items shown or indicated to be used in the Work.
 - 3. Replace in-kind or with new items those items of materials and equipment damaged during removal, storage, or handling through CONTRACTOR's actions, negligence, or improper procedures.

- D. CONTRACTOR may furnish and install new items, with ENGINEER's approval, instead of those specified or indicated to be salvaged and reused, in which case such removed items will become CONTRACTOR's property.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

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SECTION 01 14 16

COORDINATION WITH OWNER'S OPERATIONS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes requirements for coordinating with OWNER's operations during the Project, and includes requirements for tie-ins and shutdowns necessary to complete the Work without impact on OWNER's operations except as allowed in this Section.
2. CONTRACTOR shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to coordinate with OWNER's operations during the Work in accordance with this Section.

B. Coordination:

1. Review construction procedures under other Specifications sections and coordinate Work that will be performed with or before the Work specified in this Section.

C. Related Sections:

1. Section 01 12 13, Summary of Work.
3. Section 01 73 29, Cutting and Patching.
4. Section 01 73 24, Connections to Existing Facilities.

D. Except for shutdowns specified in this Section, perform the Work such that OWNER's facilities remain in continuous satisfactory operation during the Project. Schedule and conduct the Work such that the Work does not: impede OWNER's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products or effluent, cause odors or other nuisances, or affect the public health, safety, and convenience.

E. Work not specifically covered in this Section or in referenced Sections may, in general, be completed, within the Contract Times, at any time during regular working hours in accordance with the Contract Documents, subject to the requirements in this Section.

F. As a substitute to the procedures specified in this Section, CONTRACTOR may propose providing additional temporary facilities that can eliminate or mitigate a constraint without additional cost to OWNER, provided such additional temporary facilities: do not present hazards to the public, personnel, structures, and equipment; that such additional temporary facilities do not adversely affect OWNER's ability to comply with Laws and Regulations, permits, and operating requirements; that such temporary facilities do not generate or foster the generation of odors and other nuisances; and that requirements of the Contract Documents are fulfilled.

G. Coordinate shutdowns with OWNER and ENGINEER. When possible, combine multiple tie-ins into a single shutdown to reduce impacts on OWNER's operations and processes.

H. Operation of Existing Systems and Equipment during the Work:

1. Do not shut off or disconnect existing operating systems or equipment, unless accepted by ENGINEER in writing.

2. Operation of existing systems and equipment will be by OWNER unless otherwise specified or indicated.
3. Where necessary for the Work, CONTRACTOR shall seal or bulkhead OWNER-operated gates and valves to prevent leakage that may affect the Work, OWNER's operations, or both.
4. Provide temporary watertight plugs, bulkheads, and line stops as required. After completing the Work, remove seals, plugs, bulkhead, and line stops to satisfaction of ENGINEER.

I. Bypassing:

1. Diversion of flows around treatment processes is not allowed.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:

1. Substitute Sequence Submittal: When deviation from specified sequence or procedures is proposed, furnish submittal explaining in detail the proposed sequence or procedures and associated effects, including evidence that OWNER's operations will not be adversely affected, to an extent greater than originally contemplated in the Contract Documents, by proposed substitution. List benefits of proposed substitution, including benefits to Progress Schedule. Submit in accordance with Section 01 25 00, Substitution Procedures, and other requirements of the Contract Documents regarding substitution requests.

B. Informational Submittals: Submit the following:

1. Shutdown Planning Submittal:
 - a. For each shutdown, submit an inventory of labor, materials, and equipment required to perform the shutdown and tie-in tasks, an estimate of time required to accomplish the complete shutdown including time for OWNER to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.
 - b. Furnish submittal to ENGINEER not less than 30 days prior to proposed shutdown start date. Do not start shutdown until obtaining ENGINEER's acceptance of shutdown planning submittal.
2. Shutdown Notification: After ENGINEER's acceptance of shutdown planning submittal and prior to starting the shutdown, submit written notification to OWNER and ENGINEER of date and time each shutdown is to start. Submit notification not less than 72 hours in advance of each shutdown.

1.3 GENERAL CONSTRAINTS

- A. Indicated in the Contract Documents are the sequence and shutdown durations, where applicable, for OWNER'S equipment, systems, and conduits (including piping and ducting) that are to be taken out of service temporarily for the Work. New materials, equipment, and systems may be used by OWNER after the specified field quality controls and testing are successfully completed and the materials or equipment are Substantially Complete in accordance with the Contract Documents.

B. The following constraints apply to coordination with OWNER's operations:

1. Operational Access: OWNER'S personnel shall have access to equipment and areas of the facility that remain in operation.

2. Temporary Partitions and Enclosures: Provide temporary partitions and enclosures necessary to maintain dust-free, heated, and ventilated spaces in areas of the facility that are adjacent to the Work and that must be kept operational. Comply with Section 01 51 05, Temporary Utilities.
3. Schedule and perform equipment and system start-ups for Monday through Thursday. Equipment and systems shall not be placed into operation on Friday, Saturday, and Sunday without prior approval of OWNER, unless specifically indicated otherwise in the Contract Documents.
4. Dead End Valves or Conduits: Provide blind flanges, watertight bulkheads, or valve at temporary and permanent terminuses of conduits, including piping and ducting. Blind flanges and bulkheads shall be suitable for the service and braced and blocked, as required, or otherwise restrained as directed by ENGINEER. Temporary valves shall be suitable for their associated service. Where valve is provided at permanent terminus of conduit, including piping or ducting, also provide on downstream side of valve a blind flange with drain/flushing connection.
5. OWNER will assist CONTRACTOR in dewatering process tanks, basins, conduits, and other work areas to be dewatered for shutdowns. Maintain clean and dry work area by pumping and properly disposing of fluid and other material that accumulates in work areas.
6. Draining and Cleaning of Conduits, Tanks, and Basins:
 - a. Unless otherwise shown or indicated, CONTRACTOR shall dewater process tanks, basins, conduits (including piping) at beginning of each shutdown. Flush, wash down, and clean tanks, basins, conduits (including piping), and other work areas.
 - b. CONTRACTOR shall remove liquids and solids and dispose of them at appropriate location at the Site as directed by ENGINEER. Unless otherwise specified or indicated, contents of tanks, basins, and conduits (including piping) undergoing modifications shall be transferred to existing process tanks or conduits at the Site with capacity sufficient to accept such discharges, using hoses, temporary piping, temporary pumps, or other means provided by CONTRACTOR. Discharge of fluids across floors is not allowed.
 - c. If drainage point is not available on the conduit (including piping) to be drained, provide a wet tap using tapping saddle and valve or other method approved by ENGINEER. Uncontrolled spillage of contents of conduits (including piping) is not allowed.
 - d. Spillage shall be brought to ENGINEER's attention immediately, both verbally and in writing, and reported in accordance with Laws and Regulations. CONTRACTOR shall wash down spillage to floor drains or sumps or other appropriate location and flush the system to prevent clogging and odors. If spillage is not suitable for discharge to the drainage system, such as chemical spills, as determined by ENGINEER, CONTRACTOR shall remove spillage by other method, such as vacuum truck, sorbents, or other method acceptable to ENGINEER.

1.4 SEQUENCE OF WORK

- A. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if OWNER's operations are not adversely affected by proposed sequence change, with ENGINEER's acceptance.

1.5 TIE-INS

- A. Table 01 14 16-A in this Section lists connections by CONTRACTOR to existing facilities. Table 01 14 16-A may not include all tie-ins required for the Work; CONTRACTOR shall perform tie-ins required to complete the Work as shown or indicated regardless of whether tie-in is indicated in Table 01 14 16-A. For tie-ins not indicated in Table 01 14 16-A, obtain requirements for tie-ins from ENGINEER by requesting an interpretation or clarification.

1.6 SHUTDOWNS

A. General:

1. Terminology: A “shutdown” is when a portion of the normal operation of OWNER’s facility, whether equipment, systems, conduit (including piping and ducting), has to be temporarily suspended or taken out of service to perform the Work.
2. Work that may interrupt normal operations shall be accomplished at times convenient to OWNER unless otherwise indicated in the Contract Documents.
3. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, materials, equipment, spare parts, both temporary and permanent, necessary to successfully perform the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to commencing the associated shutdown. Demonstrate to ENGINEER’s satisfaction that CONTRACTOR has complied with such requirements before commencing the shutdown.
4. If CONTRACTOR’s operations cause an unscheduled interruption of OWNER’s operations, immediately re-establish satisfactory operation for OWNER.
5. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of OWNER’s facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by CONTRACTOR if, in ENGINEER’s opinion, CONTRACTOR did not comply with requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in performing the Work and complying with applicable permits, Laws, and Regulations.
6. Shutdowns shall be in accordance with Table 01 14 16-B of this Section. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.
7. Temporary, short-term shutdowns of smaller conduits (including piping and ducting), equipment, and systems may not be included in Table 01 14 16-B. Coordinate requirements for such shutdowns with ENGINEER and OWNER. Where necessary, obtain ENGINEER’s interpretation or clarification before proceeding.

B. Shutdowns of Electrical Systems:

1. Comply with Laws and Regulations, including the National Electric Code.
2. CONTRACTOR shall lock out and tag circuit breakers and switches operated by OWNER and shall verify that affected cables and wires are de-energized to ground potential before shutdown Work is started.
3. Upon completion of shutdown Work, remove the locks and tags and notify ENGINEER that facilities are available for use.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL

- A. In addition to requirements of this Section, comply with Section 01 73 29, Cutting and Patching, and Section 01 73 24, Connections to Existing Facilities, and other Contract Documents applicable to Work associated with shutdowns, tie-ins, temporary pumping (where applicable), and similar work.

3.2 SCHEDULES

- A. The schedules indicated below, attached following this Section's "End of Section" designation, are part of this Specifications Section:
 - 1. Table 01 14 16-A, Schedule of Tie-ins.

+ + END OF SECTION + +

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SECTION 01 14 19

USE OF SITE

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
1. This Section includes requirements for use of the Site during the Project, and includes requirements for use of existing facilities, as applicable.
 2. CONTRACTOR shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to comply with restrictions on CONTRACTOR's use of the Site and other areas.
 3. Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions, regarding the CONTRACTOR's use of the Site and other areas.

1.2 USE OF PREMISES

- A. Limit use of premises at the Site to work areas shown or indicated on the Drawings and as specified in this Section. Do not disturb portions of the Site beyond areas of the Work.
1. Limits:
 - a. Confine construction operations to the following areas:
 - 1) Wastewater Treatment Plant Admin Building
 - b. Confine storage of materials and equipment, and locations of temporary facilities to the following areas:
 - 1) As shown on Drawings.
 - c. Do not enter the following areas:
 - 1) Areas outside of the work areas indicated in Paragraph 1.2.A.1.a of this Section and outside of work areas indicated on the Drawings, including outside the Project areas indicated on the Drawings.
 2. Access to Site, Access Roads, and Parking Areas: Refer to Section 01 55 13, Access Roads and Parking Areas.
- B. Use of Existing Buildings and Structures: Maintain existing buildings and structures in weather-tight condition throughout construction unless otherwise indicated in the Contract Documents. Protect buildings, structures, and occupants during construction.
1. Use of Existing Utilities, Sanitary Facilities, and First-aid Facilities: Refer Section 01 51 05, Temporary Utilities.

- C. Promptly repair damage to premises caused by construction operations. Upon completion of the Work, restore premises to specified condition; if condition is not specified, restore to pre-construction condition.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 21 00

CONTINGENCY ALLOWANCES

PART 1 – GENERAL

1.1 SCOPE

- A. Scope:
 - 1. This Section includes administrative and procedural requirements governing contingency allowances:
- B. Authorization of Allowances:
 - 1. Work that will be paid under an allowance will be authorized in Owner's written instruction to Contractor using the form included with this Section or other written allowance authorization issued by Owner.
 - 2. Do not perform Work under an allowance without written authorization of Owner.

1.2 CONTINGENCY ALLOWANCE

- A. Contingency allowances are stipulated amounts available as reserve for sole use by Owner to cover unanticipated costs.
- B. When authorization of Work under contingency allowance is contemplated by Owner for a defined scope, submit Change Proposal to Engineer. Prepare Change Proposal in accordance with the General Conditions and Supplementary Conditions and Section 01 26 00, Contract Modification Procedures, except those payments within limit of contingency allowance shall exclude cost of bond and insurance premiums.

1.3 SCHEDULE OF ALLOWANCES

- A. Contingency Allowances:
 - 1. Schedule of Contingency Allowances: Include the following allowances for use in accordance with Owner's instructions:

Contract and Bid/Payment Item No.	Allowance Name	Allowance Amount
1-G / Payment Item 2	General Contingency	\$75,000
2-E / Payment Item 2	General Contingency	\$50,000

3-H / Payment Item 2	General Contingency	\$25,000
4-P / Payment Item 2	General Contingency	\$15,000

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

- A. The document listed below and attached following this Section’s “End of Section” designation, are part of this Specification Section.
 - 1. Allowance Authorization Form (one page).

+ + END OF SECTION + +

ALLOWANCE AUTHORIZATION

Project: _____	Authorization Number: _____
_____	From: _____
To: _____	Date: _____
_____	Engineer Project No.: _____
Re: _____	Contract For: _____

You are authorized to perform the following item(s) of Work and to adjust the Contract allowance amount accordingly:

1. [Allowance Title] / [Title of Change]:

THIS IS NOT A CHANGE ORDER AND DOES NOT INCREASE OR DECREASE THE CONTRACT PRICE

Original Allowance	\$ _____
Allowance Expenditures prior to this Authorization.....	\$ _____
Allowance Balance prior to this Authorization.....	\$ _____
Allowance will be decreased by this Authorization.....	\$ _____
New Allowance Balance.....	\$ _____

RECOMMENDED BY

ARCADIS U.S., Inc.
Engineer

By _____ Date _____

OWNER APPROVAL

Owner

By _____ Date _____

CONTRACTOR ACCEPTANCE

Contractor

By _____ Date _____

☐ Attachments

Copies: ☐ Owner ☐ Contractor ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ File

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SECTION 01 22 13

MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.1 SUMMARY

A. Scope:

1. Items listed starting in Article 1.4 of this Section refer to and are the same pay items listed in the Bid Form and constitute all pay items for completing the Work.
2. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, plant or facility services, Contractor's or Engineer's field offices, layout surveys, Project signs, sanitary requirements, testing, safety provisions and safety devices, submittals and record drawings, water supplies, power and fuel, maintenance of traffic, removal of waste, security, coordination with Owner's operations, information technology (including hardware, software, and services) required during construction, commissioning where specified, bonds, insurance, or other requirements of the General Conditions, Supplementary Conditions, Division 01 Specifications, and other requirements of the Contract Documents.
3. Compensation for all services, items, materials, and equipment shall be included in prices stipulated for lump sum and unit price pay items listed in this Section and included in the Contract.

1.2 RELATED PROVISIONS

- A. Payments to Contractor: Refer to General Conditions, Supplementary Conditions, Agreement, and Section 01 29 76, Progress Payment Procedures.
- B. Changes in Contract Price: Refer to General Conditions, Supplementary Conditions, and Section 01 26 00, Contract Modification Procedures.
- C. Schedule of Values: Refer to General Conditions, Supplementary Conditions, and Section 01 29 73, Schedule of Values.

1.3 GENERAL CONSTRUCTION

A. Item 1 – Lump Sum Base Bid:

1. Measurement and Payment: Lump sum payment for Item 1 will be full compensation for completing the Work, as shown or indicated.

B. Item 2 – Contingency Allowance:

1. Measurement: Section 01 21 00, Allowances, includes a stipulated amount available as reserve for sole use by Owner to cover unanticipated costs.

2. Payment: Payment for Work authorized under Item 1.2 will be full compensation for providing all Work authorized under the contingency allowance, complete as shown, indicated, or directed by Engineer. Work authorized under contingency allowance may be included in subsequent Application(s) for Payment, as applicable, following authorization of and performance of contingency allowance Work.

1.4 CONTRACT NO. 2 – HEATING, VENTILATING, AND AIR CONDITIONING

- A. Item 2.1 – Heating, Ventilating, and Air Conditioning Construction:
 1. Measurement and Payment: Lump sum payment for Item 2.1 will be full compensation for completing the Work as shown and indicated under Contract No. 2, Heating, Ventilating, and Air Conditioning.
- B. Item 2 – Contingency Allowance:
 1. Measurement: Section 01 21 00, Allowances, includes a stipulated amount available as reserve for sole use by Owner to cover unanticipated costs.
 2. Payment: Payment for Work authorized under Item 1.2 will be full compensation for providing all Work authorized under the contingency allowance, complete as shown, indicated, or directed by Engineer. Work authorized under contingency allowance may be included in subsequent Application(s) for Payment, as applicable, following authorization of and performance of contingency allowance Work.

1.5 CONTRACT NO. 3 – PLUMBING

- A. Item 3.1 – Plumbing:
 1. Measurement and Payment: Lump sum payment for Item 3.1 will be full compensation for completing the Work as shown and indicated under Contract No. 3, Plumbing.
- B. Item 2 – Contingency Allowance:
 1. Measurement: Section 01 21 00, Allowances, includes a stipulated amount available as reserve for sole use by Owner to cover unanticipated costs.
 2. Payment: Payment for Work authorized under Item 1.2 will be full compensation for providing all Work authorized under the contingency allowance, complete as shown, indicated, or directed by Engineer. Work authorized under contingency allowance may be included in subsequent Application(s) for Payment, as applicable, following authorization of and performance of contingency allowance Work.

1.6 CONTRACT NO. 4 – ELECTRICAL

- A. Item 4.1 – Electrical Construction:
 1. Measurement and Payment: Lump sum payment for Item 4.1 will be full compensation for completing the Work as shown and indicated under Contract No. 4, Electrical.
- B. Item 2 – Contingency Allowance:

1. Measurement: Section 01 21 00, Allowances, includes a stipulated amount available as reserve for sole use by Owner to cover unanticipated costs.
2. Payment: Payment for Work authorized under Item 1.2 will be full compensation for providing all Work authorized under the contingency allowance, complete as shown, indicated, or directed by Engineer. Work authorized under contingency allowance may be included in subsequent Application(s) for Payment, as applicable, following authorization of and performance of contingency allowance Work.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope: Section includes:
 - 1. Administrative and procedural requirements for selecting materials and equipment for the Project.
 - 2. Procedural requirements for substitutions of materials and equipment.
 - 3. Procedural requirements for substitute construction methods or procedures, when construction methods or procedures are specified.
- B. A proposed substitute will not be accepted for review if:
 - 1. Approval would require changes in design concept or a substantial revision of the Contract Documents.
 - 2. Approval would delay completion of the Work or the work of other contractors.
 - 3. Substitution request is indicated or implied on a Shop Drawing or other submittal, or on a request for interpretation or clarification, and is not accompanied by CONTRACTOR's formal and complete request for substitution.
- C. If proposed substitute is not approved, CONTRACTOR shall provide the specified materials, equipment, method, or procedure, as applicable.
- D. Approval of a substitute does not relieve CONTRACTOR from requirement for submitting Shop Drawings and other submittals in accordance with the Contract Documents.
- E. ENGINEER and OWNER have the right to rely upon the completeness and accuracy of the information included in CONTRACTOR's request for approval of a substitute, and CONTRACTOR accepts full responsibility for the completeness and accuracy thereof.
- F. When approved substitute is defective or fail to perform in accordance with the Contract Documents, responsibility for remedying the defect or failure resides solely with CONTRACTOR and Supplier.

1.2 SUBSTITUTE MATERIALS AND EQUIPMENT

- A. Procedure:
 - 1. Submit requests for substitution in accordance with requirements for furnishing submittals, as indicated in Section 01 33 00, Submittal Procedures.
 - 2. Submit separate request for each proposed substitute.

3. Submit request for substitution using forms attached to this Section. Complete all information requested on each form, and enclose with the forms supplementary information as required. In addition to requirements of the General Conditions and information required on substitution request forms, include with each substitute request the following:
 - a. Identification of the materials and equipment (as applicable), including manufacturer's name and address.
 - b. Manufacturer's literature with description of the materials and equipment, performance and test data, and reference standards with which materials and equipment comply.
 - c. Samples, when appropriate.
 - d. Name and address of similar projects on which the materials and equipment were used, date of installation, and names and contact information (including telephone number) for the facility operations and maintenance manager.

1.3 SUBSTITUTE CONSTRUCTION METHODS OR PROCEDURES

- A. Where construction methods or procedures are specified, for a period of 60 days after the Effective Date of the Contract, ENGINEER will consider CONTRACTOR's written requests for substitute construction methods or procedures shown or specified in the Contract Documents.
- B. The provisions of the General Conditions, as may be modified by the Supplementary Conditions, regarding substitute items of materials and equipment are hereby extended to apply to substitute construction methods or procedures.
- C. Procedure:
 1. Submit requests for substitution in accordance with requirements for furnishing submittals, as indicated in Section 01 33 00, Submittal Procedures.
 2. Submit separate request for each proposed substitute.
 3. Submit request for substitution using forms attached to this Section. Complete all information requested on each form, and enclose with the forms supplementary information as required. In addition to requirements of the General Conditions and information required on substitution request forms, include with each substitute request the following:
 - a. Detailed description of proposed method or procedure.
 - b. Itemized comparison of the proposed substitution with the specified method or procedure.
 - c. Drawings illustrating method or procedure.
 - d. Other data required by ENGINEER to establish that proposed substitution is equivalent to specified method or procedure.

1.4 CONTRACTOR'S REPRESENTATIONS

- A. In submitting request for substitution, CONTRACTOR represents that:

1. CONTRACTOR has read and fully understands the provisions regarding substitutes as indicated in the General Conditions, as may be modified by the Supplementary Conditions.
2. Substitution request is complete and includes all information required by the Contract Documents.
3. CONTRACTOR certifications required by the General Conditions, as may be modified by the Supplementary Conditions, are valid and made with CONTRACTOR's full knowledge, information, and belief.
4. CONTRACTOR will provide the same or better guarantees or warranties for proposed substitute as for the specified materials, equipment, methods, or procedures, as applicable.
5. CONTRACTOR waives all Claims for additional costs or extension of time related to proposed substitute that subsequently may become apparent.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

- A. The documents listed below, and attached following this Section's "End of Section" designation, are part of this Specification Section.
 1. Substitution Request Form (two pages).
 2. Product Substitution Checklist (one page).

+ + END OF SECTION + +

SUBSTITUTION REQUEST

Project: _____ Substitution Request Number: _____

From: _____
To: _____ Date: _____

Engineer Project. No. _____
Re: _____ Contract For: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitute: _____
Manufacturer: _____ Address: _____ Phone: _____
Trade Name: _____ Model No.: _____
Installer: _____ Address: _____ Phone: _____
History: ☐ New product ☐ 1 to 4 years old ☐ 5 to 10 years old ☐ More than 10 years old

Differences between proposed substitute and specified item: _____

☐ Point-by-point comparative data attached — REQUIRED BY THE CONTRACT DOCUMENTS

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Engineer: _____
Address: _____ Owner: _____
_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

Savings to Owner for accepting substitute: _____ (\$ _____)
(attach detailed, itemized estimate)

Proposed substitute changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.
(clarify whether change is to Substantial Completion, Milestone, or time for readiness for final payment)

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

SUBSTITUTION REQUEST

(Continued)

☐ Substitute product, method, or procedure is subject to payment of licensing fee or royalty (check if “yes” and attach information)

☐ Substitute product, method, or procedure is patented or copyrighted (check if “yes” and attach information)

The undersigned certifies:

- Representations in the General Conditions and in Section 01 25 00, Substitution Procedures, regarding substitutions are valid.
- Same or better warranty and guarantee will be furnished for proposed substitution as for specified item.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitute will have no adverse effect on other trades and will not affect or delay Progress Schedule.
- Cost data as stated above is complete. Claims for additional costs or time related to accepted substitution which may subsequently become apparent are waived.
- Proposed substitute does not affect dimensions and functional clearances.
- Payment will be made for Engineer’s review and changes, if any, to the design and Contract Documents, and construction costs caused by the substitute.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

Attachments: ☐

ENGINEER’S REVIEW AND ACCEPTANCE (OR NON-ACCEPTANCE) WILL BE DOCUMENTED IN A FIELD ORDER OR CHANGE ORDER, AS APPROPRIATE. _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ Engineer
☐ Other:

PRODUCT SUBSTITUTION CHECKLIST

Date: _____ Re: _____

Engineer Proj No.: _____ Manufacturer's Project No.: _____

Filing No.: _____ Contract For: _____

Item Equivalence:

- ☐ Is the submitted item equivalent to the specified item? _____
- ☐ Does it serve the same function? _____
- ☐ Does it have the same dimensions? _____
- ☐ Does it have the same appearance? _____
- ☐ Will it last as long? _____
- ☐ Does it comply with the same codes, and standards and performance requirements? _____
- ☐ Has the item been used locally, and where are the projects? _____

- ☐ Has a problem occurred with the item, and what was the remedy? _____

Effect on the Project:

- ☐ Will the substitute affect other aspects of the construction? _____
- ☐ Are any details affected and are changes required? _____
- ☐ What is the cost of the changes? _____
- ☐ Who pays for the required changes? _____
- ☐ Are Contract Times affected? _____

Effect on the Warranty:

- ☐ How does the proposed warranty differ from the specified warranty? _____

- ☐ Does the manufacturer have a track record of standing behind the warranty? _____

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

- A. Scope.
 - 1. This Section includes administrative and procedural requirements governing the following:
 - a. Requests for interpretation.
 - b. Written clarifications.
 - c. Minor changes in the Work and Field Orders.
 - d. Work Change Directives.
 - e. Proposal requests.
 - f. Change Proposals.
 - g. Change Orders.
- B. Submit Contract modification documents to Engineer, addressed to the contact person and contact information indicated in Section 01 33 00, Submittal Procedures, and in accordance with Section 01 31 26, Electronic Document Protocol.

1.2 REQUESTS FOR INTERPRETATION

- A. General.
 - 1. Do not transmit request for interpretation when another form of communication is appropriate, such as Contractor's submittals, requests for approvals of substitutes, notices, ordinary correspondence, or other form of communication. Improperly prepared or inappropriate requests for interpretation will be returned without response or action by Engineer.
 - 2. Do not submit request for interpretation or clarification when:
 - a. answer may be obtained by observations at the Site; or
 - b. required information is clearly indicated in the Contract Documents; or
 - c. required information is included in industry standards referenced in the Contract Documents or Supplier's instructions that are consistent with the Contract Documents; or
 - d. answers are reasonably inferable from any of foregoing.
 - 3. Contractor shall have sole financial responsibility for requests for interpretations or clarifications that are submitted late.
- B. Procedure.

1. Transmit requests for interpretation to Engineer in accordance with Section 01 31 26, Electronic Document Protocol, and requirements of this Section. Include with each request for interpretation a separate letter of transmittal.
2. Engineer's response to requests for interpretation will be transmitted in accordance with Section 01 31 26, Electronic Document Protocol, and requirements of this Section. Each response to a request for interpretation will include a separate letter of transmittal.
3. Engineer's written response to each request for interpretation will be distributed to:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).
4. If Engineer requests additional information to make an interpretation, entity requesting the interpretation shall transmit the information requested within ten days, unless Engineer allows additional time, via correspondence referring to request for interpretation number.
5. If Contractor or Owner believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of Engineer's interpretation, advise Engineer in writing before proceeding with the Work associated with the request for interpretation.
6. If, after this initial communication, either Owner or Contractor believes that change in Contract Price or Contract Times, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.

C. Preparation of Requests for Interpretation:

1. Prepare each request for interpretation on the "Request for Interpretation" form included with this Section, or other form acceptable to Engineer.
2. Numbering system for Requests for Information shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First request for interpretation on the general contract for project titled, "Contract A15" would be, "RFI No. A15-GC-001".
3. In space provided on form, describe the interpretation requested. Provide additional sheets as necessary. Include text and sketches as required in sufficient detail to describe the need for an interpretation.
4. When applicable, request for interpretation shall include Contractor's recommended resolution.

1.3 WRITTEN CLARIFICATIONS

A. General:

1. Written clarifications, when required, will be initiated and issued by Engineer.
2. Written clarifications do not change the Contract Price or Contract Times, and do not alter the Contract Documents.

B. Procedure.

1. Engineer's written clarifications will be transmitted as correspondence in accordance with Section 01 31 26, Electronic Document Protocol, and requirements of this Section.
2. Each written clarification will be distributed to:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).
3. If Contractor or Owner believes that a change in the Contract Price or Contract Times, or other change to the Contract is required as a result of Engineer's written clarification, advise Engineer in writing before proceeding with the Work associated with the written clarification.
4. If, after this initial communication, either Owner or Contractor believes that change in Contract Price or Contract Times, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
5. If Engineer's written clarification is unclear, prepare and transmit a request for interpretation.

1.4 MINOR CHANGES IN THE WORK AND FIELD ORDERS

A. General:

1. Field Orders, when required, will be initiated and issued by Engineer in the form of Engineers Joint Contract Documents Committee document EJCDC® C-942, "Field Order".

B. Procedure.

1. Field Orders will be transmitted in accordance with Section 01 31 26, Electronic Document Protocol, and requirements of this Section. Each Field Order will include a separate letter of transmittal.
2. Each Field Order will be distributed to:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).
3. If Contractor or Owner believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of a Field Order, so advise Engineer in writing before proceeding with the Work associated with the Field Order.
4. If, after this initial communication, Contractor believes that change in Contract Price or Contract Times, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
5. If the Field Order is unclear, submit request for interpretation.

1.5 WORK CHANGE DIRECTIVES

A. General:

1. Work Change Directives will be in the form of EJCDC® C-940, "Work Change Directive".

B. Procedure.

1. Work Change Directives signed by Owner and Engineer will be transmitted in accordance with Section 01 31 26, Electronic Document Protocol, and requirements of this Section. Each Work Change Directive will include a separate letter of transmittal. Contractor shall print three originals of Work Change Directive for Contractor's signature.
2. Contractor shall promptly sign each original Work Change Directive and, within five days of receipt, return all originals to Engineer.
3. Original, signed Work Change Directives will be distributed as follows:
 - a. Contractor: One original.
 - b. Owner: One original.
4. One copy of each Work Change Directive will be distributed to:
 - a. Resident Project Representative (RPR).
5. Transmit documentation of costs to Engineer as a Change Proposal.

1.6 PROPOSAL REQUESTS

A. General:

1. Proposal Requests are for requesting the effect on the Contract Price or Contract Times and other information relative to contemplated changes in the Work. Proposal Requests do not authorize changes or variations in the Work, and do not change the Contract Price or Contract Times or terms of the Contract.
3. Proposal Requests will be issued by Engineer using the "Proposal Request" form included with this Section.

B. Procedure.

1. Proposal Requests will be transmitted in accordance with Section 01 31 26, Electronic Document Protocol, and requirements of this Section. Each Proposal Request will include a separate letter of transmittal.
2. Each signed Proposal Request will be transmitted to:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).
3. Transmit request for interpretation to clarify conflicts, errors, ambiguities, and discrepancies in Proposal Request.
4. Upon receipt of Proposal Request prepare and transmit to Engineer a Change Proposal for the proposed Work described in the Proposal Request.

1.7 CHANGE PROPOSALS

A. General.

1. Change Proposals shall be submitted on the "Change Proposal" form included with this Section.

B. Procedure.

1. Transmit Change Proposals in accordance with Section 01 31 26, Electronic Document Protocol, and requirements of this Section. Include with each Change Proposal all required supporting documentation and a separate letter of transmittal.
 2. Engineer's Review and Requests for Additional Information:
 - a. When, Engineer requests additional information to render a decision, submit required information within five days of receipt of Engineer's request, unless Engineer allows more time. Submit the required information via correspondence that refers to the specific Change Proposal number.
 - b. Owner will transmit to Engineer such comments, if any, that Owner has on the Change Proposal, within 10 days of Owner's receipt of the Change Proposal.
 - c. Engineer's response to Change Proposals will be transmitted in accordance with Section 01 31 26, Electronic Document Protocol, and requirements of this Section, the General Conditions, and the Supplementary Conditions.
 3. Engineer's response to each Change Proposal will be distributed to:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).
 4. If Change Proposal is recommended for approval by Engineer and is approved by Owner, a Change Order will be issued or, when applicable, an appropriate use of contingency allowance will be authorized by Owner.
- C. Preparation of Change Proposals:
1. Numbering system for Change Proposals shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First Change Proposal for the general contract for project named "Contract A15" would be, "Change Proposal No. A15-GC-001".
 2. In space provided on Change Proposal form:
 - a. Describe scope of each proposed change. Include text and sketches on additional sheets as required to provide detail sufficient for Engineer's review and response. If a change item is submitted in response to Proposal Request, write in as scope, "In accordance with Proposal Request No." followed by the Proposal Request number.
 - b. Submit justification for each proposed change. If change is in response to proposal request, write in as justification, "In accordance with Proposal Request No." followed by the proposal request number.
 - c. List the total change in the Contract Price and Contract Times for each separate change item included in the Change Proposal.
 3. Unless otherwise directed by Engineer, attach detailed breakdowns of pricing to the Change Proposal.

1.8 CHANGE ORDERS

A. General:

1. Change Orders will be in the form of EJCDC® C-941, “Change Order”.
- B. Procedure.
1. Change Orders for signature by Contractor will be transmitted in accordance with Section 01 31 26, Electronic Document Protocol, and requirements of this Section. Each Change Order will include a separate letter of transmittal. Contractor shall print three originals of Change Order for Contractor’s signature.
 2. Contractor shall promptly sign each original Change Order and, within five days of receipt, return all originals to Engineer.
 3. Engineer will sign each original Change Order and forward them to Owner.
 4. After approval and signature by Owner, original Change Orders will be distributed as indicated below.
 5. Original, signed Change Orders will be distributed as follows:
 - a. Contractor: One original.
 - b. Owner: One original.
 6. One copy of each Change Order will be distributed to:
 - a. Resident Project Representative (RPR).

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

- A. The forms listed below, following this Section’s “End of Section” designation, are part of this Specifications Section:
1. Request for Interpretation form (one page).
 2. Proposal Request form (one page).
 3. Change Proposal form (one page).

+ + END OF SECTION + +

REQUEST FOR INTERPRETATION

Owner: _____

Project Name: _____

Contractor: _____ RFI No. _____

Date Transmitted: _____ Date Received: _____

Date Response Requested: _____ Date Response Transmitted: _____

Subject: _____

Specification Section and Paragraph: _____

Drawing References: _____

INTERPRETATION REQUESTED:

Signature: _____ Date: _____

ENGINEER'S RESPONSE:

Signature: _____ Date: _____

PROPOSAL REQUEST

Owner: _____

Project Name: _____

Proposal Request No.: _____ Date: _____

Contract Name and No.: _____

Contractor: _____

Other Contracts Involved in Proposed Change: _____

TO CONTRACTOR: Please submit a complete Change Proposal for the proposed modifications described below. If the associated Change Proposal is approved, a Change Order or allowance authorization will be issued to authorize adjustment so the scope of the Work. This Proposal Request is not a Change Order, Work Change Directive, Field Order, or an authorization to proceed with the proposed Work described below.

SCOPE OF PROPOSED WORK:

1. *Item:*

2. *Item:*

3. *Item:*

Proposal requested by: _____

Signature of Requestor: _____

CHANGE PROPOSAL

Owner: _____

Project Name: _____

Change Proposal No.: _____ Date: _____

Submitted in Response to Proposal Request No.: _____

Contract Name and No.: _____

Contractor: _____

Subject: _____

The following changes to the Contract are proposed:

SCOPE OF WORK: *(attach and list supporting information as required)*

1. *Item:*

2. *Item:*

JUSTIFICATION:

1. *Item:*

2. *Item:*

CHANGES IN CONTRACT PRICE AND CONTRACT TIMES:

We propose that the Contract Price and Contract Times be changed as follows:

For Contract Price, attach detailed cost breakdowns for Contractor and Subcontractors, Supplier quotations, and other information required.

For the Contract Times, state increase, decrease, or no change to Contract Times for Substantial Completion, readiness for final payment, and Milestones, if any. If increase or decrease, state specific number of days for changes to the Contract Times.

Description	Amount	Contract Times (days)	
		Substantial	Final
1. Item	\$0.00	0	0
2. Item	\$0.00	0	0
Total This Change Proposal	\$0.00	0	0

Changes to Milestones, if any: _____

Contractor represents that supporting data attached to this Change Proposal are accurate and complete. The requested time or price adjustment indicated in this Change Proposal is the entire adjustment to which Contractor believes it is entitled as a result of the proposed change(s) indicated herein.

Change Proposal by: _____

Signature of Proposer: _____

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SECTION 01 29 73

SCHEDULE OF VALUES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall prepare and submit to ENGINEER for acceptance a Schedule of Values that allocates cost to each item of the Work. Schedule of Value list of line items shall correspond to each aspect of the Work, establishing in detail the portion of the Contract Price allocated to each major component of the Work.
2. Upon request of ENGINEER, support values with data that substantiate their correctness.
3. Submit preliminary Schedule of Values to ENGINEER for initial review. CONTRACTOR shall incorporate ENGINEER's comments into the Schedule of Values and resubmit to ENGINEER. ENGINEER may require corrections and re-submittals until Schedule of Values is acceptable.
4. Schedule of Values may be used as a basis for negotiating price of changes, if any, in the Work.
5. Schedule of Values and the Progress Schedule updates specified in Section 01 32 16, Progress Schedule, will be basis for preparing each Application for Payment.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Submit to ENGINEER Schedule of Values in the form and quantity required in Section 01 33 00, Submittal Procedures, and in accordance with Section 01 31 26, Electronic Communication Protocols.
2. Content of Schedule of Values submittals shall be in accordance with Article 1.3 of this Section.
3. Timing of Submittals:
 - a. Submit preliminary Schedule of Values within ten days following the date that the Contract Times commence running in accordance with the Notice to Proceed.
 - b. Submittal of the Schedule of Values for acceptance by ENGINEER shall be in accordance with the General Conditions. ENGINEER will not accept Applications for Payment without an acceptable Schedule of Values.
 - c. When required by ENGINEER, promptly submit updated Schedule of Values to include cost breakdowns for changes in the Contract Price.

1.3 SCHEDULE OF VALUES FORMAT AND CONTENT

- A. Organization and Major Elements of Schedule of Values
 - 1. Prepare Schedule of Values on the “progress estimate” or “continuation sheets”, as applicable, of the Application for Payment form indicated in Section 01 29 76, Progress Payment Procedures.
 - 2. Organization in Accordance with Specification Sections:
 - a. Within each work area, organize the Schedule of Values by the various Specifications Section numbers and titles included in the Contract Documents.
 - b. Label each row in the Schedule of Values with the appropriate Specifications Section number. Include an amount for each row in the Schedule of Values.
 - c. List sub-items of major products or systems, as appropriate or when requested by ENGINEER.
 - 3. Include in Schedule of Values unit price payment items with their associated quantity. Provide in the Schedule of Values detailed breakdown of unit prices when required by ENGINEER.
- B. Requirements for preliminary Schedule of Values and Schedule of Values are:
 - 1. Subcontracted Work:
 - a. Schedule of Values shall show division of Work between CONTRACTOR and Subcontractors.
 - b. Line items for Work to be done by Subcontractor shall include the word, “(SUBCONTRACTED)”.
 - 2. Apportionment between Materials and Equipment, and Installation:
 - a. Schedule of Values shall include breakdown of costs for materials and equipment, installation, and other costs used in preparing the Bid by CONTRACTOR and each Subcontractor.
 - b. List purchase and delivery costs for materials and equipment for which CONTRACTOR may apply for payment as stored materials.
 - 3. Sum of individual values shown on the Schedule of Values shall equal the total of associated payment item. Sum of payment item totals in the Schedule of Values shall equal the Contract Price.
 - 4. Overhead and Profit: Include in each line item a directly proportional amount of CONTRACTOR’s overhead and profit. Do not include overhead and profit as separate item(s).
 - 5. Include separate line item for each allowance, and for each unit price item.
 - 6. Bonds and Insurance Costs: Include line item for bonds and insurance in amount not exceeding 2.0 percent of the Contract Price. This amount may be applied for in the first Application for Payment.
 - 7. Include relevant items for the General Conditions, permits (when applicable), construction Progress Schedule, and other items required by ENGINEER. Include such items in Applications for Payment on payment schedule acceptable to ENGINEER
 - 8. Line items for Site maintenance such as dust control, snow removal, compliance with storm water pollution prevention plans and permits, spill

prevention control and countermeasures plans, and for construction photographic documentation; temporary utilities and temporary facilities, field offices, temporary controls, field engineering, and similar Work shall be included in the Schedule of Values and proportioned in Applications for Payment throughout duration of the Work.

9. Mobilization and Demobilization:
 - a. Include separate line items under each appropriate payment item for mobilization and demobilization. Document for ENGINEER the activities included in mobilization and demobilization line items.
 - b. Mobilization will be limited to 2.0 percent of the Contract Price, and will be paid in two payments, each fifty percent of total amount for mobilization.
 - c. Demobilization shall be not less than 1.0 percent of the Contract Price and shall be included with the Application for Payment following Substantial Completion, or other schedule acceptable to ENGINEER.
10. Costs for Shop Drawings, Samples, and other submittals; operations and maintenance manuals; field testing; and training of operations and maintenance personnel shall be as follows, unless otherwise accepted by ENGINEER:
 - a. Up to eight percent of cost (including all associated overhead and profit) of each equipment item, exclusive of transportation and installation costs associated with that item, may be allocated to preparation of Shop Drawings, Samples, and other submittals and may be included in the Application for Payment following ENGINEER's approval of Shop Drawings (and acceptance of other submittals, as applicable) required for fabricating or purchasing for that item for the Work.
 - b. Up to three percent of total cost of each item (including all associated overhead and profit), including materials and equipment, and installation, may be apportioned to testing and included in the Application for Payment following ENGINEER's acceptance of the associated written field testing report(s).
 - c. Up to a total of four percent of equipment cost (including all associated overhead and profit), exclusive of transportation and installation costs, may be apportioned to operations and maintenance manuals and training of operations and maintenance personnel, which may be included in the Application for Payment following completion of training for that item.
11. Project Record Documents:
 - a. Include in the Schedule of Values a line item with appropriate value for Project record documents.
 - b. If adequate record documents are maintained, up to 50 percent of the value of the record documents line item will be eligible for payment, spread evenly over those progress payments in which construction at the Site is performed.
 - c. Remainder of Project record documents line item will be eligible for payment when complete record documents are submitted in accordance with the Contract Documents. If record documents submitted are unsatisfactory to ENGINEER, amount may be reduced via set-offs in accordance with the Contract Documents.

12. Schedule of Values shall include an itemized list of Work by work area, as applicable, for Work included in Section 01 14 16, Coordination with Owner's Operations.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 29 76

PROGRESS PAYMENT PROCEDURES

PART 1 – GENERAL

1.1 PROGRESS PAYMENTS

A. Scope:

1. CONTRACTOR's requests for payment shall be in accordance with the Agreement, General Conditions and Supplementary Conditions, and the Specifications.
2. Form: Applications for Payment shall be in the form of Engineers Joint Contract Documents Committee (EJCDC) document EJCDC® C-620, "Contractor's Application for Payment", 2013 edition or later.

B. Procedure:

1. Review with Resident Project Representative (RPR) quantities and the Work proposed for inclusion in each progress payment. Application for Payment shall cover only the Work and quantities recommended by the RPR.
2. CONTRACTOR will be required to review with ENGINEER or RPR the status of record documents in connection with ENGINEER's review of each Application for Payment. Failure to maintain record document current will be just cause for ENGINEER to recommend a reduction in payment for record documents in accordance with Section 01 29 73, Schedule of Values, and will entitle OWNER to set-offs in accordance with the Contract Documents.
3. Submit to ENGINEER three printed originals, each with CONTRACTOR's original, "wet" signature, of each complete Application for Payment and other documents to accompany the Application for Payment.
4. ENGINEER will act on request for payment in accordance with the General Conditions and Supplementary Conditions.

C. Each request for progress payment shall include:

1. Completed Application for Payment form, including summary/signature page, progress estimate sheets, and stored materials summary. Progress estimate sheets shall have the same level of detail as the Schedule of Values.
2. Documentation for Stored Materials and Equipment:
 - a. For materials and equipment not incorporated in the Work but suitably stored, submit documentation in accordance with the General Conditions and Supplementary Conditions.
 - b. Photographs of the stored items at the storage location, in accordance with requirements for progress photographs in Section 01 32 33, Photographic Documentation. Submit photographs sufficient to clearly indicate each stored item, clearly showing marking of OWNER's property in accordance with Paragraph 1.2.C.1 of this section. Such photographs do not count as photographs required under Section 01 32 33, Photographic Documentation. For each month that such

- item(s) are stored, take and submit monthly new photographs of each stored item.
- c. Legibly indicate on invoice or bill of sale the specific stored materials or equipment included in the payment request and corresponding bid/payment item number for each and the Supplier price for each item.
3. Listing of Subcontractors and Suppliers:
 - a. In accordance with the General Conditions, submit not less than monthly updated listing of all Subcontractors and Suppliers known to CONTRACTOR, whether or not such entities have a contract directly with CONTRACTOR.
 - b. Submit complete information using the form attached to this Section.
 4. Allowance Work:
 - a. For payment requests that include payment for Work under an allowance, include with the progress payment request copy of OWNER's authorization of the associated allowance Work, in accordance with Section 01 21 00, Allowances.
 5. Partial Release or Reduction of Retainage:
 - a. For each Application for Payment where CONTRACTOR requests partial release or reduction of retainage in any amount (other than request for final payment), submit with associated progress payment request consent of surety to partial release or reduction of retainage, duly completed by CONTRACTOR and surety.
 - b. Acceptable form includes AIA® G707A™, "Consent of Surety to Reduction in or Partial Release of Retainage", 1994 or later edition, or other form acceptable to OWNER.
 - c. For payment requests that include reduction in or payment of retainage in an amount greater than that required by the Contract Documents, obtain OWNER's concurrence for partial release or reduction in retainage prior to submitting such Application for Payment.

D. Final Payment:

1. Requirements for request for final payment are in the General Conditions, as may be modified by the Supplementary Conditions, and Section 01 77 19, Closeout Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

- A. The forms listed below, following this Section’s “End of Section” designation, are part of this Specification Section:
 - 1. List of Subcontractors and Suppliers form (two pages).

+ + END OF SECTION + +

LIST OF SUBCONTRACTORS AND SUPPLIERS

Owner: _____

Project Name: _____

Contractor: _____ Date: _____

Contract Designation: _____

Indicate below complete information for each Subcontractor and Supplier known to Contractor, regardless of whether the firm has a direct contract with Contractor. Include all lower-tier Subcontractors and associated Suppliers. Copy and paste the paragraphs below as required to indicate all Subcontractors and Suppliers.

SUBCONTRACTORS

1. Subcontractor Name:

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Work Under Specifications Section Nos.:*
- *Brief Description of Work:*
- *Current Subcontract Price:*
- *Approximate Subcontract Start Date:*
- *Approximate Subcontract End Date:*

2. Subcontractor Name:

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Work Under Specifications Section Nos.:*
- *Brief Description of Work:*
- *Current Subcontract Price:*
- *Approximate Subcontract Start Date:*
- *Approximate Subcontract End Date:*

3. Subcontractor Name:

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Work Under Specifications Section Nos.:*
- *Brief Description of Work:*
- *Current Subcontract Price:*
- *Approximate Subcontract Start Date:*
- *Approximate Subcontract End Date:*

Total of Subcontract Prices for all subcontracts equals approximately ____ percent of the Contract Price (*Contractor to fill in blank monthly*)

SUPPLIERS

1. Supplier Name:

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Furnishing Items Under Specifications Section Nos.:*
- *Brief Description of Items:*
- *Current Purchase Order Amount:*
- *Approximate Purchase Order Date:*
- *Approximate Purchase Order End Date:*

2. Supplier Name:

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Furnishing Items Under Specifications Section Nos.:*
- *Brief Description of Items:*
- *Current Purchase Order Amount:*
- *Approximate Purchase Order Date:*
- *Approximate Purchase Order End Date:*

3. Supplier Name:

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Furnishing Items Under Specifications Section Nos.:*
- *Brief Description of Items:*
- *Current Purchase Order Amount:*
- *Approximate Purchase Order Date:*
- *Approximate Purchase Order End Date:*

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SECTION 01 31 16

MULTIPLE CONTRACT COORDINATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Prime Contractors:

- a. Prime CONTRACTORS shall coordinate their work and cooperate among themselves as required for satisfactory, expeditious completion of the Project (i) within the Contract Times, (ii) in accordance with the Progress Schedule, and (iii) in accordance with the Contract Documents.
- b. Prime contracts for the Project are indicated in Section 01 12 13, Summary of Work.
- c. Additional requirements regarding coordination among prime contractors are in the General Conditions and elsewhere in the Contract Documents

2. Subcontractors and Suppliers:

- a. Prime CONTRACTORS shall coordinate and cooperate fully with their own Subcontractors and Suppliers and others whose services, materials, or equipment, are required to complete their Work in accordance with the Contract Documents.
- b. Additional requirements regarding prime CONTRACTORS' responsibility for coordinating and scheduling their Subcontractors and Suppliers are in the General Conditions and elsewhere in the Contract Documents.

B. Coordination:

1. Each prime CONTRACTOR shall review the Progress Schedule and installation procedures under other Specifications Sections and other prime contracts that may affect their Work, and coordinate installation of such work with appropriate entity or entities.
2. General CONTRACTOR shall provide openings in concrete formwork and in other construction as required to accommodate the Work under other Specifications Sections and the work of other contractors, assist other contractors in installing "built-in" items required for other contractors' work, and protect such "built-in" items and other work of other contractors from damage.
3. Prime CONTRACTORS shall notify ENGINEER in writing if prime CONTRACTOR believes that another contractor is failing to coordinate its work with work of other contractors. ENGINEER will promptly investigate

- the charge and will issue such clarifications and interpretations to other contractor(s) as the situation requires.
4. Should a prime CONTRACTOR suffer loss, damages, delay, or require other relief with respect to the terms of the Contract Documents because of the actions or inactions of another contractor working for OWNER at the Site, said prime CONTRACTOR shall prepare and transmit a Change Proposal in accordance with the Contract Documents. OWNER may in turn file a Claim against the infringing contractor, in accordance with the Contract Documents.
 5. OWNER does not guarantee continuous efficiency of prime contractors.

1.2 QUALITY ASSURANCE

A. Coordination Meetings:

1. Coordination meetings shall be held on a weekly basis, unless mutually agreed by the prime CONTRACTORS, and other interested or involved entities that another schedule is suitable.
2. Site Mobilization Meeting:
 - a. Initial meeting will be the Site mobilization meeting (unless such meeting is held as part of the preconstruction conference) and will be held within ten days after the Contract Times commence running.
 - b. At the Site mobilization meeting, prime CONTRACTORS, OWNER, and FACILITY MANAGER, with advice of ENGINEER when such decisions have potential to affect the completed Project, will make decisions on allocations of space at the Site, construction plant requirements, and future coordination meetings.
 - c. A preliminary agenda of topics to be covered at the Site mobilization meeting is indicated in Section 01 31 19.13, Preconstruction Conference.
 - d. ENGINEER will advise each prime CONTRACTOR of the time, place, and tentative agenda for the Site mobilization meeting.
3. Coordination Meetings during the Project:
 - a. Purposes of coordination meetings include:
 - 1) Establishing and modifying work schedules and achieving agreement on orderly sequences of operations acceptable to all prime contractors.
 - 2) Reviewing and adjusting conflicts, work arrangements, and schedules to reduce the potential for and avoid delays and work stoppages.
 - 3) Discussing and accepting coordination drawings prepared by each prime CONTRACTOR, as required to assist and guide others.
4. General (applicable to all meetings required under this Section):
 - a. Scheduling:
 - 1) Meetings required under this Section will be arranged through the Resident Project Representative (RPR) and shall be separate from and in addition to progress meetings.
 - 2) If a prime CONTRACTOR cannot, for compelling reasons, attend a coordination meeting, prime CONTRACTOR shall advise the

- Resident Project Representative (RPR) so that the meeting may be rescheduled.
- b. Attendees:
 - 1) Each prime CONTRACTOR shall have a representative present at each meeting required under this Section.
 - 2) Resident Project Representative (RPR).
 - 3) OWNER, FACILITY MANAGER or ENGINEER may attend coordination meetings, but their attendance is not mandatory.
 - d. Representatives:
 - 1) Representatives of prime CONTRACTORS at meetings required under this Section shall have competence and authority to make necessary decisions.
 - 2) Representatives' decisions and statements shall commit the associated prime CONTRACTOR to the agreed procedures, sequence of operations, and schedules.
 - e. Failure to be represented at one or more meetings required under this Section will cause absent prime CONTRACTOR(s) to be liable for damages, delays, costs of alterations, and other costs that result because CONTRACTOR was not present to arrange coordination of their Work with other construction activities.
 - f. Where procedures have been agreed upon and accepted by the Resident Project Representative (RPR) and prime CONTRACTORS concerned, procedures shall become binding on prime CONTRACTORS concerned relative to time and performance.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 31 19.13

PRE-CONSTRUCTION CONFERENCE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. A pre-construction conference will be held for the Project.
2. CONTRACTOR shall attend the conference prepared to discuss all items on the pre-construction conference agenda.
3. ENGINEER will distribute an agenda, preside at conference, and prepare and distribute minutes to all conference participants and others as requested.

B. Purpose of Pre-construction Conference:

1. Purpose of conference is to designate responsible personnel, establish working relationships, discuss preliminary schedules submitted by CONTRACTOR, and review administrative and procedural requirements for the Project.
2. Matters requiring coordination will be discussed and procedures for handling such matters will be established.
3. Unless otherwise indicated in the Contract Documents or otherwise agreed to by the entities involved, Site mobilization meeting will be part of the pre-construction conference.

1.2 PREPARATION FOR PRE-CONSTRUCTION CONFERENCE

A. Date, Time, and Location:

1. Conference will be held after execution of the Contract and before Work starts at the Site.
2. ENGINEER will establish the date, time, and location of conference and notify the interested and involved entities.

B. Submittals Required Prior to Pre-construction Conference:

1. Not less than three days prior to pre-construction conference, submit the following preliminary schedules in accordance with the General Conditions and other requirements of the Contract Documents:
 - a. Preliminary Progress Schedule.
 - b. Preliminary Schedule of Submittals.
 - c. Preliminary Schedule of Values.
 - d. Listing of identity and general scope of Work or supply (as applicable) of planned Subcontractors and Suppliers. Indicate extent of each Subcontract proposed and overall percentage of Contract Price to be subcontracted.

- C. CONTRACTOR shall furnish information required and contribute appropriate items for discussion at the pre-construction conference.
- D. Handouts for Pre-Construction Conference:
 - 1. CONTRACTOR shall bring to the conference the following, with sufficient number of copies for each attendee:
 - a. Preliminary Progress Schedule, as submitted to ENGINEER.
 - b. Preliminary Schedule of Submittals, as submitted to ENGINEER.
 - c. Preliminary Schedule of Values, as submitted to ENGINEER.
 - d. Listing of identity and general scope of Work or supply of planned Subcontractors and Suppliers.
 - e. List of emergency contact information, in accordance with Article 1.5 of Section 01 35 23, Safety Requirements.

1.3 REQUIRED ATTENDEES

- A. Representative of each entity attending the conference shall be authorized to act on that entity's behalf.
- B. Contractor Attendance: Conference shall be attended by CONTRACTOR's:
 - 1. Project manager.
 - 2. Site superintendent
 - 3. Project managers for major Subcontractors, and major equipment Suppliers as CONTRACTOR deems appropriate.
- C. Other attendees will be representatives of:
 - 1. OWNER.
 - 2. ENGINEER.
 - 3. Resident Project Representative (RPR), if available.
 - 4. Authorities having jurisdiction over the Work, if available.
 - 5. Utility owners, as applicable.
 - 6. Others as requested by OWNER, CONTRACTOR, or ENGINEER.

1.4 AGENDA

- A. Preliminary Agenda: Be prepared to discuss in detail the topics indicated below. Revisions, if any, to the agenda below will be furnished to required attendees prior to the pre-construction conference.
 - 1. Procedural and Administrative:
 - a. Personnel and Teams:
 - 1) Designation of roles and personnel.
 - 2) Limitations of authority of personnel, including personnel who will sign Contract modifications and make binding decisions.
 - 3) Subcontractors and Suppliers in attendance.
 - 4) Authorities having jurisdiction.
 - b. Procedures for communications and correspondence, including electronic communication protocols.

- c. Copies of the Contract Documents and availability.
- d. Subcontractors and Suppliers.
 - 1) Lists of proposed Subcontractors and Suppliers.
- e. The Work and Scheduling:
 - 1) General scope of the Work.
 - 2) Contract Times, including Milestones (if any).
 - 3) Phasing and sequencing.
 - 4) Preliminary Progress Schedule.
 - 5) Critical path activities.
- f. Safety:
 - 1) Responsibility for safety.
 - 2) Contractor's safety representative.
 - 3) Emergency procedures and accident reporting.
 - 4) Emergency contact information.
 - 5) Confined space entry permits.
 - 6) Hazardous materials communication program.
 - 7) Impact of Project on public safety.
- g. Permits.
- h. Review of insurance requirements and insurance claims.
- i. Coordination:
 - 1) Project coordination, and coordination among contractors.
 - 2) Construction coordinator.
 - 3) Coordination with Owner's operations.
 - 4) Progress meetings.
 - 1) Preliminary Schedule of Submittals.
 - 2) Procedures for furnishing and processing submittals.
 - 3) Work not eligible for payment until submittals are approved or accepted (as required).
 - 4) Construction photographic documentation.
- j. Submittals:
 - 1) Preliminary Schedule of Submittals.
 - 2) Submittal procedures.
 - 3) Contractor coordination and approval stamp.
 - 4) Meaning of Engineer's actions/submittal disposition.
 - 5) Preliminary discussion of initial, critical submittals.
 - 6) Construction photographic documentation.
- k. Substitutes and "Or-Equals":
 - 1) Product options.
 - 2) Procedures for proposing "or-equals".
 - 3) Procedures for proposing substitutes.
- l. Contract Modification Procedures
 - 1) Requests for interpretation
 - 2) Written clarifications
 - 3) Field Orders
 - 4) Proposal Requests
 - 5) Change Proposals
 - 6) Work Change Directives.

- 7) Change Orders.
- 8) Procedure for Claims and dispute resolution
- m. Payment:
 - 1) Owner's Project financing and funding, as applicable.
 - 2) Owner's tax-exempt status.
 - 3) Preliminary Schedule of Values
 - 4) Procedures for measuring for payment.
 - 5) Retainage.
 - 6) Progress payment procedures.
 - 7) Prevailing wage rates and payrolls.
- n. Testing and inspections, including notification requirements.
- o. Disposal of demolition materials.
- p. Record documents.
- q. Preliminary Discussion of Contract Closeout:
 - 1) Procedures for Substantial Completion.
 - 2) Contract closeout requirements.
 - 3) Correction period.
 - 4) Duration of bonds and insurance.
- 2. Site Mobilization (if not covered in a separate meeting):
 - a. Working hours and overtime.
 - b. Field offices, storage trailers, and staging areas.
 - c. Temporary facilities.
 - d. Temporary utilities and limitations on utility consumption (where applicable).
 - e. Utility company coordination (if not done as a separate meeting).
 - f. Access to Site, access roads, and parking for construction vehicles.
 - g. Maintenance and protection of traffic.
 - h. Use of Site and premises.
 - i. Protection of property.
 - j. Security.
 - k. Temporary controls, such as sediment and erosion controls, noise controls, dust control, storm water controls, and other such measures.
 - l. Site barriers and temporary fencing.
 - m. Storage of materials and equipment.
 - n. Reference points and benchmarks; surveys and layouts.
 - o. Site maintenance during the Project.
 - p. Cleaning and removal of trash and debris.
 - q. Restoration.
- 3. General discussion and questions.
- 4. Next meeting.
- 5. Site visit, if required.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 31 19.23

PROGRESS MEETINGS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Progress meetings will be held throughout the Project. CONTRACTOR shall attend each progress meeting prepared to discuss in detail all items on the agenda.
2. ENGINEER will preside at progress meetings and will prepare and distribute minutes of progress meetings to all meeting participants and others as requested.

1.2 PREPARATION FOR PROGRESS MEETINGS

A. Date and Time:

1. Regular Meetings: Every two weeks on a day and time agreeable to OWNER, ENGINEER, and CONTRACTOR.
2. Other Meetings: As required.

B. Location:

1. CONTRACTOR's field office at the Site or other location mutually agreed upon by OWNER, CONTRACTOR, and ENGINEER.

C. Handouts:

1. CONTRACTOR shall bring to each progress meeting not less than three copies of each of the following:
 - a. List of Work accomplished since the previous progress meeting.
 - b. Up-to-date Progress Schedule.
 - c. Up-to-date Schedule of Submittals.
 - d. Detailed "look-ahead" schedule of Work planned through the next progress meeting, with specific starting and ending dates for each activity, including shutdowns, deliveries of important materials and equipment, Milestones (if any), and important activities affecting the OWNER, Project, and Site.
 - e. When applicable, list of upcoming, planned time off (with dates) for personnel with significant roles on the Project, and the designated contact person in their absence.

1.3 REQUIRED ATTENDANCE

- ###### A. Representatives present for each entity shall be authorized to act on that entity's behalf.

B. Required Attendees:

1. CONTRACTOR:
 - a. Project manager.
 - b. Site superintendent.
 - c. Safety representative.
 - d. When needed for the discussion of a particular agenda item, representatives of Subcontractors and Suppliers shall attend meetings.
2. Construction coordinator (if any).
3. ENGINEER:
 - a. Project manager or designated representative
 - b. Resident Project Representative (if any).
 - c. Others as required by ENGINEER.
4. OWNER's representative(s), as required.
5. Testing and inspection entities, as required.
6. Others, as appropriate.

1.4 AGENDA

- A. Preliminary Agenda: Be prepared to discuss in detail the topics listed below. Revised agenda, if any, will be furnished to CONTRACTOR prior to first progress meeting. Progress meeting agenda may be modified by ENGINEER during the Project as required.
1. Review, comment, and amendment (if required) of minutes of previous progress meeting.
 2. Review of progress since the previous progress meeting.
 3. Planned progress through next progress meeting.
 4. Review of Progress Schedule
 - a. Contract Times, including Milestones (if any)
 - b. Critical path.
 - c. Schedules for fabrication and delivery of materials and equipment.
 - d. Corrective measures, if required.
 5. Submittals:
 - a. Review status of critical submittals.
 - b. Review revisions to Schedule of Submittals.
 6. Contract Modifications
 - a. Requests for interpretation
 - b. Written clarifications
 - c. Field Orders
 - d. Proposal Requests
 - e. Change Proposals
 - f. Work Change Directives.
 - g. Change Orders.
 - h. Claims.
 7. Applications for progress payments.
 8. Problems, conflicts, and observations.
 9. Quality standards, testing, and inspections.

10. Coordination between parties.
11. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues.
12. Safety.
13. Permits.
14. Construction photographic documentation.
15. Record documents status.
16. Punch list status, as applicable.
17. Other business.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 31 26

ELECTRONIC DOCUMENT PROTOCOL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section establishes the procedures with which the parties will comply regarding transmission or exchange of electronic data for the Project.
2. Contractor shall provide labor, materials, tools, equipment, services, utilities, and incidentals shown, specified, and required for complying with this Section throughout the Project.
3. This Section does not supersede the General Conditions, as may be modified by the Supplementary Conditions, regarding transmitting of the Contract Documents to Contractor after the Effective Date of the Contract.
4. In addition to the requirements of this Section, comply with requirements for exchange of electronic data in the following:
 - a. Section 01 32 16, Progress Schedule.
 - b. Section 01 32 33, Photographic Documentation.
 - c. Section 01 33 00, Submittal Procedures.
 - d. Section 01 78 39, Project Record Documents.

B. Coordination:

1. Except as otherwise explicitly stated herein, the terms of this Protocol will be incorporated into any other agreement or subcontract between a party and any third party for any portion of the Work on the Project, or any Project-related services, where that third party is, either directly or indirectly, required to exchange Electronic Documents with a party or with Engineer. Nothing herein will modify the requirements of the Contract regarding communications between and among the parties and their subcontractors and consultants.

1.2 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:

1. “Confidential information” means electronic data that the transmitting party has designated as confidential and clearly marked with an indication such as “Confidential”, “Business Proprietary”, or similar designation.
2. “Written” or “in writing” means any and all communications, including without limitation a notice, consent, or interpretation, prepared and sent to an address provided in the Contract Documents or otherwise agreed upon by the parties and Engineer using a transmission method sent forth in this Section that allows the recipient to print or store the communication. Communications transmitted electronically are presumed received when sent in conformance with this Paragraph 1.2.A.3.

3. Electronic “data” means information, communications, drawings, or designs created or stored for the Project in electronic or digital form.

1.3 TRANSMISSION OF ELECTRONIC DATA

- A. Transmission of Electronic Documents constitutes a warrant by the transmitting party to the receiving party that the transmitting party is one or more of the following:
 1. The copyright owner of the Electronic Document.
 2. Has permission from the copyright owner to transmit the Electronic Document for its use on the Project.
 3. Is authorized to transmit confidential information.
- B. Receiving party agrees to keep confidential information confidential and not to disclose it to another person except to (1) its employees, (2) those who need to know the content of the confidential information to perform services or construction solely and exclusively for the Project, or (3) its consultants, contractors, Subcontractors, and Suppliers whose contracts include similar restrictions on the use of any Electronic Document and confidential information.
- C. Transmitting party does not convey any right in any Electronic Document or in the software used to generate or transmit such data. Receiving party may not use electronic data unless permission to do so is provided in the Contract Documents, or in a separate license.
- D. Unless otherwise granted in a separate license, receiving party’s use, modification, or further transmission of Electronics Documents, as provided the Contract Documents, is specifically limited to the design and construction of the Project in accordance with this Section, and nothing contained in this Section conveys any other right to use the Electronic Document for any other purpose.
- E. To the fullest extent permitted by Laws and Regulations, receiving party shall indemnify and defend the transmitting party from and against all claims arising from or related to receiving party’s modification to, or unlicensed use of, Electronic Documents.
- F. Means of Transmitting Electronic Data: Unless otherwise indicated in Table 01 31 26-A of this Section or elsewhere in the Contract Documents, transmission of electronic data for the Project will generally be via:
 1. E-mail and files attached to e-mail. Maintain e-mail system capable of transmitting and receiving files not less than 20 megabytes (MB) file size.

1.4 ELECTRONIC DATA PROTOCOLS

- A. Comply with the data formats, transmission methods, and permitted uses set forth in Table 01 31 26-A, Electronic Data Protocol Table, below, when transmitting or using electronic data on the Project. Where a row in the table has no indicated means of

transmitting electronic data, use for such documents only printed copies transmitted to the receiving party via appropriate delivery method.

TABLE 01 31 26-A
ELECTRONIC DATA PROTOCOL TABLE (E-MAIL ATTACHMENTS)

Electronic Data	Data Format	Transmitting Party	Transmission Method	Receiving Party	Permitted Uses	Notes
1.4.A.1. Project communications						
General communications & correspondence	EM, PDF	O, E, C	EM, EMA	O, E, C	R	
Meeting notices and agendas	EM, PDF	E	EM, EMA	O, C	R	
Meeting minutes	PDF	E	EM, EMA	O, C	R	
1.4.A.2. Contractor's submittals to Engineer						
Shop Drawings	PDF	C	EMA	E	M (1)	(1)
Product data	PDF	C	EMA	E	M (1)	(1)
Informational and closeout submittals:	PDF	C	EMA	E	M (1)	(1) (6)
Documentation of delivery of maintenance materials submittals	PDF	C	EMA	E	M (1)	
1.4.A.3. Engineer's return of reviewed submittals to Contractor						
Shop Drawings	PDF	E	EMA	O., C	R	
Product data	PDF	E	EMA	O., C	R	
Informational and closeout submittals:	PDF	E	EMA	O., C	R	(6)
Documentation of delivery of maintenance materials submittals	PDF	E	EMA	O. C	R	
1.4.A.4. Contract Modifications Documents						
Requests for interpretation to Engineer	PDF	C., O	EMA	E	M (1)	(1)
Engineer's interpretations (RFI responses)	PDF	E	EMA	C, O	R	
Engineer's clarifications to Contractor	EM, PDF	E	EM, EMA	C, O	R	
Engineer's issuance of Field Orders	PDF	E	EMA	C, O	R	
Proposal Requests	PDF	E, O	EMA	C	R	
Change Proposals – submitted to Engineer	PDF	C	EMA	O, E	S	
Change Proposals – Engineer's response	PDF	E	EMA	C. O		
Work Change Directives (for Contractor signature)	PDF	E	EMA	C	R	(2)
Change Orders (for Contractor signature)	PDF	E	EMA	C	R	(2)
1.4.A.5. Applications for Payment						(3)
1.4.A.6. Claims and other notices						(4)
1.4.A.7. Closeout Documents						
Record drawings	DWG and PDF	C	EMA	E, O	M (5)	(5)
Other record documents	PDF	C	EMA	E. O	M (5)	(5)
Contract closeout documents						

B. Key to Electronic Data Protocol Table:

Data Format:

EM .msg, .htm, .txt, .rtf, e-mail text
W .docx, Microsoft® Word 2007 or later
EX .xlsx, Microsoft® Excel 2007 or later
PDF .pdf. Portable Document Format
DWG .dwg. Autodesk AutoCAD 2013 drawing.

Transmitting Party:

O	OWNER
C	CONTRACTOR
E	ENGINEER

Transmission Method:

EM	Via e-mail
EMA	As an attachment to an e-mail transmission
CD	Delivered via compact disc
PW	Posted to Project website
FTP	FTP transfer to receiving FTP server

Receiving Party:

O	OWNER
C	CONTRACTOR
E	ENGINEER

Permitted Uses:

S	Store and view only
R	Reproduce and distribute
I	Integrate (incorporate additional electronic data without modifying data received)
M	Modify as required to fulfill obligations for the Project

Notes:

- (1) Modifications by ENGINEER to CONTRACTOR's submittals and requests for interpretations are limited to printing out, marking-up, and adding comment sheets.
- (2) May be distributed only to affected Subcontractors and Suppliers. Print out, sign document, and return executed printed copy originals to ENGINEER.
- (3) Submit printed Applications for Payment with original ("wet") signatures.
- (4) Submit notices, including Claims, in accordance with the notice provisions of the General Conditions, as may be modified by the Supplementary Conditions.
- (5) Submit record drawings in native CAD format indicated when CONTRACTOR has executed ENGINEER's standard agreement for release of electronic files. In addition, always submit record drawings as a PDF file. Comply with requirements of Section 01 78 39, Project Record Documents.

- (6) For operation and maintenance data, also submit printed copies as required by Section 01 78 23, Operations and Maintenance Data.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

Exhibit A - Software Requirements for Electronic Document Exchange

Item	Electronic Documents	Transmittal Means	Data Format	Note (1)
a.1	General communications, transmittal covers, meeting notices and responses to general information requests for which there is no specific prescribed form.	Email	Email	
a.2	Meeting agendas, meeting minutes, RFI’s and responses to RFI’s, and Contract forms.	Email w/ Attachment	PDF	(2)
a.3	Contractors Submittals (Shop Drawings, “or equal” requests, substitution requests, documentation accompanying Sample submittals and other submittals) to Owner and Engineer, and Owner’s and Engineer’s responses to Contractor’s Submittals, Shop Drawings, correspondence, and Applications for Payment.	Email w/ Attachment	PDF	
a.4	Correspondence; milestone and final version Submittals of reports, layouts, Drawings, maps, calculations and spreadsheets, Specifications, Drawings and other Submittals from Contractor to Owner or Engineer and for responses from Engineer and Owner to Contractor regarding Submittals.	Email w/ Attachment or LFE	PDF	
a.5	Layouts and drawings to be submitted to Owner for future use and modification.	Email w/ Attachment or LFE	DWG	
a.6	Correspondence, reports and Specifications to be submitted to Owner for future word processing use and modification.	Email w/ Attachment or LFE	DOC	
a.7	Spreadsheets and data to be submitted to Owner for future data processing use and modification.	Email w/ Attachment or LFE	EXC	
a.8	Database files and data to be submitted to Owner for future data processing use and modification.	Email w/ Attachment or LFE	DB	
Notes				
(1)	All exchanges and uses of transmitted data are subject to the appropriate provisions of Contract Documents.			
(2)	Transmittal of written notices is governed by Paragraph 18.01 of the General Conditions.			
Key				
Email	Standard Email formats (.htm, .rtf, or .txt). Do not use stationery formatting or other features that impair legibility of content on screen or in printed copies			
LFE	Agreed upon Large File Exchange method (FTP, CD, DVD, hard drive)			
PDF	Portable Document Format readable by Adobe® Acrobat Reader Version [number] or later			
DWG	Autodesk® AutoCAD .dwg format Version [number]			
DOC	Microsoft® Word .docx format Version [number]			
EXC	Microsoft® Excel .xls or .xml format Version [number]			
DB	Microsoft® Access .mdb format Version [number]			

SECTION 01 32 16.00.30

PROGRESS SCHEDULE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. General CONTRACTOR shall prepare and submit Progress Schedules and related documents in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and this Section, unless otherwise accepted by ENGINEER.
2. Maintain and update Progress Schedules and related documents.
3. ENGINEER's acceptance of the Progress Schedule or related documents, and comments or opinions concerning activities in the Progress Schedule and related documents shall not control independent judgment of CONTRACTOR concerning means, methods, techniques, sequences and procedures of construction, unless the associated means, method, technique, sequence, or procedure is directed by the Contract Documents. CONTRACTOR is solely responsible for complying with the Contract Times.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Progress Schedules:
 - a. Submit preliminary Progress Schedule in accordance with Paragraph 2.03 of the General Conditions. Submit in accordance with Section 01 33 00, Submittal Procedures and Section 01 31 26, Electronic Communication Protocols.
 - b. After making revisions in accordance with ENGINEER's comments on the preliminary Progress Schedule, submit the Progress Schedule in accordance with Paragraph 2.05 of the General Conditions. Submit in accordance with Section 01 33 00, Submittal Procedures and Section 01 31 26, Electronic Communication Protocols.
 - c. Submit updated Progress Schedule at each progress meeting. If a Progress Schedule remains unchanged from one progress meeting to the next, submit a written statement to that effect. For monthly Progress Schedule submittals, bring to progress meeting the number of printed copies of the updated Progress Schedule specified in Section 01 31 19.23, Progress Meetings, and formally submit in accordance with Section 01 33 00, Submittal Procedures and Section 01 31 26, Electronic Communication Protocols.
 - d. Furnish each Progress Schedule submittal with letter of transmittal complying with requirements of Section 01 33 00, Submittal Procedures, and specifically indicating the following:

- 1) Listing of activities and dates that have changed since the previous Progress Schedule submittal.
 - 2) Discussion of problems causing delays, anticipated duration of delays, and proposed countermeasures.
2. Recovery Schedules: Submit in accordance with this Section, and other provisions of the Contract Documents.

1.3 PROGRESS SCHEDULE FORMAT AND CONTENT

A. Format:

1. Type:
 - a. Horizontal bar chart or Gantt chart.
 - a. Gantt chart prepared using software such as Microsoft Project 2007 or later edition, Oracle Primavera P6, Oracle Primavera Project Planner – P3, or similar software.
2. Sheet Size: 11 inches by 17 inches, unless otherwise accepted by ENGINEER.
3. Time Scale: Indicate first date of each work week.
4. Organization:
 - a. Indicate on the separate Schedule of Submittals dates for submitting and reviewing Shop Drawings, Samples, and other submittals.
 - b. Group deliveries of materials and equipment into a separate sub-schedule that is part of the Progress Schedule.
 - c. Group construction into a separate sub-schedule (that is part of the Progress Schedule) by activity.
 - d. Group critical activities that dictate the rate of progress (the “critical path”) into a separate sub-schedule that is part of the Progress Schedule. Clearly indicate the critical path on the Progress Schedule.
 - e. Organize each sub-schedule by Specification Section number.
5. Activity Designations: Indicate title and related Specification Section number.

B. Content: Progress Schedules shall indicate the following:

1. Dates for shop-testing.
2. Delivery dates for materials and equipment to be incorporated into the Work.
3. Dates for beginning and completing each phase of the Work by activity and by trade.
4. Dates for start-up and check-out, field-testing, and instruction of operations and maintenance personnel.
5. Dates corresponding to the Contract Times, and planned completion date associated with each Milestone (if any), Substantial Completion, and readiness for final payment.

C. Coordinate the Progress Schedule with the Schedule of Submittals.

1.4 RECOVERY SCHEDULES

A. Recovery Schedules – General:

1. When updated Progress Schedule indicates that the ability to comply with the Contract Times falls ten or more days behind schedule, and the delay is within the control of CONTRACTOR, and there is no corresponding Change Order or Work Change Directive to support an extension of the Contract Times, CONTRACTOR shall prepare and submit a Progress Schedule demonstrating CONTRACTOR's plan to accelerate the Work to achieve compliance with the Contract Times ("recovery schedule") for ENGINEER's acceptance.
 2. Submit recovery schedule within five days after submittal of updated Progress Schedule where need for recovery schedule is indicated.
- B. Implementation of Recovery Schedule:
1. At no additional cost to OWNER, do one or more of the following: furnish additional resources (additional workers, additional construction equipment, increased work hours or additional shifts, and other resources), provide suitable materials, expedite procurement of materials and equipment to be incorporated into the Work, and other measures necessary to complete the Work within the Contract Times.
 2. Upon acceptance of recovery schedule by ENGINEER, incorporate recovery schedule into the next Progress Schedule update.
- C. Lack of Action:
1. CONTRACTOR's refusal, failure, or neglect to take appropriate recovery action, or to submit a recovery schedule, shall constitute reasonable evidence that CONTRACTOR is not prosecuting the Work or separable part thereof with the diligence that will ensure completion within the Contract Times. Such lack of action shall constitute sufficient basis for OWNER to exercise remedies available to OWNER under the Contract Documents.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements governing the following types of Submittals:

1. Action Submittals that include:
 - a. Shop Drawings.
 - b. Product data.
 - c. Delegated design Submittals, which include documents prepared, sealed, and signed by a design professional retained by Contractor, Subcontractor, or Supplier for materials and equipment to be incorporated into the completed Work. Delegated design Submittals do not include Submittals related to temporary construction unless specified otherwise in the related Specifications Section. Delegated design Submittals include: design drawings, design data including calculations, specifications, certifications, and other Submittals prepared by such design professional.
 - d. Samples.
 - e. Testing plans, procedures, and testing limitations.
2. Informational Submittals that include:
 - a. Certificates.
 - b. Design data not sealed and signed by a design professional retained by Contractor, Subcontractor, or Supplier.
 - c. Pre-construction test and evaluation reports, such as reports on pilot testing, subsurface investigations, testing for a potential Hazardous Environmental Condition, and similar reports.
 - d. Supplier instructions, including installation data, and instructions for handling, starting-up, and troubleshooting.
 - e. Source quality control Submittals (other than testing plans, procedures, and testing limitations), including results of shop testing.
 - f. Field or Site quality control Submittals (other than testing plans, procedures, and testing limitations), including results of operating and acceptability tests at the Site.
 - g. Supplier reports.
 - h. Sustainable design Submittals (other than sustainable design closeout documentation).
 - i. Special procedure Submittals, including plans for shutdowns and tie-ins and other procedural Submittals.
 - j. Qualifications statements.
 - k. Administrative Submittals including:

- 1) Progress Schedules.
 - 2) Schedules of Submittals.
 - 3) Schedules of Values.
 - 4) Photographic documentation.
 - 5) Coordination drawings, when submittal of such is required.
 - 6) Copies of permits obtained by Contractor.
 - 7) Field engineering reports, survey data, and similar information.
3. Closeout Submittals that include:
- a. Maintenance contracts.
 - b. Operations and maintenance data.
 - c. Bonds, such as special maintenance bonds and bonds for a specific material, equipment item, or system.
 - d. Warranty documentation.
 - e. Record documentation.
 - f. Sustainable design closeout documentation.
 - g. Software.
 - i. Keying.
- B. Not Included in this Section: Administrative and procedural requirements for following are covered elsewhere in the Contract Documents:
1. Requests for interpretations of the Contract Documents.
 2. Change Orders, Work Change Directives, and Field Orders.
 3. Applications for Payment
 4. Reports, documentation, and permit applications required to be furnished by Contractor to authorities having jurisdiction.
- C. When type of Submittal is not specified and is not included in the list above, request an interpretation from Engineer.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling
1. Provide Submittals well in advance of need for the material or equipment, or procedure (as applicable), in the Work and with ample time required for delivery of materials and equipment and to implement procedures following Engineer's approval or acceptance of the associated Submittal. Work covered by a Submittal will not be included in progress payments until approval or acceptance of related Submittals has been obtained in accordance with the Contract Documents.
 2. Samples and Submittals that are related to the same element of the Work or Specifications section should be furnished at the same time. Engineer will not review Submittals without associated Samples and will not review Samples without associated Shop Drawing or product data.
 - a. Samples shall clearly illustrate functional characteristics of materials, all related parts and attachments, and full range of color, texture, pattern, and materials

B. Coordination for Multiple Prime Contracts

1. Expedite Submittals for Work that requires coordination with work of other contractors.
2. Simultaneously with furnishing Submittal to Engineer, transmit to each other prime contractor one copy of each Submittal, with transmittal letter to other contractors advising that Submittal is being furnished to Engineer.
3. Upon receipt of Submittal from another contractor, Contractor shall determine its effect on the Work. Within five days of receipt of Submittal, Contractor shall advise Engineer in writing of interferences, objections, or questions and request clarification.
4. If no interferences, objections, or questions are reported by other contractors within time specified, Engineer will assume that none exist and will review the Submittal. If Contractor fails to report interferences or objections of other contractors within time specified, Contractor shall, at no additional cost to Owner, do all cutting, restoring, or relocating that may result from interference or inconsistency with work performed relative to the Submittal as approved or accepted by Engineer.
5. After Submittal is approved or accepted by Engineer, the Engineer will distribute one copy to each other prime contractor, except for those Submittals that do not require written response from Engineer.

C. Dimensions Contractor is responsible for dimensions to be confirmed and corrected at the Site; quantities; information pertaining solely to fabrication processes; means, methods, sequences, procedures, and techniques of construction; safety precautions and programs incident thereto; and for coordinating the work of all trades.

D. Representation: Contractor's signature on Submittal's stamp and letter of transmittal shall be Contractor's representation that Contractor has complied with his obligations under the Contract Documents relative to that Submittal. Engineer and Owner shall be entitled to rely on such representations by Contractor.

1.3 SCHEDULE OF SUBMITTALS

A. Timing:

1. Furnish Schedule of Submittals within time frames indicated in the Contract Documents.
2. Submit updated Schedule of Submittals with each Submittal of the updated Progress Schedule.

B. Content: Identify on Schedule of Submittals all Submittals required in the Contract Documents. Requirements for content of preliminary Schedule of Submittals and subsequent updates of the Schedule of Submittals are identical. . Updates of Schedule of Submittals shall show scheduled dates and actual dates for completed tasks. Indicate Submittals that are on the Project's critical path. Indicate the following for each Submittal:

1. Date by which Submittal will be received by Engineer.
2. Whether Submittal will be for a substitution or "or-equal". Procedures for

requesting approval of substitutes and “or-equals” are specified in the General Conditions, Section 01 25 00, Substitution Procedures, and Section 01 62 00, Product Options (for “or-equals”).

3. Date by which Engineer’s response is required. Not less than (–1–) days shall be allowed for Engineer’s review, starting upon Engineer’s actual receipt of each Submittal. Allow increased time for large or complex Submittals.
 4. For Submittals for materials or equipment, date by which material or equipment must be at the Site to avoid delaying the Work and to avoid delaying the work of other contractors, if any.
- C. Prepare Schedule of Submittals using same software, and in same format, specified for Progress Schedules in Section 01 32 16, Progress Schedule.
- D. Coordinate Schedule of Submittals with the Progress Schedule.
- E. Schedule of Submittals that is not compatible with the Progress Schedule, or that does not indicate Submittals on the Project’s critical path, or that places extraordinary demands on Engineer for time and resources, is unacceptable. Do not include Submittals not required by the Contract Documents.
- F. In preparing Schedule of Submittals:
1. Consider the nature and complexity of each Submittal, and allow sufficient time for review and revision.
 2. Reasonable time shall be allowed for: Engineer’s review and processing of Submittals, for Submittals to be revised and resubmitted, and for returning Submittals to Contractor.
 3. Identify and accordingly schedule Submittals that are expected to have long anticipated review times.

1.4 PROCEDURE FOR SUBMITTALS

- A. Submittal Identification System: Use the following Submittal identification system, consisting of Submittal number and review cycle number.
1. Submittal Number: Shall be separate and unique number correlating to each individual Submittal required. Assign Submittal numbers as follows:
 - a. First part of Submittal number shall be the applicable Specifications Section number, followed by a hyphen.
 - b. Second part of Submittal number shall be a three-digit number (sequentially numbered from 001 through 999) assigned to each separate and unique Submittal furnished under the associated Specifications Section.
 - c. Submittal number for the third Submittal furnished for Section 40 05 19, Ductile Iron Process Pipe, would be “40 05 19-003”.
 2. Review Cycle Number: Shall be a (1) designation indicating the initial Submittal or re-submittal associated with each Submittal number:
 - a. “(2)” = Initial (first) Submittal.
 - b. “(3)” = Second Submittal (e.g., first re-submittal).
 - c. “(4)” = Third Submittal (e.g., second re-submittal).

3. Examples:

Example Description	Submittal Identification	
	Submittal No.	Review Cycle
Initial (first) review cycle of the third Submittal provided under Section 40 05 19, Ductile Iron Process Pipe	40 05 19-003-	(5)
Second review cycle (first re-submittal) of third Submittal provided under Section 40 05 19, Ductile Iron Process Pipe	40 05 19-003-	(6)

B. Letter of Transmittal for Submittals:

1. Each letter of transmittal shall be for one Specifications Section.
2. At beginning of each letter of transmittal, include a reference heading indicating: Contractor's name, Owner's name, Project name, Contract designation, transmittal number, and Submittal number.
3. For Submittals with proposed deviations from requirements of the Contract Documents, letter of transmittal shall specifically describe each proposed variation.

C. Contractor's Review and Stamp:

1. Contractor's Review: Before transmitting Submittals to Engineer, review Submittals to:
 - a. ensure proper coordination of the Work;
 - b. determine that each Submittal is in accordance with Contractor's needs;
 - c. verify that Submittal contains sufficient information for Engineer to determine compliance with the Contract Documents.
2. Incomplete or inadequate Submittals will be returned without review.
3. Contractor's Stamp and Signature:
 - a. Each Submittal furnished shall bear Contractor's stamp of approval and signature, as evidence that Submittal has been reviewed by Contractor and verified as complete and in accordance with the Contract Documents.
 - b. Submittals without Contractor's stamp and signature will be returned without review. Signatures that appear to be computer-generated will be regarded as unsigned and the associated Submittal will be returned without review.
 - c. Contractor's stamp shall contain the following:

“Project Name: _____

Contractor’s Name: _____

Contract _____ Designation: _____

Date: _____

----- *Reference* -----

Submittal Title: _____

Specifications:

Section: _____

Page No.: _____

Paragraph No.: _____

Drawing No.: _____ of _____

Location of Work: _____

Submittal No. and Review Cycle: _____

Coordinated by Contractor with Submittal Nos.: _____

—
I hereby certify that the Contractor has satisfied Contractor’s obligations under the Contract Documents relative to Contractor’s review and approval of this Submittal.

Approved for Contractor by: _____”

D. Submittal Marking and Organization:

1. Mark on each page of Submittal and each individual component submitted with Submittal number and applicable Specifications paragraph.
2. Arrange Submittal information in same order as requirements are written in the associated Specifications Section.
3. Each Shop Drawing sheet shall have title block with complete identifying information satisfactory to Engineer.
4. Package together Submittals for the same Specifications Section. Do not furnish required information piecemeal.

E. Format of Submittal and Recipients:

1. Action Submittals and Informational Submittals: Furnish in accordance with Table 01 33 00-A:

**TABLE 01 33 00-A: SUBMITTAL CONTACTS
AND REQUIRED FORMAT**

	Address for Deliveries	Contact Person	E-mail Address	Format*	No. of Printed Copies
a.	Engineer: ARADIS U.S., Inc.,	A.J. Brooks	a.j.brooks@arcadis-us.com	E	Zero
b.	Resident Project Representative: At the Site.	TBD	TBD	E & P	One
* Format: E = Electronic files; P = Printed copies. TBD = To Be Determined					

2. Closeout Submittals:

- a. Furnish the following Closeout Submittals in accordance with Table 01 33 00-A: maintenance contracts; bonds for specific materials, equipment, or systems; warranty documentation; and sustainable design closeout documentation. On documents such as maintenance contracts and bonds, include on each document furnished original (“wet”) signature of entity issuing said document. When original “wet” signatures are required, furnish such Submittals in printed form and electronic form to Engineer, and to other entities furnish as indicated in Table 01 33 00-A.
- b. Operations and Maintenance Data: Submit in accordance with Section 01 78 23, Operation and Maintenance Data.
- c. Record Documentation: Submit in accordance with Section 01 78 39, Project Record Documentation.
- d. Software: Submit number of copies required in Specifications Section where the software is specified. If number of copies is not specified, provide two copies on compact disc in addition to software loaded on Owner’s computer(s) or microprocessor(s).

3. Maintenance Material Submittals: For spare parts, extra stock materials, and tools, furnish quantity of items specified in associated Specifications Section. Furnish in accordance with Section 01 78 43, Spare Parts and Extra Materials.

F. Electronic Submittals:

1. Format: Electronic files shall be in accordance with Section 01 31 26, Electronic Document Protocol. Files shall be electronically searchable.
2. Organization and Content:
 - a. Each electronic Submittal shall be one file; do not divide individual Submittals into multiple files.
 - b. When Submittal is large or contains multiple parts, furnish PDF file with bookmark for each section of Submittal.
 - c. Content shall be identical to printed Submittal. First page of electronic Submittal shall be Contractor’s letter of transmittal.

3. Quality and Legibility: Electronic Submittal files shall be made from the original and shall be clear and legible. Do not submit scans of faxed copies. Electronic file shall be full size of original, printed documents. Properly orient all pages for reading on a computer screen.
 4. Submitting Electronic Files:
 - a. Transmit electronic files in accordance with Section 01 31 26, Electronic Document Protocol.
- G. Distribution:
1. Distribution of Engineer's Response via Electronic Files: Upon completion of Engineer's review, electronic Submittal response will be distributed by Engineer to
 - a. Contractor.
 - b. Other prime contractors.
 - c. Owner.
 - d. Resident Project Representative (RPR).
 - e. Engineer's file.
- H. Resubmittals: Refer to the General Conditions for requirements regarding resubmitting required Submittals.

1.5 ENGINEER'S REVIEW

- A. Submittals not required by the Contract Documents will not be reviewed by Engineer nor be recorded in Engineer's Submittal log and the Contractor will be advised accordingly and all printed copies of such Submittals will be returned to Contractor. Electronic copies of such Submittals, if any, will not be retained by Engineer.
- B. Action Submittals, Results of Engineer's Review: Each Submittal will be given one of the following dispositions by Engineer:
1. Approved: Upon return of Submittal marked "Approved", order, ship, or fabricate materials and equipment included in the Submittal (pending Engineer's approval or acceptance, as applicable, of source quality control Submittals) or otherwise proceed with the Work in accordance with the Submittal and the Contract Documents.
 2. Approved as Corrected: Upon return of Submittal marked "Approved as Corrected", order, ship, or fabricate materials and equipment included in the Submittal (pending Engineer's approval or acceptance, as applicable, of source quality control Submittals) or otherwise proceed with the Work in accordance with the Submittal and the Contract Documents, and in accordance with the corrections indicated in the Engineer's Submittal response.
 3. Approved as Corrected – Resubmit: Upon return of Submittal marked "Approved as Corrected – Resubmit", order, ship, or fabricate materials and equipment included in the Submittal (pending Engineer's approval or acceptance, as applicable, of source quality control Submittals) or otherwise

proceed with the Work in accordance with the Submittal and the Contract Documents, and in accordance with corrections indicated in Engineer's Submittal response. Furnish to Engineer a re-submittal with all corrections made. Receipt of corrected re-submittal is required before materials or equipment covered in the Submittal will be eligible for payment.

4. **Revise and Resubmit:** Upon return of Submittal marked "Revise and Resubmit", make the corrections indicated and re-submit to Engineer for approval.
 5. **Not Approved:** This disposition indicates material or equipment that cannot be approved. Upon return of Submittal marked "Not Approved", repeat initial Submittal procedure utilizing approvable material or equipment, with a complete Submittal clearly indicating all information required.
- C. **Informational Submittals, Results of Engineer's Review:**
1. Each Submittal will be given one of the following dispositions:
 - a. **Accepted:** Information included in Submittal complies with the applicable requirements of the Contract Documents, and is acceptable. No further action by Contractor is required relative to this Submittal, and the Work covered by the Submittal may proceed, and materials and equipment with Submittals with this disposition may be shipped or operated, as applicable.
 - b. **Not Accepted:** Submittal does not indicate compliance with applicable requirements of the Contract Documents and is not acceptable. Revise Submittal and re-submit to indicate acceptability and compliance with the Contract Documents.
- E. **Closeout Submittals, Results of Engineer's Review:** Dispositions and meanings are the same as specified for Informational Submittals. When acceptable, Closeout Submittals will not receive a written response from Engineer. Disposition as "accepted" will be recorded in Engineer's Submittal log. When Closeout Submittal is not acceptable, Engineer will provide written response to Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 35 23

SAFETY REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section augments the requirements elsewhere in the Contract Documents regarding CONTRACTOR's responsibilities for safety and protection and includes requirements for CONTRACTOR's safety representative and other safety requirements applicable to the Project.
2. CONTRACTOR shall provide labor, materials, tools, equipment, training, certifications, protective measures, and incidentals shown, specified, and required to comply with CONTRACTOR's obligations under the Contract for safety and protection of personnel and property.

B. Coordination:

1. When multiple contractors are working at the Site, CONTRACTOR shall communicate to each other contractor, OWNER, ENGINEER, and other entities working at the Site those elements of CONTRACTOR's safety program with which such other entities are to comply.
2. Prime CONTRACTOR with responsibility for coordinating the safety programs of the various prime contractors at the Site shall be (--1--).

C. Related Sections: Provisions of this Section are coordinated with, but are not limited to, the following:

1. Section 01 35 43.13, Environmental Procedures for Hazardous Materials.
2. Section 01 35 44, Spill Prevention Control and Countermeasures Plan.
3. Section 01 41 28, Confined Space Entry Permit.
4. Section 01 71 33, Protection of the Work and Property.

1.2 QUALITY ASSURANCE

A. Qualifications:

1. CONTRACTOR's Safety Representative:
 - a. ENGINEER's acceptance of CONTRACTOR's safety representative's qualifications does not in any way mitigate or relieve CONTRACTOR of CONTRACTOR's safety obligations under the Contract Documents.
 - b. CONTRACTOR's safety representative shall possess not less than five years of experience serving as the safety representative on projects similar to or larger in size than this Contract, and for type(s) of construction similar in nature to the Work.
 - c. CONTRACTOR's safety representative shall be experienced in the types of Work to be performed under the Contract and shall be experienced

with safety precautions, procedures, and equipment appropriate for the safe performance of the Work.

- d. Prior to the Effective Date of the Contract, shall have successfully completed a 30-hour OSHA Construction Safety and Health training course, and a 40-hour OSHA Hazardous Materials training course, and training for confined space entry.
- e. CONTRACTOR's safety representative shall be completely experienced with and knowledgeable of all applicable health and safety Laws and Regulations and with good safety practices, and shall ensure compliance with such Laws and Regulations and practices at the Site.
- f. Minimum responsibilities of CONTRACTOR's safety representative are indicated in this Section.

1.3 SUBMITTALS

- A. Informational Submittals: Submit the following:
 - 1. Emergency contact information, in accordance with Article 1.5 of this Section.
 - 2. Citations:
 - a. Copies of safety citations from authorities having jurisdiction and insurance companies, submitted within 24 hours of CONTRACTOR's receipt of such citations.
 - 3. Qualifications Statements:
 - a. CONTRACTOR's Safety Representative: Submit name and qualifications of CONTRACTOR's safety representative, including summary of experience, and training received and valid certifications and accreditations applicable to the Project.

1.4 SAFETY REPRESENTATIVE RESPONSIBILITIES

- A. General:
 - 1. CONTRACTOR's safety representative shall have appropriate space at the Site to maintain and keep available safety records, up-to-date copies of pertinent safety Laws and Regulations, Material Data Sheets, CONTRACTOR's site-specific health and safety plan, copies of OWNER's health and safety requirements with which CONTRACTOR shall comply, and the Site safety plan including information concerning foreseeable emergency conditions, and emergency contact information as required in Article 1.5 of this Section.
- B. CONTRACTOR's safety representative's responsibilities include:
 - 1. Duties and responsibilities in accordance with the General Conditions.
 - 2. CONTRACTOR's safety representative shall coordinate with CONTRACTOR's "competent person" required under Laws and Regulations.
 - 3. CONTRACTOR's safety representative shall attend progress meetings in accordance with Section 01 31 19.23, Progress Meetings.
 - 4. Schedule and conduct safety meetings and safety training programs as required by Laws and Regulations, CONTRACTOR's Site-specific health and safety plan (SSHASP), and good safety practices. Include in the SSHASP a specific

schedule (dates) of such meetings and an outline of materials to be covered. Advise ENGINEER prior to the time and place of such meetings. Invite OWNER's personnel to meetings. Instruct CONTRACTOR's employees (and Subcontractors, Suppliers with personnel at the Site, and others for whom CONTRACTOR is responsible) on recognition of hazards, observance of precautions, of the contents of the SSHASP and other safety programs with which CONTRACTOR shall comply, and use of personal protective equipment (PPE) and safety equipment.

5. Determine that operators of specific construction equipment (and permanent equipment used for construction operations) are qualified by training and experience before such personnel are allowed to operate such equipment.
6. Develop and implement emergency response procedures, including names, locations, and contact telephone numbers for emergency services and medical assistance as indicated in requirements for the emergency contact list in Article 1.5 of this Section.
7. Post appropriate notices regarding health and safety Laws and Regulations at locations at the Site and CONTRACTOR's office that afford maximum exposure to personnel.
8. Post appropriate instructions and warning signs in regard to all hazardous areas and hazardous conditions that cannot be eliminated. Identification of such areas shall be based on experience, site surveillance, and severity of the associated hazard. Signage shall not be used in place of appropriate workplace controls.
9. Ascertain via personal inspection that safety Laws and Regulations and safety program requirements are enforced. Make inspections at appropriate frequencies to ensure that machines, tools, and equipment are in a safe operating condition; and that all work areas are free of hazards to the extent practicable. Implement necessary and timely corrective actions to eliminate unsafe acts and unsafe conditions, and submit to ARCADIS daily copy of findings resulting from inspection, using inspection checklist forms established in CONTRACTOR's SSHASP.
10. Submit to ENGINEER copies of safety citations from authorities having jurisdiction and insurance companies within 24 hours of CONTRACTOR's receipt of such citations.
11. Provide appropriate orientation to employees, visitors, Subcontractors, and Supplier personnel at the Site.
12. Perform all related tasks necessary to achieve the highest degree of safety that the nature of the Work allows.

1.5 EMERGENCY CONTACT INFORMATION

- A. CONTRACTOR shall submit list of emergency contact information for 24-hour use throughout the Project. Emergency contact information shall be updated and kept current throughout the Project. If personnel or contact information change, furnish updated emergency contact information list at the next progress meeting.
- B. CONTRACTOR's list of emergency contact information shall include:

1. CONTRACTOR's project manager's office, field office, cellular, and home telephone numbers.
 2. CONTRACTOR's Site superintendent's office, field office, cellular, and home telephone numbers.
 3. CONTRACTOR's foreman's field office, cellular (if available), and home telephone numbers.
 4. CONTRACTOR's safety representative's office, cellular, and home telephone numbers.
 5. Major Subcontractors' and Suppliers' office, cellular, and home telephone numbers of project manager and foreman (when applicable).
- C. Additional Emergency Contact Information:
1. OWNER's emergency contact: office, cellular, and home telephone numbers.
 2. OWNER's central 24-hour emergency telephone number.
 3. ENGINEER's project manager's office, cellular, and home telephone numbers.
 4. ENGINEER's project engineer's office, cellular, and home telephone numbers.
 5. Resident Project Representative's office, field office, cellular, and home telephone numbers.
 6. Utility companies' 24-hour contact telephone number(s), including gas, water, sewer, oil, telephone, cable television/telecommunications, and other companies or concerns having utilities in the vicinity of the Work.
 7. Highway and street owners' 24-hour telephone number(s).
 8. Emergency telephone numbers, including: "Emergency: Dial 911", and seven-digit telephone numbers for the hospital, ambulance, police, and fire department nearest to the Site. Furnish names of each of these institutions.
 9. Other involved entities as applicable.
 10. Include with list of emergency contact information an 8.5-inch by 11-inch map showing route from the Site to the nearest hospital.
- D. Emergency Contact Information for Multiple-Prime Contract Project:
1. General CONTRACTOR shall have responsibility to assemble all emergency contact information into a single emergency contact list for the Project, and shall maintain, update, and redistribute the listing throughout the Project.
 2. Prime contractors other than General CONTRACTOR are not required to submit the "additional emergency contact information" indicated in Paragraph 1.5.C of this Section.
 3. Prime contractors other than General CONTRACTOR shall promptly furnish to General CONTRACTOR updated emergency contact information when prime contractor's emergency contact information or personnel change.

1.6 SAFETY EQUIPMENT

- A. General:
1. CONTRACTOR shall provide proper safety and rescue equipment, adequately maintained and readily available, for any foreseeable contingency.
 2. Such equipment shall include items such as safety ropes and harnesses, fall-prevention devices, stretchers, water safety devices, oxygen breathing

apparatus, resuscitators, gas detectors, oxygen deficiency indicators, combustible gas detectors, fire extinguishers and first-aid equipment in accordance with the Division 01 Specifications, and similar equipment.

3. Keep safety equipment in protected areas. Check safety equipment at scheduled intervals.
4. Temporary First-Aid Facilities: Provide and maintain in accordance with Section 01 51 05, Temporary Facilities.

B. Safety Equipment Log:

1. Maintain a log indicating the person who checked the equipment, when equipment was checked, and that equipment was acceptable.
2. Update equipment log not less-often than monthly.
3. Include in safety representative's onsite records copies of equipment calibration records.

C. Provide replacement safety equipment when primary safety equipment is unavailable due to use or when undergoing maintenance.

D. Personal Protective Equipment (PPE):

1. All persons entering the work areas shall wear appropriate PPE required for the particular area.
2. Remove from the Site any person failing to comply with this or any other safety requirement.
3. Continuously provide all necessary PPE for ENGINEER's employees, Resident Project Representative, and consultants. ENGINEER will furnish for ENGINEER's employees and consultants protective helmets (hard hats), safety eyewear, reflective vests, and hearing protection. CONTRACTOR shall furnish other equipment required.

1.7 EVACUATION DRILL

- A. Included in CONTRACTOR's SSHASP shall be evacuation drills, conducted not less-often than once every six months, held in coordination with existing facility's alarm signal under the control of OWNER's facility manager
- B. Perform evacuation drill during regular working hours, scheduled to minimize disruption of the Work.
- C. Upon evacuation, CONTRACTOR and all personnel for whom CONTRACTOR is responsible, immediately advise ENGINEER's onsite personnel and OWNER's facility manager that all personnel have been evacuated.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 35 43.13

ENVIRONMENTAL PROCEDURES FOR HAZARDOUS MATERIALS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, tools, and incidentals necessary to comply with environmental procedures for Constituents of Concern.
2. CONTRACTOR shall develop, implement, and maintain throughout the Project a hazardous materials management program (HMMP) in accordance with Laws and Regulations.
3. Constituents of Concern Brought to Site by CONTRACTOR: Transport, handle, store, label, use, and dispose of in accordance with this Section, other applicable provisions of the Contract Documents, and Laws and Regulations.
4. Constituents of Concern Generated by CONTRACTOR:
 - a. Materials containing Constituents of Concern shall be properly handled, stored, labeled, transported and disposed of by CONTRACTOR in accordance with Laws and Regulations, and this Section.
 - b. If CONTRACTOR will generate or has generated materials containing Constituents of Concern at the Site, obtain a USEPA identification number listing CONTRACTOR's name and address of the Site as generator of the Constituents of Concern. Obtain identification number from state environmental agency or similar authority having jurisdiction at the Site. Submit identification number within time frame specified in Article 1.3 of this Section.
 - c. CONTRACTOR shall be responsible for identifying, analyzing, profiling, transporting, and disposing of Constituents of Concern generated by CONTRACTOR.
5. Fines or civil penalties levied against OWNER for violations committed at the Site by CONTRACTOR, and costs to OWNER (if any) associated with cleanup of a Hazardous Environmental Condition created by CONTRACTOR shall be paid by CONTRACTOR. If CONTRACTOR has exacerbated a Hazardous Environmental Condition existing at the Site prior to the start of the Work, CONTRACTOR shall pay a share of costs associated with fines, civil penalties, and cleanup costs to in proportion equal to the extent of CONTRACTOR's responsibility for creating the Hazardous Environmental Condition and fines and civil penalties associated therewith.

B. Enforcement of Laws and Regulations:

1. Interests of OWNER are that accidental spills and emissions, Site contamination, and injury of personnel at and near the Site are to be avoided.

2. When OWNER is aware of suspected violations, OWNER will notify CONTRACTOR, and authorities having jurisdiction if OWNER reasonably concludes that doing so is required by Laws or Regulations.
3. Responsibilities regarding Laws and Regulations shall be in accordance with the General Conditions, as may be modified by the Supplementary Conditions.

C. Related Sections:

1. Section 01 35 44, Spill Prevention Control and Countermeasures Plan.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following to the entity(ies) specified for each:

1. Constituents of Concern (including Chemicals) Proposed for Use at the Site:
 - a. Content:
 - 1) Current (dated within the past two years) material safety data sheets (MSDS) in accordance with 29 CFR 1910.1200 (OSHA Hazard Communication Standard).
 - 2) Manufacturer of material or equipment containing such substance.
 - 3) Supplier (if different than manufacturer).
 - 4) Container size(s) and number of containers proposed to be at the Site.
 - 5) Minimum and maximum volume of material intended to be stored at the Site.
 - 6) Description of process or procedures in which Constituent of Concern will be used at the Site.
 - b. Furnish the information required above in sufficient time to obtain OWNER's acceptance not later least three days before bringing Constituent of Concern to the Site.
 - c. Submit to OWNER's environmental representative with copy to ENGINEER.
2. Material Containing Constituents of Concern Generated at the Site:
 - a. Submit for each Constituent of Concern generated at the Site identification number, analysis results, and number and size of storage containers at the Site.
 - b. Furnish such information within not less than 48 hours after CONTRACTOR's receipt of analytical results.
 - c. Submit to OWNER's environmental representative with copy to ENGINEER.
3. Permits:
 - a. Submit copies of permits for storing, handling, using, transporting, and disposing of materials containing Constituents of Concern, obtained from authorities having jurisdiction.
 - b. Submit to OWNER's environmental representative with copy to ENGINEER.
4. Other Documents required for the HMMP: Submit to OWNER's environmental representative the requested documents within 72 hours of CONTRACTOR's receipt of such request. HMMP documents may include emergency/spill response plan, communication plan, and other documents.

1.3 HAZARDOUS MATERIALS MANAGEMENT

- A. Obtain OWNER's environmental representative's acceptance before bringing to the Site each material containing a Constituent of Concern.
- B. Communication Plan:
 - 1. CONTRACTOR shall develop a communication plan relative to materials containing one or more Constituents of Concern.
 - 2. MSDS Notebooks:
 - a. At minimum, maintain at the Site two notebooks containing: 1) Inventory of materials containing a Constituent of Concern (including all chemicals); and, 2) Current (dated within the past two years) material safety data sheets (MSDS) for all materials being used to accomplish the Work, whether or not defined as a Constituent of Concern.
 - b. Keep one notebook in CONTRACTOR's field office at the Site; keep second notebook at location acceptable by OWNER's environmental representative.
 - c. Keep notebooks up-to-date as materials are brought to and removed from the Site.
- C. Emergency/Spill Response Plan: Develop, implement, and maintain an emergency/spill response plan, for each Constituent of Concern or each class/group of material containing a Constituent of Concern, as applicable. At minimum, response plan shall include the following:
 - 1. Description of equipment available at the Site to contain or respond to emergency related to or spill of the material.
 - 2. Procedures for notifying, and contact information for: authorities having jurisdiction, emergency responders, OWNER, ENGINEER, the public as applicable, and other entities as required.
 - 3. Response coordination procedures between CONTRACTOR, OWNER, and others as appropriate.
 - 4. Site plan showing proposed location of Constituents of Concern storage area and location of spill containment/response equipment, and location of storm water drainage inlets and drainage routes, including storm sewers, ditches and swales, and surface waters.
 - 5. Description of Constituent of Concern handling and spill response training provided to CONTRACTOR's and Subcontractors' employees, in accordance with 29 CFR 1926.21(b) and other Laws and Regulations.
 - 6. Comply with Section 01 35 44, Spill Prevention Control and Countermeasures Plan.
- D. Storage of Materials Containing Constituents of Concern and Storage of Non-Hazardous Materials:
 - 1. Vessels containing materials with a Constituent of Concern shall bear applicable hazard diamond(s).
 - 2. Container Labeling:

- a. Properly label each container of consumable materials, whether or not classified as containing a Constituent of Concern.
 - b. Stencil CONTRACTOR's name and, as applicable, Subcontractor's name, on each vessel containing a Constituent of Concern and, for non-hazardous materials, on each container over five-gallon capacity. Containers shall bear securely-attached label clearly identifying contents. Label containers that are filled from larger containers.
 - c. If OWNER becomes aware of unlabeled containers at the Site, OWNER's environmental representative will so advise CONTRACTOR. Properly label container(s) within one hour of receipt of such notice from OWNER or remove container from the Site.
3. To greatest extent possible, store off-Site materials containing a Constituent of Concern until required for use in the Work.
- E. Area for Storing Materials Containing a Constituent of Concern:
1. Maintain designated storage area for materials containing a Constituent of Concern. Storage area shall include secondary containment to prevent release of spilled or leaking substances. Storage area shall include barriers to prevent vehicles from colliding with storage containers, and shall include protection from environmental factors such as weather.
 2. Provide signage in accordance with Laws and Regulations, clearly identifying the storage area.
- F. Not less than monthly, CONTRACTOR's safety representative shall meet with OWNER's environmental representative to review CONTRACTOR's HMMP documents, procedures, and inspect storage areas and the Site in general, to verify compliance with this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 35 44

SPILL PREVENTION CONTROL AND COUNTERMEASURES PLAN

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section pertains to spill prevention control and countermeasures applicable to the Project under the provisions of 40 CFR 112 and other Laws and Regulations.
2. CONTRACTOR shall provide all labor, materials, equipment, tools, professional services (when required), and incidentals as shown, specified, and required to comply with Laws and Regulations regarding spill prevention control and countermeasures (SPCC) planning and compliance, including 40 CFR 112.
3. Multiple Prime Contracts:
 - a. General CONTRACTOR shall determine whether a SPCC Plan is required. Other prime contractors shall furnish to General CONTRACTOR information and data relative to the work under their respective contracts as necessary for determining whether the Project requires a SPCC Plan.
 - b. When SPCC Plan is required, General CONTRACTOR shall prepare, implement, and maintain SPCC Plan as required by Laws and Regulations.
 - c. In cooperation with the General CONTRACTOR, each prime contractor at the Site shall implement the SPCC Plan for tanks at the Site used by such prime contractor.
 - d. General CONTRACTOR shall have overall responsibility for the Project's SPCC Plan.

1.2 DETERMINATION OF NEED FOR SPCC PLAN FOR PROJECT

A. Determination of Need for SPCC Plan:

1. CONTRACTOR shall determine need for SPCC Plan for the Project.
2. CONTRACTOR's Professional Engineer:
 - a. If the Site will include storage of more than 10,000 gallons of oil in above-ground storage, or if the Site does not comply with oil discharge history criteria specified in 40 CFR 112, CONTRACTOR shall retain a qualified professional engineer to determine need for SPCC Plan for the Project and, if SPCC Plan is required, professional engineer shall prepare or supervise preparation of SPCC Plan for the Project.
 - b. If a professional engineer is not required to prepare the full SPCC Plan for the Project, but the SPCC Plan includes environmentally-equivalent SPCC measures, or impracticality determinations, CONTRACTOR shall retain a qualified professional engineer to

prepare and certify those portions of the SPCC Plan dealing with environmentally equivalent measures and impracticality determinations; the balance of the SPCC Plan may be prepared by and be self-certified by CONTRACTOR.

3. Submit to ENGINEER letter presenting results of evaluation of whether a SPCC Plan is required for the Project in accordance with Laws and Regulations.
- B. SPCC Plan is required when the Project activities at the Site meet the following criteria:
1. The Site and activities thereon are not exempt from Laws and Regulations relative to SPCC planning and implementation.
 2. Oil is stored, used, transferred, or otherwise handled at the Site, unless otherwise exempted by Laws and Regulations.
 3. Maximum oil storage capacity at the Site equals or exceeds either of the following thresholds: 42,000 gallons of completely-buried capacity, or 1,320 of above-ground capacity. Capacity includes total storage tank volume and operational storage volume at the Site for contractors and Subcontractors, including bulk storage tanks, containers with 55-gallon storage capacity and larger, mobile tanks located at the Site, and other containers covered by Laws and Regulations. Exempt are motive storage containers, such as those on construction equipment and vehicles. Oil includes petroleum products, fuel oil, hydraulic fluid, oil sludge, oil refuse, oil mixed with wastes other than dredged material, synthetic oil, vegetable oil, animal fats and oils, and other oils defined in Laws and Regulations.
 4. There is reasonable expectation, based on location of the Site, that oil spill would reach navigable waters of the United States or adjoining shorelines.
- C. When SPCC Plan is not required, (---) CONTRACTOR shall ensure that conditions that preclude the need for SPCC Plan for the Project, including the activities of all contractors and Subcontractors working on the Project at the Site, are maintained throughout duration of the Project. Should changes that affect the storage, use, or handling of oil at the Site occur, reassess the need for SPCC Plan for the Project at no additional cost to OWNER and submit to ENGINEER evaluation letter regarding need for SPCC Plan.

1.3 SPCC PLAN AND IMPLEMENTATION

- A. When SPCC Plan is required, develop SPCC Plan and submit for acceptance by OWNER, with copy to ENGINEER. SPCC Plan shall be specific to the Site and the Project and shall include the following:
1. Seal or stamp, original signature, and license number of CONTRACTOR'S professional engineer, when self-certification by CONTRACTOR is not allowed by Laws and Regulations.
 2. Site plan identifying the name (or tag number) and location of each tank and container that will contain a substance regulated in 40 CFR 112 and other Laws and Regulations, including above-ground and buried tanks. Site plan

shall indicate general directions of storm water runoff, including storm sewers and drainage inlets (including arrows indicating directions of flow), and storm sewer outfall locations shown and labeled.

3. For each tank and container shown or indicated on the Site plan, include a table that lists the tank or container's name and tag number, type of oil stored therein, and maximum storage capacity. List total storage capacity of all regulated tanks and containers at the Site covered by SPCC Laws and Regulations.
4. Predictions of direction, rate of flow, and total quantity of oil that could be discharged from the Site as result of storage tank or container failure.
5. Operating procedures that prevent oil spills, including procedures for oil handling, details of secondary containment structures at fuel and oil transfer areas, and details and descriptions of equipment to be used for oil handling, including piping.
6. Control Structures and Secondary Containment:
 - a. Furnish details of and descriptions of control measures installed at the Site by CONTRACTOR to prevent spill from reaching navigable waters of the United States and associated shorelines, including secondary containment and diversionary structures.
 - b. For on-shore Sites, one of the following must be used, at minimum: dikes, berms, or retaining walls; curbing; culverts, gutters, or other drainage systems; weirs, booms, or other barriers; spill diversion ponds; retention ponds; or sorbent materials.
 - c. Where appropriate, the SPCC Plan shall clearly demonstrate that containment or diversionary structures or equipment are not practical.
 - d. Include brittle fracture evaluation, where required, for field-constructed above-ground storage containers undergoing repair, alteration, construction, or change in service.
7. Plans for countermeasures to contain, clean up, and mitigate effects of oil spill that reaches navigable waters of the United States or their shorelines, including written commitment of manpower, equipment, and materials to quickly control and remove spilled oil. Include estimation of time required to contain spill after spill occurs.
8. Contact list and telephone numbers for facility response coordinator, National Response Center, cleanup contractors, and all appropriate federal, state, and local authorities having jurisdiction to be contacted in event of spill or discharge.
9. Program for monthly inspections of the Site by CONTRACTOR for SPCC Plan compliance. Advise OWNER in writing of each inspection not less than 72 hours in advance.
10. Measures for Site security relative to oil storage.
11. Procedures for safely handling mobile containers such as totes, drums, and fueling vehicles and construction equipment that remain at the Site.
12. Procedures and schedules for periodic testing of integrity of tanks and containers, and associated piping and valves.
13. Plans for bulk storage container compliance.
14. Plans for personnel training and oil spill prevention briefings.

15. For SPCC Plans that do not follow the format listed in Laws and Regulations, provide cross-reference to requirements of Laws and Regulations, including 40 CFR 112.7.
- B. Obtain acceptance of SPCC Plan by OWNER, for coordination with OWNER's Site-specific SPCC Plan, if any.
 - C. SPCC Plan shall be reviewed by CONTRACTOR's professional engineer (when professional engineer is required) and OWNER every five years, as applicable. CONTRACTOR shall perform updates and revisions of the Project's SPCC Plan as necessary and submit same in accordance with the provisions of this Section for submittal and acceptance of initial SPCC Plan.
 - D. Post a copy of accepted, certified SPCC Plan in conspicuous location at the Site and furnish copies to OWNER, ENGINEER, other contractors, and Subcontractors as appropriate. All contractors shall comply with SPCC Plan.
 - E. In event of violation of SPCC Plan or release of oils attributable to construction operations, CONTRACTOR shall:
 1. Immediately issue notifications in accordance with Laws and Regulations, including 40 CFR 110 and 40 CFR 112. When required by Laws and Regulations, report to National Response Center, US Environmental Protection Agency, and other authorities having jurisdiction, if any.
 2. Have spill clean-up performed in accordance with Laws and Regulations, the SPCC Plan, and requirements of authorities having jurisdiction.
 3. Pay fines and civil penalties (or responsible portion thereof) imposed on OWNER by authorities having jurisdiction, and pay costs associated with clean-up of spills.
 4. Should cleanup of spills attributable to CONTRACTOR be necessary, no resulting change in the Contract Price or Contract Times will be allowed. Should CONTRACTOR share responsibility for spill and cleanup with another entity, changes in Contract Price and Contract Times, if any, will be proportionate.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 1. CONTRACTOR's Professional Engineer:
 - a. When required by Laws and Regulations, engage a licensed, registered professional engineer legally qualified to practice in the jurisdiction where the Site is located and experienced in performing engineering services of the type required.
 - b. Submit qualifications data.
 - c. Responsibilities include but are not necessarily limited to:
 - 1) Carefully reviewing Laws and Regulations relative to SPCC.
 - 2) Preparing written requests for clarifications or interpretations of criteria specified in the Contract Documents for submittal to

ENGINEER by CONTRACTOR, and obtaining from authorities having jurisdiction clarifications regarding Laws and Regulations as required.

- 3) Preparing or supervising the preparation of letter-report evaluation of need for SPCC Plan in accordance with the Contract Documents. Evaluation shall include professional engineer's seal or stamp, registration number, and original signature.
- 4) When SPCC Plan is required, preparing, supervising the preparation of, or reviewing the SPCC Plan (or designated portions thereof when oil storage at the Site will be 10,000 gallons or less) in accordance with the Contract Documents. SPCC Plan (or designated portions thereof) shall include professional engineer's seal or stamp, registration number, and original signature.
- 5) Periodically re-evaluating the need for SPCC Plan and issuing findings as letter-reports with seal or stamp, license number, and signature. When SPCC Plan is required, periodically evaluating the SPCC Plan and providing recommendations for compliance with Laws and Regulations, in accordance with the Contract Documents.
- 6) Certifying that:
 - a) it is familiar with the Laws and Regulations, including 40 CFR 112, and
 - b) it has visited, examined, and is familiar with the Site, planned modifications to the Site under the Project as such modifications pertain to SPCC Laws and Regulations, and
 - c) it has performed the evaluations and prepared SPCC Plan in accordance with the Contract Documents, and
 - d) procedures for required testing and inspections have been established, and
 - e) the said evaluations and SPCC Plan are adequate for the Project, and
 - f) the said evaluations and SPECC Plan complies with Laws and Regulations, applicable industry standards, and to prevailing standards of practice.

1.5 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Certifications: With each evaluation letter and SPCC Plan submittal, include certification signed by preparer of submittal that the submittal complies with the Contract Documents and Laws and Regulations. Signature on all certifications shall be original.
2. Evaluations:
 - a. Submit letter presenting results of evaluation of whether a SPCC Plan is required for the Project. Submit evaluation not later than fourteen days after the Contract Times commence running, unless longer time is allowed by ENGINEER.

- b. Submit updated evaluations as required when conditions at the Site change. Submit updated evaluation not later than seven days after the conditions at the Site change, or within seven days of ENGINEER's request, unless longer time is allowed by ENGINEER.
- 3. SPCC Plan: When SPCC Plan is required:
 - a. Submit jointly to OWNER and ENGINEER. Submit within 14 days of receipt of ENGINEER's acceptance of evaluation submittal.
 - b. Update and resubmit the SPCC Plan, or acceptable SPCC Plan amendments, as required when conditions at the Site change. Submit updated SPCC Plan or amendments not later than seven days after the change in conditions at the Site change giving rise to the SPCC Plan change or amendment, or within seven days of ENGINEER's request, unless longer time is allowed by ENGINEER.
- 4. SPCC Plan Distribution: When SPCC Plan is required, submit copies of letters transmitting SPCC Plan and amendments (if any) to contractors and Subcontractors working at the Site.
- 5. Qualifications Statements: CONTRACTOR's professional engineer, when requested by ENGINEER or OWNER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 41 24

PERMIT REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes general requirements relative to permitting requirements of which OWNER and ENGINEER are aware that apply to the Project.
2. CONTRACTOR shall provide labor, materials, equipment, tools, and incidentals shown, specified, and required to obtain required permits and comply with required permits and licenses.
3. Obtain, pay for, and comply with required permits and licenses whether or not indicated in this Section or elsewhere in the Contract Documents.

B. Coordination:

1. Coordinate compliance with permit and license requirements with Work under other Sections and with other contractors, if any, working at the Site.
2. Coordinate with the Progress Schedule the time required to apply for and obtain required permits and licenses. Changes in Contract Times or Contract Price will not be authorized because of timing and costs associated with obtaining permits and licenses required for the Work.

C. Related Sections: In addition to permits and licenses required under this Section, obtain and comply with permits required under the following Sections:

1. Section 01 35 43.13, Environmental Procedures for Hazardous Materials.
2. Section 01 41 28, Confined Space Entry Permit.
3. Section 01 41 27, Earthmoving Permit and Dust Control.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Copy of each of the following permits as applicable to the Contract.
2. Copy of each of the following licenses as applicable to the Contract.

1.3 MUNICIPAL PERMITS AND LICENSES

A. Permits:

1. Prior to commencing the Work CONTRACTOR shall obtain any and all permits necessary including but not limited to the following:
 - a. Building Permit.
 - b. Heating Permit.
 - c. Plumbing Permit.
2. Owner will waive all fees for City of Newburgh permits.

B. Licenses:

1. City licenses are required for electrical, plumbing, and HVAC construction. The City licenses individuals, not firms. Obtain licenses from the City Bureau of Code Enforcement.
2. Work of an electrical, plumbing, or HVAC nature in the City of Newburgh shall be performed under the supervision of a “Master Electrician”, “Master Plumber”, “Master of HVAC”, as applicable, possessing a valid City license.
3. CONTRACTOR’s apprentices and journeymen are to be registered with the City in accordance with City ordinance.
4. Before starting Work at the Site, submit to ENGINEER copies of the applicable City licenses required for the Project.”

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 41 27

EARTHMOVING PERMIT AND DUST CONTROL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes requirements for controlling fugitive dust emissions resulting from construction activities, including earthmoving, in coordination with Laws and Regulations.
2. CONTRACTOR shall obtain, pay for, and comply with permits required for earthmoving and dust control required because of dust-generating operations related to the Work, and shall develop and comply with provisions of dust control plan.
3. Provide necessary labor, materials, equipment, tools, services, and incidentals to: apply sufficient dust suppressants; properly clean all track-out areas to driveways, roadways, and highways; and provide adequate physical stabilizations of soils to comply with earthmoving permits and accepted dust control plan.
4. Control fugitive dust generation from CONTRACTOR's operations including the following:
 - a. Construction areas.
 - b. Vehicle and equipment parking areas.
 - c. Material and equipment storage areas.
 - d. Field office area(s) and staging areas.
 - e. Haul and access roadways.
 - f. Track-out areas.
 - g. Other areas where CONTRACTOR will work, store materials or equipment, or park vehicles and equipment.
5. Do not cause or allow dust-generating operations, earthmoving operations, use of property, or other operations that result in fugitive dust emissions that exceed limits prescribed by authorities having jurisdiction.
6. Pay fines and civil penalties incurred by OWNER because of CONTRACTOR's actions or violations of earthmoving permits and dust control plan. OWNER may deduct as set-offs such amounts from payments due CONTRACTOR.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:

- 1 Dust Control Plan:
 - a. Prepare and submit to ENGINEER and OWNER in accordance with Article 1.4 of this Section. Submit within the earlier of 30 days after

- the Contract Times commence running or prior to commencing earth-disturbing operations at the Site.
2. Daily Logs and Reasonably-Available Control Measures (RACM) Records:
 - a. Submit upon request of OWNER or ENGINEER.
 3. Field Quality Control Submittals:
 - a. When opacity monitoring is required, submit results not later than two days following completion of observations.

1.3 POSTING AND RECORDKEEPING

- A. Post copy of accepted dust control plan at conspicuous location at the Site.
- B. Recordkeeping:
 1. Maintain daily written log to record the actual application or implementation of reasonably-available control measures (RACM) described in the accepted dust control plan.
 2. Maintain the written log and supporting documentation at the Site, and submit copies to ENGINEER or OWNER upon request.
 3. Retain copies of dust control plan, RACM implementation records, and supporting documentations for not less than three years after Substantial Completion of the entire Project.

1.4 DUST CONTROL PLAN

- A. Prepare and submit to ENGINEER and OWNER a dust control plan that includes the following:
 1. Names, address, office and cellular telephone numbers, and e-mail address of person(s) responsible for preparing and overseeing implementation of dust control plan. Designate one person responsible for overseeing implementation of dust control plan for the Project.
 2. Name(s), address(es), office and cellular telephone numbers, and e-mail addresses of person(s) responsible for dust generating operations.
 3. Site plan delineating total area of land surface to be disturbed. Delineate each area of phased disturbances, when applicable.
 4. Total disturbed area in acres; earthmoving and dust-generating operations and activities to be performed at the Site; actual and potential sources of fugitive dust emissions; and delivery, transportation, and storage areas for the Site, including types of materials stored and appropriate size of material stockpiles.
 5. Description of reasonably-available control measures (RACM) to be implemented during dust-generating operations at actual and potential sources of fugitive dust.
 6. Description of dust suppressants to be used including product data and material safety data sheets (MSDS); method, frequency, and intensity of application; type, number, and capacity of application equipment; and certifications related to the suppressant's appropriate and safe use. (--1--)

7. Description of specific surface treatment(s) or RACM proposed for controlling material deposition along paved surfaces (e.g., “track-out” areas) where unpaved Site surfaces or Site access points meet paved surfaces.
8. As contingency measure, designate and include description of not less than one alternative RACM for each actual and potential fugitive dust source.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Testing and Monitoring.
 1. Upon direction of OWNER or ENGINEER, obtain opacity observations for visible emissions of fugitive dust.
 2. Opacity Monitoring Method:
 - a. USEPA Method 9, Visual Determination of Opacity of Emissions from Stationary Sources (Emission Measurement Technical Information Center Test Method 009).
 3. Location and Frequency of Opacity Observations:
 - a. Obtain opacity observations from not less than six locations at downwind perimeter of the Site during construction operations.
 - b. Perform opacity monitoring at frequency required by applicable earthmoving/dust control permit, unless more-frequent monitoring is required by OWNER or ENGINEER.
 4. Qualifications: Opacity monitoring observations shall be by person trained and experienced with the opacity monitoring method specified.
 5. Prepare and submit to ENGINEER written report of results of opacity monitoring and observations.
 6. No additional compensation or addition to the Contract Times will be authorized for opacity observations.

+ + END OF SECTION + +

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SECTION 01 41 28

CONFINED SPACE ENTRY PERMIT

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. OWNER has determined that portions of the Site may constitute confined spaces or permit-required confined spaces, as defined in this Section.
2. CONTRACTOR shall provide appropriate measures, including labor, supervision, equipment, protective devices, and incidentals, to protect the health and safety of personnel at the Site relative to confined spaces, and who may be affected by the Work in confined spaces including, without limitation: employees and agents of CONTRACTOR, Subcontractors, Suppliers, OWNER, ENGINEER, and ENGINEER's consultants, while engaged in performance of their respective duties at Site.
3. Comply with requirements of OWNER's confined space entry permitting program, if any.

1.2 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:

1. "Confined spaces" are areas on or about the Site as defined in 29 CFR 1910.146(b), 29 CFR 1926.21(b)(6), and other Laws and Regulations. Confined spaces include, but are not limited to: storage tanks, process vessels, bins, boilers and similar spaces; ventilation or exhaust ducts and stacks; manholes, underground utility vaults and chambers, sewers, pipelines, tunnels; and open-topped spaces greater than four feet deep, such as pits, tubs, vaults, and vessels.
2. "Entry permit" means the written or printed document provided by the employer of personnel entering permit-required confined space, to allow and control entry into permit-required confined space and that contains the information specified in 29 CFR 1926.146(f), and other Laws and Regulations.
3. "Permit-required confined space" means confined space as defined in 29 CFR 1926.146(b) and other Laws and Regulations, and that has one or more of the following characteristics:
 - a. Contains or has potential to contain a hazardous atmosphere.
 - b. Contains material that has potential for engulfing an entrant.
 - c. Has internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or floors, or by floor that slopes downward and tapers to a smaller cross-section.
 - d. Contains other recognized serious safety or health hazard.

4. “Hot work permit” means the written authorization of employer of personnel entering a confined space to perform operations, such as riveting, welding, cutting, burning, and heating, capable of providing a source of ignition.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with Laws and Regulations related to protecting personnel working in or entering confined spaces, including:
 1. Code of Federal Regulations (CFR), Title 29, Part 1910, Occupational Safety and Health Standards.
 2. CFR, Title 29, Part 1926, Safety and Health Regulations for Construction.

1.4 SUBMITTALS

- A. Informational Submittals: If acceptable, written response for Informational Submittals required in this Section will not be returned to CONTRACTOR. Submit the following to OWNER; if submittals under this Section are furnished to ENGINEER, ENGINEER will forward all submittals under this Section to OWNER without review.
 1. Plan: Site-specific confined space entry plan, submitted upon request of OWNER.
 2. Permits and Reports: For each time personnel enter a confined space, copies of completed permits required for confined space entry, and completed confined space data sheets, submitted upon request of OWNER.

1.5 CONFINED SPACE ENTRY PLAN

- A. Prepare, maintain, and implement Site-specific confined space entry plan which shall be incorporated into CONTRACTOR’s Site-specific health and safety plan. Maintain copy of the confined space entry plan at the Site for access by employees, OWNER, and authorities having jurisdiction. Confined space entry plan shall include:
 1. Results of CONTRACTOR’s Site-specific hazard assessment to identify confined spaces that are permit-required confined spaces, including list of all such spaces that will be accessed for the Work. Update the list as required throughout the Project.
 2. Requirements for safeguarding access to, and restricting non-permitted personnel from accessing, permit-required confined spaces during the Project.
 3. Project-specific procedures to be followed when entering or accessing permit-required confined spaces.
 4. Documentation of training provided to each person that will enter, or work in conjunction with entry to, permit-required confined spaces
 5. Update the plan by adding copies of permits issued and records of entry to permit-required confined spaces, as required in Article 1.6 of this Section.

1.6 CONFINED SPACE SAFETY

- A. Personnel entering confined space shall be trained in accordance with 29 CFR 1926.21 (b)(6), 29 CFR 1910.146(g), and other Laws and Regulations.

- B. Comply with 29 CFR 1910.146, other Laws and Regulations, and requirements of authorities having jurisdiction.
- C. Recordkeeping: Using the example forms attached to this Section, or other forms required by CONTRACTOR, OWNER, or authority having jurisdiction, issue for each instance of access to permit-required confined space, completed permit(s) and complete associated data sheet. File completed permits and data sheets in the Site-specific confined space entry plan, and submit in accordance with Article 1.4 of this Section. Such permits and information shall include:
 - 1. Permit for entry to permit-required confined space(s).
 - 2. Permit for hot work in permit-required confined space(s).
 - 3. Complete confined space data sheet.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SUPPLEMENTS

- A. The example forms listed below, following this Section’s “End of Section” designation, are part of this Specifications Section:
 - 1. “Confined Space Data Sheet” (one page).
 - 2. “Confined Space Entry Permit (two pages).
 - 3. “Confined Space Hot Work Permit” (one page).

+ + END OF SECTION + +

CONFINED SPACE DATA SHEET

Name of Confined Space Entered: _____

Location of Confined Space Entered: _____

Contractor/Subcontractor Accessing Confined Space: _____

PRE-ENTRY SYSTEM CONTROLS USED

Mechanical: Isolate, lockout and de-energize to zero potential energy.

Engulfment: Blank/block/cap/bleed off lines. Lock out gates, valves, pumps.

Electrical: Lockout/Tag-out

Inerting: Flush/Purge/Vent

Special Precautions: _____

Check

☐

☐

☐

☐

ATMOSPHERE RESULTS

Date of Last-measured Values: _____

	Oxygen	Explosive	H ₂ S/Toxic	CO	Date/Time Completed	Initials
Permissible Range	19.5%-23.5%	< 10% LFL	< 10 ppm H ₂ S	< 35 ppm	--	--
Last Measured						
Values This Entry						

SITE AND PERSONNEL SAFETY (check if required, list type where applicable)

Personal Protective Equipment (PPE) Used:

Safety Harness ☐. Life Lines ☐. Hard Hats ☐. Fall Protection ☐. Retrieval ☐. Eye ☐. Ear ☐. Face ☐. Hand ☐.

Foot ☐. Respiratory ☐ (type) _____. Clothing ☐ (type) _____

Other: ☐ _____

Rescue and Emergency Equipment On-Hand/Used:

Retrieval Equipment ☐. Fire Extinguishers ☐. Radios/Telephone ☐. Ladder ☐. Other ☐ _____

Equipment on Standby for Rescue Personnel ☐ _____

Site Safety Equipment/Items On-Hand/Used:

Explosion-Proof Lighting ☐. Barriers/Shield/Barricades ☐ (type) _____. Postings/Flagging ☐.

Other ☐ _____

List specific equipment that was isolated, de-energized, and locked out.

CONFINED SPACE ENTRY PERMIT

ENTRY TEAM

Contractor/Subcontractor Accessing Confined Space: _____

Site or Facility: _____

Specific Confined Space to be Entered: _____

Purpose of Entry (describe the work to be performed): _____

Date: _____ Time: _____ Expected Job Duration (days/hours): _____

Entry Supervisor: _____ Designated Attendant: _____

Authorized/Qualified Entrants: _____

Entry Team Rotation:

Date: _____ Time: _____

Entry Supervisor: _____ Designated Attendant: _____

Authorized/Qualified Entrants: _____

Entry Team Rotation:

Date: _____ Time: _____

Entry Supervisor: _____ Designated Attendant: _____

Authorized/Qualified Entrants: _____

Communication Procedures:

Entry Team: _____

Standby/Rescue Personnel: _____

Sign-Offs:

Person Authorizing this Entry: _____

Entry Supervisor: _____

Person Terminating Permit: _____ Date: _____ Time: _____

Distribution to: _____

Attach to this permit a list of rescue and emergency services that can be summoned and the means (such as the equipment to use and the telephone numbers to call) for summoning such emergency services.

Confined Space Entry Permit (PAGE 2 of 2)

PRE-ENTRY SYSTEM CONTROL

Mechanical: Isolate, lockout and de-energize to zero potential energy.

Engulfment: Blank/block/cap/bleed off lines. Lock out gates, valves, pumps.

Electrical: Lockout/Tag-out

Inerting: Flush/Purge/Vent

Special Precautions: _____

Check **Date/Initials**

Completed ☐ _____

Completed ☐ _____

Completed ☐ _____

Completed ☐ _____

ATMOSPHERE - Tested by portable atmospheric monitor with audible and visual alarms.

No one will enter a space with an unsafe atmosphere without approval from the Contractor Superintendent.

	Oxygen	Explosive	H ₂ S/Toxic	CO	Date/Time Completed	Initials
Permissible Range	19.5%-23.5%	< 10% LFL	< 10 ppm H ₂ S	< 35 ppm	--	--
Pre-Entry						
Post Ventilation						
Continuous						
Continuous						
Continuous						

Ventilation Used (circle one): Mechanical Natural

Special Precautions: (See Confined Space Data Sheet) _____

SITE AND PERSONNEL SAFETY (check if required, list type where applicable)

Personal Protective Equipment (PPE) Required:

Safety Harness ☐. Life Lines ☐. Hard Hats ☐. Fall Protection ☐. Retrieval ☐. Eye ☐. Ear ☐. Face ☐. Hand ☐.

Foot ☐. Respiratory ☐ (type) _____. Clothing ☐ (type) _____.

Other: ☐ _____

Rescue and Emergency Equipment Required:

Retrieval Equipment ☐. Fire Extinguishers ☐. Radios/Telephone ☐. Other ☐ _____.

Equipment on Standby for Rescue Personnel ☐ _____

Site Safety Equipment/Items Required:

Explosion-Proof Lighting ☐. Barriers/Shield/Barricades ☐ (type) _____. Postings/Flagging ☐.

Other ☐ _____

List specific equipment to be isolated, de-energized, and locked out.

CONFINED SPACE HOT WORK PERMIT

Contractor/Subcontractor Accessing Confined Space for Hot Work: _____

Site or Facility: _____

Specific Confined Space to be Entered: _____

Date: _____ **Time:** _____

Expected Job Duration (days/hours): _____

Purpose of Entry (describe the work to be done): _____

Explain Why Work Cannot be Done Outside of the Confined Space: _____

Safety Equipment Required:

Fire Extinguishers: Yes _____ No _____ Number _____

 Type _____

Respirators: Yes _____ No _____ Number _____

 Type _____

Other Equipment: _____

Authorizing Supervisor:

Print Name _____

Signature _____

Date Signed _____

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SECTION 01 42 00

REFERENCES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Section includes the following:
 - a. Definitions and terminology in general use in the Contract Documents.
 - b. Applicable codes.
 - c. Owner's referenced specifications, where applicable.
 - d. Abbreviations in general use throughout the Contract Documents.
 - e. General requirements regarding reference standards, including a listing of standard-issuing organizations (and their acronyms) used in the Contract Documents.

1.2 DEFINITIONS AND TERMINOLOGY

A. Definitions and terminology applicable to all the Contract Documents are included in the General Conditions, as may be modified by the Supplementary Conditions.

B. Additional terminology used in the Contract Documents includes the following:

1. "Indicated" refers to graphic representations, notes, or schedules on the Drawings, or to other paragraphs, provisions, tables, or schedules in the Specifications and similar locations in the other Contract Documents. Terminology such as "shown", "noted", "scheduled", and "specified" are used to help the user locate the reference without limitation on the location.
2. "Installer", "applicator", or "erector" is CONTRACTOR or another person or entity engaged by CONTRACTOR, either as an employee or Subcontractor, to perform a particular construction activity, including installation, erection, application, or similar Work. Installers shall be experienced in the Work that installer is engaged to perform.
 - a. The term "experienced", when used in conjunction with the term "installer", means having successfully completed not less than five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated and required; being familiar with Laws and Regulations; and having complied with requirements of authorities having jurisdiction, and complying with requirements of the Supplier of the material or equipment being installed, unless other experience requirements specific to that element of the Work are indicated elsewhere in the Contract Documents.
3. Trades: Use of terms such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter", unless

otherwise indicated in the Contract Documents or required by Laws or Regulations. Such terminology also does not imply that specified requirements apply exclusively to trade personnel of the corresponding generic name.

1.3 APPLICABLE CODES

- A. References in the Contract Documents to local code(s) shall mean the following:
1. New York State Building Code
 2. New York State Mechanical Code
 3. New York State Energy Conservation Code
 4. National Electric Code in effect at the location of the Project.
 5. NFPA 101, Life Safety Code.

1.4 ABBREVIATIONS

- A. Common abbreviations that may be found in the Contract Documents are indicated below, alphabetically by their written-out meaning:

alternating current	a-c
ampere	A
antemeridian	a.m.
Architectural Barriers Act	ABA
Americans with Disabilities Act	ADA
Americans with Disabilities Act Accessibility Guidelines	ADAAG
ante meridian	a.m.
average	avg
biochemical oxygen demand	BOD
five-day biochemical oxygen demand	BOD ₅
brake horsepower	bhp
British thermal unit	Btu
building information model	BIM
carbonaceous biochemical oxygen demand	CBOD
five-day carbonaceous biochemical oxygen demand	CBOD ₅
chemical oxygen demand	COD
Centigrade (or Celsius)	C
chlorinated polyvinyl chloride	CPVC
chlorofluorocarbons	CFC
Code of Federal Regulations	CFR
computer-aided drafting and design	CADD, or CAD
cubic inch	cu in

cubic foot		cu ft
cubic yard		cu yd, or CY
cubic feet per minute		cfm
cubic feet per second		cfs
decibel		db
degree Centigrade (or Celsius)	(Write)	degrees C, °C, or deg C
degrees Fahrenheit		degrees F, °F, or deg F
diameter		dia
direct current		d-c
dollars		\$
each		ea
efficiency		eff
Fahrenheit		F
feet		ft
feet per hour		fph, or ft/hr
feet per minute		fpm
feet per second		fps, or ft/min
figure		fig
flange		flg
foot-pound		ft-lb
gallon		gal
gallons per hour		gph, or gal/hr
gallons per minute		gpm
gallons per second		gps
gram		g
grams per liter		g/L
Hertz		Hz
horsepower		hp or HP
hour		hr
human-machine interface		HMI
inch		in.
inches of mercury		in. Hg
inches water gage		in. w.g.
inch-pound		in.-lb
inside diameter		ID
iron pipe size		IPS

thousand pounds	kip
thousand pounds per square inch	ksi
kilovolt-ampere	kva
kilowatt	kw
kilowatt-hour	kwhr or kwh
linear foot	lin ft or LF
liter	L
Leadership in Energy and Environmental Design (USGBC)	LEED
maximum	max
mercury	Hg
milligram	mg
milligrams per liter	mg/l or mg/L
milliliter	ml
millimeter	mm
million gallons per day	mgd or MGD
million gallon	MG
minimum	min
national pipe threads	NPT
net positive suction head	NPSH
net positive suction head available	NPSHA
net positive suction head required	NPSHR
nitrogen oxide (total concentration of mono-nitrogen oxides such as nitric oxide (NO) and nitrogen dioxide (NO ₂))	NO _x
nominal pipe size	NPS
number	no.
operator interface terminal	OIT
ounce	oz
ounce-force	ozf
outside diameter	OD
parts per hundred	pph
parts per million	ppm
parts per billion	ppb
polyvinyl chloride	PVC
post meridian	p.m.
pound	lb
pounds per square inch	psi

pounds per square inch absolute	psia
pounds per square inch gauge	psig
pounds per square foot	psf
process control system	PCS
programmable logic controller	PLC
revolutions per minute	rpm
second	sec
specific gravity	sp gr, or SG
square	sq
square foot	sq ft, sf, or ft ²
square inch	sq in., or in ²
square yard	sq yd, or SY
standard	std
standard cubic feet per minute	scfm
total dynamic head	TDH
totally-enclosed fan-cooled	TEFC
volt	V
volts alternating current	vac
volts direct current	vdc
volatile organic compounds	VOC

1.5 REFERENCE STANDARDS

- A. Refer to Article 3 of the General Conditions, as may be modified by the Supplementary Conditions, relative to reference standards and resolving discrepancies between reference standards and the Contract Documents. Provisions of reference standards are in effect in accordance with the Specifications.
- B. Copies of Standards: Each entity engaged in the Work shall be familiar with reference standards applicable to its construction activity. Copies of applicable reference standards are not bound with the Contract Documents. Where reference standards are needed for a construction activity, obtain copies of standards from the publication source.
- C. Abbreviations and Names: Where reference standards, specifications, codes, manuals, Laws or Regulations, or other published data of international, national, regional or local organizations are referred to in the Contract Documents, the organization issuing the standard may be referred to by their acronym or abbreviation only. The following acronyms or abbreviations that may appear in the Contract Documents shall have the meanings indicated below. Listing is alphabetical by acronym.

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACS	American Chemical Society
ADSC- IAFD	International Association of Foundation Drilling.
AEIC	Association of Edison Illuminating Companies
AF&PA	American Forest and Paper Association
ABMA	American Bearing Manufacturers Association (formerly Anti-Friction Bearing Manufacturers Association (AFBMA))
AGMA	American Gear Manufacturers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AIChE	American Institute of Chemical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standards Committee
AMA	Acoustical Materials Association
AMCA	Air Movement and Control Association
AMP	National Association of Architectural Metal Manufacturers, Architectural Metal Products Division
ANSI	American National Standards Institute
APA	The Engineered Wood Association
APHA	American Public Health Association
API	American Petroleum Institute
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ASQ	American Society for Quality
ASSE	American Society of Safety Engineers

ASTM	American Society for Testing and Materials
AWCI	Association of the Wall and Ceiling Industry
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BAAQM D	Bay Area Air Quality Management District
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association
CBMA	Certified Ballast Manufacturers Association
CDA	Copper Development Association
CEMA	Conveyor Equipment Manufacturers Association
CGA	Compressed Gas Association
CISCA	Ceilings and Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CMAA	Crane Manufacturers Association of America
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DIN	Deutsches Institut fur Normung eV (German Institute for Standardization)
DIPRA	Ductile Iron Pipe Research Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ETL	Intertek Testing Services, Inc. (formerly ETL Testing Laboratories, Inc.)
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FM	Factory Mutual (FM Global)
FRPI	Fiberglass Reinforced Plastics Institute
FS	Federal Specification
GA	Gypsum Association
GANA	Glass Association of North America
HEW	United States Department of Health, Education and Welfare
HI	Hydraulic Institute
HMI	Hoist Manufacturers Institute

HUD	United States Department of Housing and Urban Development
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFI	Industrial Fasteners Institute
IRI	Industrial Risk Insurers
ISA	Instrumentation, Systems, and Automation Society (formerly Instrument Society of America)
ISO	Insurance Services Office
ISO	International Organization for Standardization
LPI	Lightning Protection Institute
MIA	Marble Institute of America
ML/SFA	Metal Lath/Steel Framing Association
MS	Military Specifications
MSS	Manufacturers' Standardization Society
MMA	Monorail Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators, Inc.
NARUC	National Association of Regulatory Utilities Commissioners
NBHA	National Builders Hardware Association
NBS	United States Department of Commerce, National Bureau of Standards
NCMA	National Concrete Masonry Association
NEC	National Electric Code
NELMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NHPMA	Northern Hardwood and Pine Manufacturers Association
NIST	United States Department of Commerce, National Institute of Standards and Technology
NLGA	National Lumber Grades Authority

NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	National Sanitation Foundation
NSSGA	National Stone, Sand, and Gravel Association
NTMA	National Terrazzo and Mosaic Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PEI	Porcelain Enamel Institute
PFI	Pipe Fabrication Institute
PPI	Plastics Pipe Institute
PGMC	Primary Glass Manufacturers Council
PS	Product Standards Section, United States Department of Commerce
RCSC	Research Council on Structural Connections (part of AISC)
RMA	Rubber Manufacturers Association
SAE	Society of Automotive Engineers
SCAQMD	Southern California Air Quality Management District
SCPRF	Structural Clay Products Research Foundation
SCTE	Society of Cable Telecommunications Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturing Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
SPI	Society of the Plastics Industry
SPIB	Southern Pine Inspection Bureau
SSPC	Society for Protective Coatings
SWI	Steel Window Institute
TCNA	Tile Council of North America
TEMA	Tubular Exchanger Manufacturers Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
UL	Underwriters Laboratories, Inc.
USAB	United States Access Board
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USGBC	United States Green Building Council

USGS	United States Geological Survey
USPHS	United States Public Health Service
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WCMA	Wood Component Manufacturers Association
WDMA	Window and Door Manufacturers Association
WEF	Water Environment Federation
WWEMA	Water and Wastewater Equipment Manufacturers Association
WWPA	Western Wood Products Association

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 45 29.13

TESTING LABORATORY SERVICES FURNISHED BY CONTRACTOR

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall employ and pay for services of independent testing laboratory to perform specified services.
2. Inspection, sampling, and testing shall be as specified in the Specifications including but not limited to:
 - a. Section 01 45 33, Code-Required Special Inspections and Procedures.
 - b. Section 03 00 05, Concrete.
 - d. Section 31 20 00, Earth Moving.
 - s. Other tests indicated in the Contract Documents that are not specifically assigned to others.
3. CONTRACTOR shall pay for:
 - a. Tests not specifically indicated in the Contract Documents as being OWNER's responsibility.
 - b. Tests made for CONTRACTOR's convenience.
 - c. Repeat tests required because of CONTRACTOR's negligence or defective Work, and retesting after failure of test for the same item to comply with the Contract Documents.
4. Testing laboratory is not authorized to approve or accept any portion of the Work or defective Work; rescind, alter, or augment requirements of Contract Documents; and perform duties of CONTRACTOR.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM E329, Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
2. ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories.
3. NIST SRM, Standard Reference Materials.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Testing Laboratory:
 - a. Comply with applicable requirements of ASTM E329.
 - b. Testing laboratory shall be licensed to operate in the same jurisdiction as the Site. Where applicable, laboratory shall be certified by the authority having jurisdiction for the types of testing required.

- c. Testing equipment used by laboratory shall be calibrated at intervals of not more than twelve months by devices of accuracy traceable to one of the following: NIST SRM, ISO/IEC 17025, certified by state or local bureau of weights and measures, or values of natural physical constants generally accepted in the engineering and scientific community.

1.4 SUBMITTALS

- A. Informational Submittals: Submit the following:
 - 1. Quality Control Submittals and Test Reports: Testing laboratory shall promptly submit to CONTRACTOR results of testing and inspections, including:
 - a. Date issued.
 - b. Project title, number, and name of the Site.
 - c. Testing laboratory name and address.
 - d. Name and signature of inspector or person obtaining samples.
 - e. Date of inspection or sampling.
 - f. Record of temperature and weather conditions.
 - g. Date of test.
 - h. Identification of material or item tested, and associated Specifications Section.
 - i. Location in the Project.
 - j. Type of inspection or test.
 - k. Results of tests and observations regarding compliance with the Contract Documents.
 - 2. Qualifications Statements:
 - a. Testing Laboratory:
 - 1) Qualifications statement indicating experience and facilities for tests required under the Contract Documents.
 - 2) Copy of report of inspection of facilities during most recent NIST inspection tour. Include memorandum of remedies of deficiencies reported during inspection.
 - 3) Copy of certificate of calibration for each instrument or measuring device proposed for use, by accredited calibration agency.

1.5 TESTING LABORATORY DUTIES

- A. Testing laboratory shall:
 - 1. Cooperate with CONTRACTOR and provide qualified personnel promptly on notice.
 - 2. Perform required inspections, sampling, and testing of materials and methods of construction; comply with applicable reference standards and the Contract Documents; and ascertain compliance with requirements of the Contract Documents.
 - 3. Promptly notify ENGINEER and CONTRACTOR of irregularities or deficiencies in the Work that are observed during performance of services.
 - 4. Promptly submit to CONTRACTOR reports of inspections and tests.
 - 5. Perform additional tests and services, as required by CONTRACTOR.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. CONTRACTOR shall:

1. Cooperate with testing laboratory personnel.
2. Provide to testing laboratory preliminary representative samples of materials and items to be tested, in required quantities.
3. Promptly submit to ENGINEER results of tests and inspections received from testing laboratory.
4. Furnish to laboratory the preliminary design mix proposed for concrete and other material mixes to be tested by testing laboratory.
5. Provide labor and facilities:
 - a. For access to the Work to be tested, and where required, to Suppliers' operations.
 - b. For obtaining and handling samples at the Site.
 - c. For facilitating inspections and tests.
 - d. For testing laboratory's exclusive use for storing and curing of test samples.
 - e. Forms for preparing concrete test beams and cylinders.
6. Notify laboratory and ENGINEER sufficiently in advance of operations to allow assignment of personnel and scheduling of tests.
7. Arrange with laboratory and pay for additional services, sampling, and testing required for CONTRACTOR's convenience.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 45 33.00

CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope
 - 1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to cooperate with the Coordinating Special Inspector and individual special inspectors employed by OWNER, and to perform required testing and inspections. CONTRACTOR shall engage the services of testing agencies as needed to facilitate Special Inspections.
 - 2. Supplement A, Statement of Special Inspections, included with this Section, lists testing and inspections required.

1.2 DEFINITIONS

- A. Coordinating Special Inspector: Professional engineer or architect, hired by OWNER, registered in the same state as the Site, responsible for coordinating and verifying the inspection and testing required by the Statement of Special Inspections included in this Section and reporting to the Building Official.
- B. Building Official: Officer or other designated authority having jurisdiction charged with the administration and enforcement of the governing building code, or a duly authorized representative.
- C. Special Inspections: Testing and inspection required in Supplement A, Statement of Special Inspections, of this Section.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. OWNER will employ and pay for services of the Coordinating Special Inspector, who will have not less than five years of experience in managing, monitoring, and inspecting building construction.
 - 2. Inspectors will be qualified in their assigned Special Inspection in accordance with Supplement A, Statement of Special Inspections, of this Section.
 - 3. Inspectors will be qualified in the responsibilities of the Special Inspection for which each is responsible.
- B. Regulatory Requirements:
 - 1. Special Inspections shall be in accordance with applicable building code and other Laws and Regulations, and Supplement A, Statement of Special Inspections, of this Section.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Samples: Representative Samples of materials when required by ENGINEER.
- B. Informational Submittals: Submit the following:
 - 1. Completed Supplement C, Contractor's Statement of Responsibility, as attached to this Section, addressing each system and component listed in the Quality Assurance Plan portion of Supplement A, Statement of Special Inspections, of this Section.
 - 2. Completed Supplement D, Fabricator's Certificate of Compliance, as attached to this Section, for fabrication of structural steel.
 - 3. Site Quality Control Submittals: Material test reports.
 - 4. Procedure Submittals: List of control procedures within CONTRACTOR's organization for testing, including methods, frequency of reporting, and distribution of testing reports.
 - 5. Qualifications Statements:
 - a. Names and qualifications of each testing agency to be employed, and qualifications of testing agency's personnel that will perform testing as required in Supplement A, Statement of Special Inspections, of this Section.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. Prepare Supplement C, Contractor's Statement of Responsibility, of this Section which shall include:
 - 1. Acknowledgment of the requirements of the Quality Assurance Plan portion of Supplement A, Statement of Special Inspections, of this Section.
 - 2. Acknowledgment that necessary quality control shall be exercised in fabricating, handling, and installing to conform to the Contract Documents.
 - 3. List CONTRACTOR's procedures for ensuring the quality of the Work required for compliance with the Contract Documents relative to each system or component listed in the Quality Assurance Plan portion of Supplement A of this Section.
 - 4. List personnel who control the quality of the Work relative to the Contract Documents and indicate their position in CONTRACTOR's organization.
- B. Employ testing agencies with personnel that comply with qualifications requirements in Supplement A, Statement of Special Inspections, of this Section.
- C. Provide safe access to the Work to be tested and inspected.
- D. Obtain and handle test samples at the Site.
- E. Facilitate inspections and tests.
- F. Provide access to Suppliers' and Subcontractors' operations as required.

- G. Notify testing agencies, Coordinating Special Inspector, and ENGINEER sufficiently in advance of the Work for the testing agencies, Coordinating Special Inspector, and ENGINEER to coordinate their personnel at the Site. Do not cover the Work to be inspected until Special Inspections have been completed and the results thereof are acceptable.
- H. Special Inspections required in this Section do not supersede or make unnecessary inspections and tests required under other Specification Sections or standard inspections required by Laws and Regulations.

1.6 COORDINATING SPECIAL INSPECTOR'S RESPONSIBILITIES

- A. Coordinating Special Inspector will:
 - 1. Hire special inspectors to provide inspections listed Supplement A, Statement of Special Inspections, of this Section and as required by Laws and Regulations, and laws.
 - 2. Review testing agencies and testing personnel submitted by CONTRACTOR, relative to compliance with Supplement A, Statement of Special Inspections, of this Section, and in accordance with Laws and Regulations.
 - 3. Complete Supplement A, Statement of Special Inspections, of this Section to provide names of each inspector and testing agency for each Special Inspection required. Provide Supplement A, Statement of Special Inspections, of this Section to the Building Official, OWNER, ENGINEER, and CONTRACTOR.
 - 4. Coordinate activities of individual inspectors and testing agencies with CONTRACTOR.
 - 5. Provide interim reports of inspections and material testing to Building Official, OWNER, ENGINEER, and ENGINEER's consultants, including structural engineer and architect.
 - 6. To obtain certificate of use and occupancy from the Building Official, complete and provide to the Building Official, OWNER, and ENGINEER Supplement B, Final Report of Special Inspections, of this Section, documenting completion of Special Inspections and correction of discrepancies noted in the Special Inspections.

1.7 INSPECTOR RESPONSIBILITIES

- A. Perform specified inspections, sampling, and testing of materials and methods of construction; review and ascertain compliance with Laws and Regulations.
- B. Promptly notify Coordinating Special Inspector, OWNER, ENGINEER and CONTRACTOR of irregularities or deficiencies in the Work observed during Special Inspections. Corrective action, if required, will be determined by ENGINEER.
- C. Promptly submit two copies of each report of inspections and tests to Coordinating Special Inspector, ENGINEER, and CONTRACTOR including:
 - 1. Date issued.
 - 2. Project title and number.

3. Name and signature of inspector.
4. Date of inspection or sampling and test.
5. Record of temperature and weather.
6. Identification of product and Specification Section.
7. Location in Project.
8. Type of inspection or test.
9. Results of inspections and tests, and observations regarding compliance with Laws and Regulations, and standards.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SUPPLEMENTS

- A. The supplements listed below, following the “End of Section” designation, are part of this Section:
 1. Supplement A – Statement of Special Inspections
 2. Supplement B – Final Report of Special Inspections
 3. Supplement C – Contractor’s Statement of Responsibility
 4. Supplement D – Fabricator’s Certificate of Compliance

+ + END OF SECTION + +

01 45 33-5

Owner's Authorization:

Building Official's Acceptance:

Signature

Date

Signature

Date

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Schedule of Inspection and Testing Agencies

This Statement of Special Inspections / Quality Assurance Plan includes the following building systems:

- | | |
|----------------------------------------------------|----------------------------------------------------------------|
| <input type="checkbox"/> Soils and Foundations | <input type="checkbox"/> Spray Fire Resistant Material |
| <input type="checkbox"/> Cast-in-Place Concrete | <input type="checkbox"/> Wood Construction |
| <input type="checkbox"/> Precast Concrete | <input type="checkbox"/> Exterior Insulation and Finish System |
| <input type="checkbox"/> Masonry | <input type="checkbox"/> Mechanical & Electrical Systems |
| <input type="checkbox"/> Structural Steel | <input type="checkbox"/> Architectural Systems |
| <input type="checkbox"/> Cold-Formed Steel Framing | <input type="checkbox"/> Special Cases |

Special Inspection Agencies	Firm	Address, Telephone, e-mail
1. Coordinating Special Inspector		
2. Inspector		
3. Inspector		
4. Testing Agency		
5. Testing Agency		
6. Other		

Note: The inspectors will be engaged by Owner or Owner's Agent, and not by Contractor or Subcontractor whose Work is to be inspected or tested. Testing agencies shall be engaged and paid for by Contractor. Conflicts of interest must be disclosed to the Building Official prior to commencing the Work.

Quality Assurance Plan

Quality Assurance for Seismic Resistance

Seismic Design Category	B
Quality Assurance Plan Required (Y/N)	N

Description of seismic force resisting system and designated seismic systems:

- None

Quality Assurance for Wind Requirements

Basic Wind Speed (three-second gust)	120
Wind Exposure Category	C
Quality Assurance Plan Required (Y/N)	Y

Description of wind force resisting system and designated wind resisting components:

Statement of Responsibility

Each contractor responsible for the construction or fabrication of a system or component designated above must submit a Statement of Responsibility.

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspections are subject to the approval of the Building Official. The credentials of all inspectors and testing technicians shall be provided if requested.

Key for Minimum Qualifications of Inspection Agents:

When Engineer deems it appropriate that the individual performing a stipulated test or inspection have a specific certification or license as indicated below, such designation shall appear below the *Agency Number* on the Schedule.

PE/SE	Structural Engineer – a licensed SE or PE specializing in the design of building structures
PE/GE	Geotechnical Engineer – a licensed PE specializing in soil mechanics and foundations
EIT	Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination

American Concrete Institute (ACI) Certification

ACI-CFTT	Concrete Field Testing Technician – Grade 1
ACI-CCI	Concrete Construction Inspector
ACI-LTT	Laboratory Testing Technician – Grade 1&2
ACI-STT	Strength Testing Technician

American Welding Society (AWS) Certification

AWS-CWI	Certified Welding Inspector
AWS/AISC-SSI	Certified Structural Steel Inspector

American Society of Non-Destructive Testing (ASNT) Certification

ASNT	Non-Destructive Testing Technician – Level II or III.
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International Code Council (ICC) Certification

ICC-SMSI	Structural Masonry Special Inspector
ICC-SWSI	Structural Steel and Welding Special Inspector
ICC-SFSI	Spray-Applied Fireproofing Special Inspector
ICC-PCSI	Prestressed Concrete Special Inspector
ICC-RCSI	Reinforced Concrete Special Inspector

National Institute for Certification in Engineering Technologies (NICET)

NICET-CT	Concrete Technician – Levels I, II, III & IV
NICET-ST	Soils Technician - Levels I, II, III & IV
NICET-GET	Geotechnical Engineering Technician - Levels I, II, III & IV

Exterior Design Institute (EDI) Certification

EDI-EIFS	EIFS Third Party Inspector
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Other

Soils and Foundations

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Item	Agency # (Qualif.)	Scope
1. Excavations	PE/GE	<i>Verify excavations are extended to proper depth and have reached proper material (periodic).</i>
2. Shallow Foundations	PE/GE	<i>Inspect subgrade below footings for adequate bearing capacity and consistency with geotechnical report (periodic).</i> <i>Inspect removal of unsuitable material and preparation of subgrade prior to placement of controlled fill</i>
3. Compacted Fill	PE/GE	<i>Perform classification and testing of compacted fill materials (periodic).</i> <i>Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill (continuous).</i> <i>Prior to placement of compacted fill, observe subgrade and verify that site has been prepared properly (periodic).</i> <i>Verify extent and slope of fill placement.</i>

Cast-in-Place Concrete

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Item	Agency # (Qualif.)	Scope
1. Mix Design	ACI-CCI ICC-RCSI	Review concrete batch tickets and verify compliance with approved mix design. Verify that water added at the site does not exceed that allowed by the mix design.
2. Material Certification	PE/SE	Review trial batch or supporting test data to verify mix meets specified requirements. Confirm materials meet specified requirements.
3. Reinforcement Installation	ACI-CCI ICC-RCSI	Inspect size, spacing, cover, positioning and grade of reinforcing steel. Verify that reinforcing bars are free of form oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters
4. Formwork Geometry		Inspect formwork for proper materials, dimensions and alignment.
5. Not used		
6. Anchor Rods	ACI-CCI ICC-RCSI	Inspect size, positioning and embedment of anchor rods. Inspect concrete placement and consolidation around anchors. (continuous)
7. Concrete Placement	ACI-CCI ICC-RCSI	Inspect placement of concrete. Verify that concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated. (continuous)
8. Sampling and Testing of Concrete	ACI-CFTT ACI-STT	Test concrete compressive strength (ASTM C31 & C39), slump (ASTM C143), air-content (ASTM C231) and temperature (ASTM C1064).
9. Curing and Protection	ACI-CCI ICC-RCSI	Inspect curing, cold weather protection and hot weather protection procedures.
10. Other:		

Masonry

Required Inspection Level: ☐ 1 ☒ 2

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Item	Agency # (Qualif.)	Scope
1. Material Certification	PE/SE	<ul style="list-style-type: none"> Confirm size and strength of masonry units. Confirm grout mix design and materials. Confirm mortar mix design and materials
2. Mixing of Mortar and Grout	ICC-SMSI	Inspect proportioning, mixing and retempering of mortar and grout. (continuous)
3. Installation of Masonry	ICC-SMSI	Inspect size, layout, bonding and placement of masonry units.
4. Mortar Joints	ICC-SMSI	Inspect construction of mortar joints including tooling and filling of head joints.
5. Reinforcement Installation	ICC-SMSI AWS-CWI	<ul style="list-style-type: none"> Inspect placement, positioning and lapping of reinforcing steel. Inspect welding of reinforcing steel. (continuous)
6. Grouting Operations	ICC-SMSI	<ul style="list-style-type: none"> Inspect that masonry cells are clear of debris prior to grouting. Inspect placement and consolidation of grout. (continuous)
7. Weather Protection	ICC-SMSI	Inspect cold weather protection and hot weather protection procedures. Verify that wall cavities are protected against precipitation.
8. Evaluation of Masonry Strength	ICC-SMSI	Test compressive strength of mortar and grout cube samples (ASTM C780).
9. Anchors and Ties	ICC-SMSI	Inspect size, location, spacing and embedment of dowels, anchors and ties.
10. Other:		

Item	Agency # (Qualif.)	Scope
1. Fabricator Certification/ Quality Control Procedures <input type="checkbox"/> Fabricator Exempt	<i>PE/SE</i> <i>AWS/AIS</i> <i>C-SSI</i> <i>ICC-SWSI</i>	<ul style="list-style-type: none"> Verify fabricator has certification from AISC for conventional buildings of the AISC Quality Certification Program and has approval by the Building Official. Review fabricator's certificate of compliance.
2. Material Certification	<i>AWS/AIS</i> <i>C-SSI</i> <i>ICC-SWSI</i>	Review certified mill test reports and identification markings on wide-flange shapes, high-strength bolts, nuts and welding electrodes
3. Bolting	<i>AWS/AIS</i> <i>C-SSI</i> <i>ICC-SWSI</i>	Inspect installation and tightening of high-strength bolts. Verify that splines have separated from tension control bolts. Verify proper tightening sequence. Continuous inspection of bolts in slip-critical connections.
		•
		•

Anchor Systems

Item	Agency # (Qualif.)	Scope
1. Material Certification	PE/SE	<ul style="list-style-type: none"> Confirm anchor type (including product name), anchor dimensions, and anchor material grade for each anchor application. Confirm post-installed anchor compliance with specified requirements and suitability for each application type by review of the anchor system ICC-ES Evaluation Service Report. For adhesive anchors, confirm adhesive type
2. Installation of Adhesive Anchors for Concrete, Grout-filled Masonry, and Hollow Concrete Masonry	ICC-RCSI ICC-SMSI	<ul style="list-style-type: none"> Review compliance with the installation requirements of the anchor system ICC Evaluation Service Report. Verify and record anchor type (including product name), anchor dimensions, anchor material grade, adhesive type, adhesive expiration date, concrete or masonry type, base material compressive strength, drill bit type, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, base material thickness, anchor embedment, curing period prior to tightening, and tightening torque. Inspect installation of each type and size of adhesive anchor by construction personnel on the site. (continuous)
3. Installation of Concrete and Grout-filled Masonry Wedge Expansion Anchors	ICC-RCSI ICC-SMSI	<ul style="list-style-type: none"> Review compliance with the installation requirements of the anchor system ICC Evaluation Service Report. Verify and record anchor type (including product name), anchor dimensions, anchor material grade, concrete or masonry type, base material compressive strength, drill bit type, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, base material thickness, anchor embedment and tightening torque. Inspect installation of each type and size of wedge anchor by construction personnel on the site. (continuous)
4. Anchor Testing	ASNT	<ul style="list-style-type: none"> Perform tension pullout test on 10 percent of each post-installed anchor type and size.

Supplement B - Final Report of Special Inspections

Project:

Location:

Owner:

Owner's Address:

Architect of Record:

Structural Engineer of Record:

To the best of my information, knowledge and belief, the Special Inspections required for this project, and itemized in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Special Inspector

(Type or print name)

Signature

Date

Licensed Professional Seal

Agent’s Final Report

Project:

Agent:

Special Inspector:

To the best of my information, knowledge and belief, the Special Inspections or testing required for this project, and designated for this Agent in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Agent of the Special Inspector

(Type or print name)

Signature Date

Licensed Professional Seal or
Certification

Supplement C - Contractor's Statement of Responsibility

Each contractor responsible for the construction or fabrication of a system or component designated in the Quality Assurance Plan of Supplement A shall submit a Contractor's Statement of Responsibility.

Project:

Contractor's Name:

Address:

License No.:

Description of designated building systems and components included in the Contractor's Statement of Responsibility:

Contractor's Acknowledgment of Special Requirements

I hereby acknowledge that I have received, read, and understand the Project's seismic requirements, Quality Assurance Plan in Supplement A, and Special Inspection program.

I hereby acknowledge that control will be exercised to obtain conformance with the Contract Documents approved by the Building Official having jurisdiction.

Signature

Date

Contractor's Provisions for Quality Control

Procedures for exercising control within the Contractor's organization, the method and frequency of reporting and the distribution of reports are attached to this Statement.

Identification and qualifications of the person(s) exercising such control and their position(s) in the organization are attached to this Statement.

Supplement D - Fabricator's Certificate of Compliance

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per section 1704.2 of the International Building Code must submit a *Fabricator's Certificate of Compliance* at the completion of fabrication.

Project:

Fabricator's Name:

Address:

Certification or Approval Agency:

Certification Number:

Date of Last Audit or Approval:

Description of structural members and assemblies that have been fabricated:

I hereby certify that items described above were fabricated in strict accordance with the Contract Documents.

Signature

Date

Title

Attach copies of fabricator's certification or building code evaluation service report and fabricator's quality control manual.

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SECTION 01 51 05

TEMPORARY UTILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all temporary utilities and temporary facilities required for the Project, including the following:
 - a. Electricity.
 - b. Lighting.
 - c. Telephone and communications.
 - d. Heating, cooling, ventilating, and temporary enclosures.
 - e. Water.
 - f. Sanitary facilities.
 - g. First-aid facilities.
 - h. Fire protection.
2. Make all arrangements with utility owners for temporary utilities and with others as appropriate for temporary facilities. Obtain required permits and approvals for temporary utilities and temporary facilities.
3. Pay all service costs for utilities and facilities indicated in this Section as CONTRACTOR's responsibility, including cost of electricity, water, fuel, and other utility services and temporary facilities required for the Work.
4. Continuously maintain adequate temporary utilities and temporary facilities for all purposes for the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities and temporary facilities through Substantial Completion and removal of temporary field offices and sheds unless otherwise approved in writing by ENGINEER.
5. Should OWNER occupy part of the Work prior to Substantial Completion of the entire Work, cost of utilities consumed via temporary utilities serving the portion occupied by OWNER will be shared proportionately by OWNER and CONTRACTOR as mutually agreed to by the parties.
6. Maintain, including cleaning, temporary utilities and temporary facilities, and continuously provide consumables as required.
7. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and the needs of the Project.
8. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.

1.2 REQUIREMENTS FOR TEMPORARY UTILITIES AND TEMPORARY FACILITIES

A. Water:

1. General:

- a. Provide temporary water facilities including piping, valves, meters if not provided by owner of existing waterline, backflow preventers, pressure regulators, and other appurtenances. Provide freeze-protection as required.
 - b. Continuously maintain adequate water flow and pressure for all purposes during the Project, until removal of temporary water systems.
 - 2. Water for Construction Purposes:
 - a. Provide water for Site maintenance and cleaning and, water necessary for construction activities, and water for disinfecting and testing of systems.
 - 3. Water for Human Consumption and Sanitation:
 - a. Provide potable water in accordance with Laws and Regulations for consumption by personnel at the Site, for field offices, and for sanitary facilities.
 - b. When necessary, provide bottled, potable water for use and consumption by personnel at the Site, including CONTRACTOR, ENGINEER, and visitors to the Site.
- F. Sanitary Facilities.
- 1. Provide suitably-enclosed chemical or self-contained toilets for CONTRACTOR's employees, Subcontractors, Suppliers, ENGINEER, and visitors to the Site. Location of temporary toilets shall be acceptable to OWNER and ENGINEER.
 - 2. Refer to Paragraph 1.2.E of this Section for requirements for water intended for human consumption during construction.
 - 3. Provide suitable temporary washing facilities for employees and visitors.
- G. First-aid Facilities.
- 1. Provide temporary first-aid stations at or immediately adjacent to the Site's work areas, and inside CONTRACTOR's temporary field office. Locations of first-aid stations shall be determined by CONTRACTOR's safety representative. Replenish supplies in first-aid stations as items are used, prior to expiration of items, and as necessary. Monitor and log inventory of supplies in first-aid stations in accordance with requirements for monitoring and logging safety equipment as indicated in Section 01 35 23, Safety Requirements.
 - 2. Provide list of emergency telephone numbers at each hardwired telephone at the Site. List shall be in accordance with the list of emergency contact information required in Section 01 35 23, Safety Requirements.

1.3 USE OF OWNER'S SYSTEM

- A. Use of Permanent Utility Systems Provided Under the Project:
- 1. Permanent electrical, lighting, water, heating, ventilating, and fire protection systems and first-aid facilities may be used to provide temporary utilities and temporary facilities if the following are met:
 - a. Obtain OWNER's written permission to use permanent systems.

- b. Permanent systems to be used for temporary utilities or temporary facilities shall be substantial complete, including complete functionality of all controls.
- c. CONTRACTOR shall pay all costs while using permanent system, including operation, maintenance, replacement of consumables, and provide replacement parts.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for temporary utilities and temporary facilities may be new or used, but shall be adequate for purposes intended and shall not create unsafe conditions, and shall comply with Laws and Regulations.
- B. Provide required materials, equipment, and facilities, including piping, cabling, controls, and appurtenances.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install temporary utilities and temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.
- B. Location of Temporary Utilities and Temporary Facilities:
 - 1. Locate temporary systems for proper function and service.
 - 2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility owners and others.
 - 3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.
- C. Modify and extend temporary systems as required by progress of the Work.

3.2 USE

- A. Maintain temporary systems to provide safe, continuous service as required.
- B. Properly supervise operation of temporary systems:
 - 1. Enforce compliance with Laws and Regulations.
 - 2. Enforce safe practices.
 - 3. Prevent abuse of services.

4. Prevent nuisances and hazards caused by temporary systems and their use.
 5. Prevent damage to finishes.
 6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.
- C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient.

3.3 REMOVAL

- A. Completely remove temporary utilities, temporary facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to preconstruction condition.
- B. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner.
- C. Where permanent utilities and systems were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

+ + END OF SECTION + +

SECTION 01 52 13

CONTRACTOR'S FIELD OFFICE AND SHEDS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide a temporary field office for CONTRACTOR's use with not less than the minimum facilities specified.
 - 2. Provide required temporary storage and work sheds.
 - 3. Obtain and pay for required permits and utilities. Field offices and sheds shall comply with Laws and Regulations.
- B. Coordination:
 - 1. Coordinate with OWNER, facility manager, other contractors, and others using the Site the location of field offices and sheds, including contracts indicated in Section 01 11 13, Summary of Work.
- C. Location:
 - 1. Locate field offices and sheds in accordance with the Contract Documents and in accordance with the Site mobilization discussions at the preconstruction conference.
- D. Furnish in CONTRACTOR's field office one complete set of the Contract Documents for ready reference by interested persons. In addition to the reference set, comply with Section 01 78 39, Project Record Documents and related provisions of the General Conditions, as may be modified by the Supplementary Conditions.

PART 2 – PRODUCTS

2.1 FIELD OFFICE AND SHEDS – FURNISHINGS, AND EQUIPMENT

- A. Contractor's Field Office and Furnishings:
 - 1. Construction: As required by CONTRACTOR and sufficient for Project meetings.
 - 2. Utilities and Services: Provide the following:
 - a. Telephone service.
 - b. Computer network and related facilities as required for CONTRACTOR's needs.
 - c. Utilities and related facilities for lighting and maintaining temperature, in accordance with Section 01 52 11, Engineer's Field Office.
 - 3. Furnishings:

- a. Conference Facilities: CONTRACTOR shall provide conference area with conference table and chairs sufficient for 20 people. Conference facilities and furnishings shall be provided with suitable utilities, lighting, ventilation, and temperature controls prior to the first progress meeting, unless otherwise approved by ENGINEER.
 - b. Other furnishings required by CONTRACTOR.
4. Provide on field office's exterior an identification sign displaying CONTRACTOR's company name. Maximum size of sign shall be four feet by eight feet. Sign shall be suitable for outdoor use for the duration of the Project.
5. Furnish and maintain at CONTRACTOR's field office 12 protective helmets ('hard hats') for use by visitors to the Site.

B. Contractor's Storage and Work Sheds:

1. Provide storage and work sheds sized, furnished, and equipped to accommodate personnel, materials, and equipment involved in the Work, including temporary utility services and facilities required for environmental controls sufficient for personnel, materials, and equipment.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation:

1. Install CONTRACTOR's temporary field offices, sheds, and related facilities in accordance with Laws and Regulations.
2. Install materials and equipment, including prefabricated structures, in accordance with manufacturer's instructions.

3.2 MAINTENANCE AND REMOVAL

A. Maintenance:

1. Clean and maintain field offices and sheds as required.
2. Provide consumables as required.

B. Removal:

1. Do not remove temporary field offices and sheds until after Substantial Completion of the entire Work, unless otherwise approved by ENGINEER.
2. Remove field offices and sheds and restore areas prior to final inspection.

+ + END OF SECTION + +

SECTION 01 52 16

FIRST AID FACILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes requirements for temporary first-aid facilities for personnel use at Site during construction, including first-aid stations, lists of emergency contact information, and first-aid-trained personnel.
2. CONTRACTOR shall provide first-aid facilities during the Project, including:
 - a. Paying all costs for first-aid facilities, including installation, maintenance, and removal.
 - b. Maintaining, including cleaning, first-aid facilities. Keep first-aid facilities continuously supplied with consumables.
 - c. Facilities shall be adequate for personnel using the Site.
 - d. Providing facilities in compliance with Laws and Regulations.

1.2 TEMPORARY FIRST-AID FACILITIES REQUIRED

A. Provide the following temporary first-aid facilities:

1. First-aid Stations at the Site:
 - a. Provide temporary first-aid stations at or immediately adjacent to the Site's major work areas, and inside CONTRACTOR's temporary field office.
 - b. Locations of first-aid stations shall be determined by CONTRACTOR's safety representative.
 - c. Other contractors shall provide first-aid stations in their own field office.
 - d. First-aid stations shall be adequate for the number of personnel at the Site and the types of work and hazards anticipated.
 - e. Not less-often than monthly, inspect each temporary first-aid station and inventory items consumed or used and remove items that are at or near their expiration date. Promptly replace and restock consumables and expired items.
2. Emergency Contact List:
 - a. Provide list of emergency telephone numbers at each hardwired telephone at the Site.
 - b. List shall be in accordance with the list of emergency contact information required in Section 01 35 23, Safety Requirements.
3. Personnel Trained in First-Aid:
 - a. When work is in progress, furnish at the Site not less than one person trained in first-aid.
 - b. First-aid-trained personnel shall possess valid certificate indicating that they have successfully completed first-aid training course by the American Red Cross or similar entity.

B. Restrictions:

1. Existing Facilities: In general, OWNER's existing first-aid facilities shall not be used by contractors without written permission of OWNER with conditions for use. Exceptions include life-threatening situations. When used, promptly and completely restock and restore such facilities with identical items.
2. Permanent Facilities Provided Under the Project: In general, contractors shall not use permanent first-aid facilities provided under the Project. Exceptions include life-threatening situations. When used, promptly and completely restock and restore such facilities with identical items.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 USE

A. Use of Temporary Facilities:

1. Properly supervise temporary facilities.
2. Properly dispose of wastes.

3.2 REMOVAL

- A. Completely remove temporary facilities and materials when no longer required. Repair damage caused by temporary facilities and their removal and restore Site to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to preconstruction condition.

+ + END OF SECTION + +

SECTION 01 52 19

SANITARY FACILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes requirements for temporary sanitary facilities, including toilet facilities, drinking water for personnel, and personnel washing facilities.
1. CONTRACTOR shall provide all temporary sanitary facilities required for the Project.
 - a. Make all arrangements with temporary sanitary facility providers for temporary sanitary services and obtain required permits and approvals for temporary sanitary facilities and associated services.
 - b. Pay all costs for temporary sanitary facilities and associated services, including cost of electricity, water, fuel, and other utility services required for temporary sanitary facilities.
 - c. Continuously maintain adequate temporary sanitary facilities for all purposes during the Project, until removal of temporary sanitary facilities. At minimum, provide and maintain temporary sanitary facilities through Substantial Completion and removal of temporary field offices and sheds, and at all times thereafter when CONTRACTOR is at the Site performing Work.
 - d. Maintain and clean the temporary sanitary facilities and continuously provide consumables as required.
 - e. Temporary sanitary facilities shall be adequate for personnel using the Site and requirements of Project.
 - f. Provide temporary sanitary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.

1.2 REQUIREMENTS FOR TEMPORARY SANITARY FACILITIES

A. Sanitary Facilities.

1. Portable Toilets:
 - a. Provide suitably-enclosed, temporary chemical or self-contained toilets for CONTRACTOR's employees and visitors to the Site.
 - b. Location of temporary toilets shall be acceptable to OWNER.
2. Drinking Water:
 - a. Provide supply of potable drinking water and related facilities and consumables for all personnel using the Site, including employees of contractors, OWNER, facility manager, ENGINEER, visitors, and others.
 - b. Location of potable drinking water supply shall be as required by CONTRACTOR and convenient for access by personnel
 - c. Provide potable drinking water supply and cups.
 - d. Replenish drinking water supply as needed. Avoid creating hazards to

- health and safety caused by shortages of drinking water quantity and inadequate quality.
- e. Drinking water quality shall comply with Laws and Regulations.
- 3. Washing Facilities:
 - a. Provide suitable temporary washing facilities for employees, ENGINEER, and visitors to the Site.
 - b. Washing facilities shall be adequate for the nature of work underway at the Site.
 - c. Properly handle, store, and dispose of used wash water, in accordance with Laws and Regulations.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for temporary sanitary facilities may be new or used, but shall be adequate for purposes intended and shall not create unsafe conditions, and shall comply with Laws and Regulations.
- B. Provide required materials, equipment, and facilities, including piping, wiring, and controls.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install temporary sanitary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.
- B. Location of Temporary Sanitary Facilities:
 - 1. Locate temporary sanitary facilities for proper function and service.
 - 2. Temporary sanitary facilities shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility companies.
- C. Modify and extend temporary sanitary facilities as required by progress of the Work.

3.2 USE

- A. Maintain temporary sanitary facilities to provide safe, continuous service as required.
- B. Supervision and Enforcement of Use:
 - 1. Properly supervise operation of temporary sanitary facilities.
 - 2. Enforce compliance with Laws and Regulations.

3. Enforce safe practices.
4. Prevent abuse of services.
5. Prevent nuisances and hazards caused by temporary sanitary facilities and their use.
6. Prevent damage to finishes.
7. Ensure that temporary sanitary facilities do not interrupt continuous progress of the Work.

C. Checks and Consumables:

1. At end of each work day, check temporary sanitary facilities and verify that sufficient consumables are available to maintain operation until work is resumed at the Site.
2. Provide additional consumables if the supply on hand is insufficient.

3.3 REMOVAL

- A. Completely remove temporary sanitary facilities and materials when no longer required. Repair damage caused by temporary sanitary facilities and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to pre-construction condition.
- B. When permanent sanitary facilities were used for temporary sanitary facilities, immediately prior to requesting inspection for Substantial Completion, replace all consumables used during the Work and verify suitability of sanitary facilities for OWNER's permanent use. Correct deficiencies and damage.

+ + END OF SECTION + +

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SECTION 01 55 13

ACCESS ROADS AND PARKING AREAS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide temporary construction roads, walks, parking areas, and appurtenances required during the Project for use by CONTRACTOR, other contractors employed on the Project, OWNER's, facility manager's, and emergency vehicles.
2. Temporary roads and parking areas shall be designed and maintained by CONTRACTOR and shall be fully passable to vehicles in all weather conditions.

B. Use of Existing Access Roads:

1. CONTRACTOR is allowed to use OWNER's existing roads starting on the Effective Date of the Contract and satisfying other Contract requirements relative to starting the Work.
2. Prevent interference with traffic on existing roads and parking areas. Always keep access roads and entrances serving the Site clear and available to OWNER, facility manager, and their respective employees; emergency vehicles; and other contractors. Do not use access roads or Site entrances for parking or storage of materials or equipment.
3. CONTRACTOR shall indemnify and hold harmless OWNER and ENGINEER from expenses and losses caused by CONTRACTOR's operations over existing roads, drives, and parking areas.
4. Schedule deliveries to minimize use of driveways and Site entrances.

1.2 SITE ACCESS

A. Site Access:

1. CONTRACTOR access to the Site shall be as shown on the drawings.

1.3 CONTRACTOR PARKING

- A. CONTRACTOR employee vehicles shall park in area(s) as designated by OWNER.
- B. Park construction vehicles and equipment in work areas off of permanent roads and parking areas, in areas of the Site designated for CONTRACTOR staging.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials for temporary roads and parking areas shall comply with the Contract Documents' requirements for permanent roads, drives, and parking areas.
- B. Traffic controls shall comply with requirements of authorities having jurisdiction. When such authority is the OWNER or facility manager, and no requirements are indicated, comply with the standard specifications of the state department of transportation in the area of the Project.

PART 3 – EXECUTION

3.1 TEMPORARY ROADS AND PARKING AREAS

- A. Temporary Roads and Parking in Areas Different from Permanent Pavement:
 - 1. Provide temporary roads and parking areas adequate to support and withstand traffic loads during the Project. Locate temporary roads and parking areas within construction limits shown or indicated.
 - 2. Provide reasonably-level, graded, well-drained subgrade of satisfactory soil material, compacted to not less than 95 percent of maximum dry density in the upper six inches.
 - 3. Where required to support loads and provide separation between subgrade and subbase materials, provide geosynthetic separation fabric as required.
 - 4. Subbase:
 - a. Provide crushed stone subbase material not less than six inches thick, roller-compacted to a level, smooth, dense surface.
 - b. Subbase for temporary roads and areas traveled by construction vehicles shall be adequate for loads and traffic served.
- B. Temporary Roads and Parking in Same Areas as Permanent Pavement:
 - 1. Provide temporary roads and parking areas adequate to support and withstand traffic and construction loads during the Project. Locate temporary roads and parking areas in same location as permanent roads and parking areas. Extend temporary roads and parking areas, within construction limits indicated, as required for construction operations.
 - 2. Coordinate elevations of temporary roads and parking areas with permanent roads and parking areas.
 - 3. Prepare subgrade, subbase, and base for temporary roads and parking areas in accordance with the Contract Documents requirements for permanent roads, drives, and parking areas.
 - 4. Where required by subgrade conditions and construction loads and traffic, provide geosynthetic separation fabric as required on compacted subgrade for subbase support and separation of subbase and subgrade materials.

5. Re-condition granular subbase of temporary roads and parking areas, including removing and properly disposing of granular material that has become intermixed with soil, re-grading, proof-rolling, compacting, and testing.

3.2 REMOVALS AND RESTORATION

A. Removals:

1. Remove temporary roads, drives, walks, and parking areas that are not intended for, or acceptable for, integration into permanent pavement. Return areas of temporary roads, drives, walks, and parking to pre-construction condition unless otherwise required by the Contract Documents.
2. Remove temporary gates, fencing, and traffic controls associated with temporary roads and parking areas.
3. Where areas of temporary roads and parking will be permanently landscaped, remove pavement, granular subbase, geosynthetic (where required by ENGINEER), soil, and other materials that do not comply with the Contract Documents regarding fill, subsoil, and landscaping.
4. Remove and properly dispose of materials contaminated with oil, bitumen, and other petrochemical compounds resulting from CONTRACTOR's operations, and other substances that might impair growth of plants and lawns.

B. Restoration:

1. Repair or replace paving, curbs, gutters, and sidewalks affected by temporary roads and parking, and restore to required conditions in accordance with authorities having jurisdiction.
2. Restore to pre-construction conditions existing roads, walks, and parking areas damaged by CONTRACTOR, subject to approval of the owner of affected roads, drives, walks, and parking areas.

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SECTION 01 55 26

MAINTENANCE AND PROTECTION OF TRAFFIC

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall keep all roads, streets, and traffic ways open for passage of traffic and pedestrians during the Work, unless otherwise approved by owner of the street, traffic way, or right-of-way, as applicable.
- B. Coordination:
 - 1. Coordinate with owner of the highway or street right-of-way, as applicable, for maintenance and protection of traffic requirements.
 - 2. Give required advance notice to fire departments, police departments, and other emergency services as applicable of proposed construction operations.
 - 3. Give reasonable notice to owners or tenants of private property who may be affected by construction operations. Give such notice not less than five days prior to when such property will or may be affected by construction operations.
 - 4. Coordinate with requirements of the following:
 - a. Section 01 55 13, Access Roads and Parking Areas.
 - b. Section 01 71 33, Protection of the Work and Property, regarding temporary barriers.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL PROVISIONS

- A. When required to cross, obstruct, or temporarily close a street or traffic way, provide and maintain suitable bridges, detours, or other acceptable temporary expedient for the accommodation of traffic. Closings shall be for shortest duration practical, and passage shall be restored immediately after completion of filling and temporary paving or bridging.
- B. Temporary Control Devices:
 - 1. Provide temporary signs, signals, barricades, flares, lights and other equipment, services, and personnel required to regulate and protect traffic and warn of hazards.
 - 2. Such Work shall comply with requirements of OWNER and authorities having jurisdiction at the Site.

3. Remove temporary equipment and facilities when no longer required, and restore grounds to condition indicated in the Contract Documents; if not indicated, resort to pre-construction conditions.
- C. Keep accessible for use permanent facilities such as hydrants, valves, fire alarm boxes, postal boxes, delivery service boxes, and other facilities that may require access during construction.

3.2 PARKING CONTROL

- A. Control CONTRACTOR-related vehicular parking at the Site to preclude interfering with: traffic and parking, access by emergency vehicles, OWNER's and facility manager's operations, and construction operations. Provide temporary parking facilities for the public, as required because of construction operations.
- B. Control parking of construction and private vehicles at the Site as follows:
 1. Maintain free vehicular access to and through parking areas.
 2. Prohibit parking on or adjacent to access roads, and in non-designated areas.
 3. Construction vehicles shall possess current vehicle registration.
 4. Private vehicles shall park only in designated areas.

3.6 HAUL ROUTES

- A. Submit proposed haul routes to ENGINEER and OWNER and obtain approval of authorities having jurisdiction.
- B. Confine construction traffic to designated haul routes.
- C. Provide temporary traffic controls at critical areas of haul routes to expedite traffic flow, and to minimize interference with normal traffic.

3.7 REMOVAL

- A. Maintain and protect traffic until Substantial Completion and at all times thereafter when CONTRACTOR is working at the Site. Provide maintenance and protection of traffic measures at the Site until no longer required due to the progress of the Work. When no longer required, completely remove maintenance and protection of traffic measures and restore the Site to condition required by the Contract Documents or, when not indicated in the Contract Documents, to pre-construction conditions.

+ + END OF SECTION + +

SECTION 01 57 05

TEMPORARY CONTROLS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide and maintain methods, materials, equipment, and temporary construction as required for controlling environmental conditions at the Site and adjacent areas during construction.
2. Maintain controls until no longer required. Provide temporary controls at all times when CONTRACTOR is working at the Site.
3. Temporary controls include, but are not limited to, the following:
 - a. Erosion and sediment controls.
 - b. Dust controls.
 - c. Control of water, including storm water runoff.
 - d. Pollution controls.

B. Related Sections:

1. Section 01 35 43.13, Environmental Procedures for Hazardous Materials.
2. Section 01 35 44, Spill Prevention Control and Countermeasures Plan.
3. Section 01 41 26, Storm Water Pollution Prevention Plan and Permit.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable provisions and recommendations of the following:

1. New York State Department of Environmental Conservation

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Plan for construction staging and maintenance of the Site relative to erosion and sediment controls. Indicate on a site plan approximate areas of planned disturbance of soils and soil cover over time during the Project. For areas not indicated in the Contract Documents as being disturbed and that CONTRACTOR proposes to disturb, Shop Drawing shall include proposed erosion and sediment control measures for the additional area.
 - b. Location and details of temporary settlement basin(s).
2. Product Data:
 - a. Silt fencing materials.
 - b. Inlet filter bags.

- B. Informational Submittals: Submit the following:
 - 1. Procedural Submittals:
 - a. Proposed dust control measures, when submittal is requested by ENGINEER.

PART 2 – PRODUCTS

2.1 MATERIALS FOR TEMPORARY EROSION AND SEDIMENT CONTROLS

- A. General:
 - 1. Materials utilized for temporary erosion and sediment controls shall be in accordance with the applicable regulatory requirements indicated in Article 1.2 of this Section, unless otherwise shown or indicated in the Contract Documents.
- B. Silt Fencing:
 - 1. Filter Cloth:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Mirafi Envirofence, or equal.
 - b. Height: Two feet, minimum.
 - c. Securely fasten filter cloth to wire mesh using ties spaced at maximum intervals of two feet on centers at top and mid-height of wire mesh.
 - 2. Wire Mesh: Support filter cloth with wire mesh complying with the following:
 - a. Woven wire mesh, 14-gauge steel wire, maximum mesh size six-inch by six-inch.
 - b. Height: To match filter cloth height.
 - c. Fasten wire mesh to fence supports with wire ties or staples.
 - 3. Fence Support Posts:
 - a. Length: Not less than three feet.
 - a. Material: Metal or other acceptable material with "U", "T", or "I" cross section, or hardwood measuring not less than 1.25-inch by 1.25-inch in cross-section.
- C. Straw Bale Dike.
 - 1. Bales shall be firmly-packed, unrotted straw bound firmly with baling wire. Cross-sectional area on the small end of each bale shall be approximately 12 inches by 12 inches or larger.
 - 2. Posts shall comply with requirements for silt fencing support posts, or may be suitable reinforcing steel rods.
- D. Mulch Materials and Soil Stabilization.
 - 1. Mulch shall be unrotted straw or salt hay.
 - 2. Soil stabilization emulsions, when used, shall be an inert, eco-friendly chemical manufactured for the specific purpose of erosion control and soil stabilization, applied with mulch or stabilization fibers.

3. Wood-fiber or paper-fiber, when used, shall be 100 percent natural and biodegradable.
 4. Erosion control mat or netting shall be biodegradable. Acceptable materials include jute, excelsior, straw or coconut fiber, and cotton.
- E. Protection of Storm Water Drainage Inlets and Catch Basins:
1. Inlet Filter Bag:
 - a. Product and Manufacturer: Provide one of the following for each drainage inlet or catch basin to be protected:
 - 1) Atlantic Construction Fabrics (ACF) Environmental, "Silt Sack".
 - 2) Or equal.
 - b. Inlet filter bag permeability shall be not less than 40 gallons per square foot of bag area exposed to the flow. Fabric shall be woven polypropylene with double stitching to prevent bursting.
 - c. Inlet filter bags shall shall:
 - 1) Fit inside the drainage inlet or catch basin and shall be secured by the structure's grate or by other acceptable means.
 - 2) Have means of removing inlet filter bag and the silt and sediment collected therein without dumping filter bag's contents into the drainage inlet or catch basin.
- F. Temporary Stone Construction Entrance:
1. Stone: Tough, hard, durable stone complying with the following gradation requirements:

Sieve Size	Total Percent Passing
Four-inch (100 mm)	100
3.5-inch (90 mm)	90 to 100
2.5-inch (65 mm)	25 to 60
1.5-inch (37.5 mm)	Zero to 15

2. Geotextile Separation Fabric: As recommended by geotextile manufacturer for separating stone from subgrade, for the vehicle weight and traffic frequency required.

PART 3 – EXECUTION

3.1 DUST CONTROL

- A. Dust Control – General:
1. Control objectionable dust caused by CONTRACTOR's operation of vehicles and equipment, clearing, demolition, cleaning, and other actions. To minimize airborne dust, apply water or use other methods subject to acceptance of ENGINEER and approval of authorities having jurisdiction.

2. CONTRACTOR shall prevent blowing and movement of dust from exposed soil surfaces and access roads to reduce onsite and off-Site damage, nuisances, and health hazards associated with dust emissions.
 3. Remove dust from roadways and access roads at maximum intervals of seven days by mechanical brooming or other method acceptable to ENGINEER.
- B. Dust Control Methods:
1. Dust control may be achieved by irrigation in which the dust-prone area of the Site shall be sprinkled with water until the surface is moist.
 2. Apply dust controls as frequently as required without creating nuisances such as excessive mud and ponding of water at the Site. Do not use water for dust control when water will cause hazardous or objectionable conditions such as ice, mud, ponds, and pollution.
 3. Provide dust control that is non-polluting and does not contribute to tracking-out of dirt and dust onto pavement.
- C. Removal of Dust and Dirt from Travelled Surfaces:
1. Remove dust and dirt from roadways, drives, parking areas, and other travelled surfaces not less than the frequency indicated in Section 01 74 05, Cleaning.
 2. Perform dust and dirt removals from travelled surfaces by mechanical sweeping or other method acceptable to ENGINEER.

3.2 WATER CONTROL

- A. Water Control – General:
1. Provide methods to control surface water and water from excavations and structures to prevent damage to the Work, the Site, and adjoining properties.
 2. Control fill, grading, and ditching to direct water away from excavations, pits, tunnels and other construction areas and to direct drainage to proper runoff courses to prevent erosion, damage, or nuisance. Avoid directing to adjoining properties runoff from the Site and construction operations.
- B. Equipment and Facilities for Water Control:
1. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
- C. Discharge and Disposal:
1. Dispose of storm water and ground water in manner to prevent flooding, erosion, and other damage to any and all parts of the Site and adjoining areas, and that complies with Laws and Regulations.

3.3 POLLUTION CONTROL

- A. Pollution Control – General:
1. Provide means, methods, and facilities required to prevent contamination of soil, water, and atmosphere caused by discharge of noxious substances from or caused by construction operations.

2. Equipment used during construction shall comply with Laws and Regulations.
 3. Comply with Section 01 35 43.13, Environmental Procedures for Hazardous Materials.
- B. Spills and Contamination:
1. Provide equipment and personnel to perform emergency measures required to contain spills and to remove contaminated soils and liquids.
 2. Excavate contaminated material and properly dispose of off-Site, and replace with suitable compacted fill and topsoil.
 3. Comply with Section 01 35 44, Spill Prevention Control and Countermeasures Plan, and OWNER's and facility manager's hazard control procedures as indicated in Section 01 35 23, Safety Requirements.
- C. Protection of Surface Waters and Ground Water:
1. Provide and maintain special measures to prevent harmful substances from entering surface waters and ground water. Prevent disposal of wastes, effluents, chemicals, and other such substances in or adjacent to surface waters and open drainage routes, in sanitary sewers, or in storm sewers, and in ground water.
- D. Atmospheric Pollutants:
1. Provide and maintain systems for controlling atmospheric pollutants related to the Work.
 2. Prevent toxic concentrations of chemicals and vapors.
 3. Prevent harmful dispersal of pollutants into atmosphere.
- E. Solid Waste:
1. Provide and maintain systems for controlling and managing solid waste related to the Work.
 2. Prevent solid waste from becoming airborne, and from discharging to surface waters and drainage routes.
 3. Properly handle and dispose of solid waste.
 4. Comply with requirements for cleaning and disposal of debris in the General Conditions, as may be modified by the Supplementary Conditions, and Section 01 74 05, Cleaning.

3.4 EROSION AND SEDIMENT CONTROLS

- A. Installation and Maintenance of Erosion and Sediment Controls – General:
1. General:
 - a. Provide temporary erosion and sediment controls as shown and indicated on the Drawings and as indicated elsewhere in the Contract Documents. Provide erosion and sediment controls as the Work progresses into previously-undisturbed areas.
 - b. Installation of erosion and sediment controls shall be in accordance with the applicable regulatory requirements indicated in Article 1.2 of this

Section, unless more-stringent methods are otherwise shown or indicated in the Contract Documents.

- c. Use necessary methods to successfully control erosion and sedimentation, including ecology-oriented construction practices, vegetative measures, and mechanical controls. Use best management practices (BMP) in accordance with Laws and Regulations, and regulatory requirements indicated in Article 1.2 of this Section, to control erosion and sedimentation during the Project.
 - d. Plan and execute construction, disturbances of soils and soil cover, and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation. Provide temporary measures for controlling erosion and sedimentation, as indicated in the Contract Documents and as required for the Project.
 - e. Where areas must be cleared for storage of materials or equipment, or for temporary facilities, provide measures for regulating drainage and controlling erosion and sedimentation, subject to the ENGINEER'S approval.
 - f. Provide erosion and sediment controls, including stabilization of soils, at the end of each workday.
- 2. Coordination:
 - a. Coordinate erosion and sediment controls with this Section's requirements on water control, and with Section 01 41 26, Storm Water Pollution Prevention Plan and Permit.
 - b. Coordinate temporary erosion and sediment controls with construction of permanent drainage facilities and other Work to the extent necessary for economical, effective, and continuous erosion and sediment controls.
 - 3. Before commencing activities that will disturb soil or soil cover at the Site, provide all erosion and sediment control measures required by the Contract Documents for the areas where soil or soil cover will be disturbed.
 - 4. In general, implement construction procedures associated with, or that may affect, erosion and sediment control to ensure minimum damage to the environment during construction. CONTRACTOR shall implement any and all additional measures required to comply with Laws and Regulations, and Section 01 41 26, Storm Water Pollution Prevention Plan and Permit.
 - 5. Vegetation Removal: Remove only those shrubs, grasses, and other vegetation that must be removed for construction. Protect remaining vegetation.
 - 6. Access Roads and Parking Areas: When possible, access roads and temporary roads and parking shall be located and constructed to avoid adverse effects on the environment. Provide measures to regulate drainage, avoid erosion and sedimentation, and minimize damage to vegetation.
 - 7. Earthwork and Temporary Controls:
 - a. Control erosion to minimize transport of silt from the Site into existing waterways and surface waters. Such measures shall include, but are not limited to, using berms, silt fencing, baled straw silt barriers, gravel or crushed stone, mulching and soil stabilization, slope drains, and other

- methods. Apply such temporary measures to erodible materials exposed by activities associated with the construction of the Project.
- b. Hold to a minimum the areas of bare soil exposed at one time.
 - c. Construct fills and waste areas by selectively placing fill and waste materials to eliminate surface silts and clays that will erode.
 - d. In performing earthwork, eliminate depressions that could serve as mosquito breeding pools.
 - e. CONTRACTOR shall provide special care in areas with steep slopes, where disturbance of vegetation shall be minimized to maintain soil stability.
8. Inspection and Maintenance:
- a. Periodically inspect areas of earthwork and areas where soil or soil cover are disturbed to detect evidence of the start of erosion and sedimentation; promptly implement corrective measures as required to control erosion and sedimentation. Continue inspections and corrective measures until soils are permanently stabilized and permanent vegetation has been established
 - b. Inspect not less often than the frequency indicated in Section 01 41 26, Storm Water Pollution Prevention Plan and Permit.
 - c. Repair or replace damaged erosion and sediment controls within 24 hours of CONTRACTOR becoming aware of such damage.
 - d. Periodically remove silt and sediment that has accumulated in or behind sediment and erosion controls. Properly dispose of silt and sediment.
9. Duration of Erosion and Sediment Controls:
- a. Maintain erosion and sediment controls in effective working condition until the associated drainage area has been permanently stabilized.
 - b. Maintain erosion and sediment controls until the Site is restored and site improvements including landscaping, if any, are complete with underlying soils permanently stabilized.
10. Work Stoppage:
- a. If the Work is temporarily stopped or suspended for any reason, CONTRACTOR shall provide additional temporary controls necessary to prevent environmental damage to the Site and adjacent areas while the Work is stopped or suspended.
11. Failure to Provide Adequate Controls:
- a. In the event CONTRACTOR repeatedly fails to satisfactorily control erosion and sedimentation, OWNER reserves the right to employ outside assistance or to use OWNER's own forces for erosion and sediment control.
 - b. Cost of such work by OWNER, plus engineering and inspection costs, will be deducted from amounts due CONTRACTOR, as set-offs in accordance with the Contract Documents.

B. Silt Fencing:

- 1. Install and maintain silt fencing in a vertical plane, at the location(s) shown or indicated in the Contract Documents and where required.
- 2. Locations of Silt Fencing:

- a. Where possible, install silt fencing along contour lines so that each given run of silt fencing is at the same elevation.
- b. On slopes, install silt fencing at intervals that do not exceed the maximum intervals indicated in the following table:

Slope (percent)	Maximum Length of Slope Above Each Silt Fence (feet)
2 and less	150
2.1 to 5	100
5.1 to 10	50
10.1 to 20	25
20.1 to 25	20
25.1 to 40	15
40.1 to 50	10

- c. Provide silt fencing around perimeter of each stockpile of topsoil, general fill material, and excavated material. Install silt fencing before expected precipitation and maintain until stockpile is removed.
- d. Do not install silt fencing at the following types of locations:
 - 1) Area of concentrated storm water flows such as ditches, swales, or channels.
 - 2) Where rock or rocky soils prevent full and uniform anchoring of silt fencing.
 - 3) Across upstream or discharge ends of storm water piping or culverts.
3. Installation:
 - a. Securely fasten wire mesh to posts, and securely fasten filter cloth to wire mesh.
 - b. When two sections of filter cloth abut each other, fold over edges and overlap by not less than six inches and securely fasten to wire mesh.
 - c. Embed posts in the ground to the depth necessary for proper controls; embed posts to not less than 16 inches below ground.
 - d. Filter cloth and wire mesh shall extend not less than eight inches below ground and not less than 16 inches above ground.
 - e. Remove sediment accumulated at silt fencing as required. Repair and reinstall silt fencing as required.
4. Maintenance:
 - a. Do not allow formation of concentrated storm water flows on slopes above silt fencing unless so shown or indicated in the Contract Documents. If unauthorized concentrated storm water flows occur, stabilize the slope via earthmoving and other stabilization measures as required to prevent flow of concentrated storm water flows toward silt fencing.

C. Straw Bale Dike.

1. Install straw bale dikes where shown or indicated, including in swales, along contours, and along toe of slopes.

2. Install straw bales in shallow excavation as wide as the bale and approximately four to six inches below surrounding grade.
3. Ends of straw bales shall tightly abut ends of adjacent straw bales.
4. Securely install straw bales using two support posts per straw bale, driven into the ground not less than 1.5 to two feet below bottom of straw bale. Top of post shall be flush with top of straw bale. Angle first post for each straw bale toward the previously-installed straw bale.
5. Frequently inspect straw bales and repair or replace as required. Remove accumulated silt and debris from behind straw bales.

D. Mulching and Soil Stabilization:

1. Use mulching to temporarily stabilize exposed soil and fill material.
 - a. Immediately following final grading, provide mulch and stabilize with mats or netting, or sprayed soil stabilization emulsion with fiber additive.
 - b. Application of mulching for soil stabilization shall be as follows.
 - 1) Unrotted Straw or Salt Hay: 1.5 to two tons per acre.
 - 2) Soil stabilization emulsions, when used, shall be applied in accordance with manufacturer's instructions, and shall be applied with mulch or stabilization fibers.
 - 3) Wood-fiber or Paper-fiber Application: 1,500 lbs. per acre, installed by hydroseeding.
 - c. Where mats or netting are used:
 - 1) Cover entire area to be stabilized with mats or netting.
 - 2) Provide anchoring trenches at the top and bottom of slopes to receive mats or netting. Bury at least the top and bottom ends of mat or netting, four inches or more wide, at top and bottom of slope. Tamp trench full of soil. Four inches from trench, secure mat or netting with appropriate staples spaced at intervals of 10 inches.
 - 3) Overlap adjacent strips of mat or netting by not less than four inches.

E. Protection of Storm Water Drainage Inlets and Catch Basins:

1. Protect each drainage inlet and catch basin that has the potential to receive storm water runoff from exposed soils, and does not discharge into a storm water settlement basin.
2. Install inlet filter bags inside of drainage inlet or catch basin in accordance with manufacturer's instructions. Secure inlet filter bag with the structure's grate or by other acceptable means.
3. Inlet filter bags shall not pose any obstruction above the pre-construction elevation of the drainage inlet or catch basin grate requiring barricades or flashers.
4. When removing silt and sediment from inlet filter bag, do not dump filter bag's contents into the drainage inlet or catch basin.
5. Remove silt and sediment from inlet filter bag, or replace inlet filter bag, when inlet filter bag is not more than half full.

F. Temporary Stone Construction Entrance:

1. Where shown on the Drawings, and where construction vehicles will regularly transit to paved surfaces from unstabilized surfaces, provide temporary stone construction entrance. CONTRACTOR vehicles shall use temporary stone construction entrances.
2. Provide temporary stone construction entrances of the width, length, and thickness shown or indicated on the Drawings. When not shown or indicated on the Drawings, temporary stone construction entrance shall be not less than 50 feet long, by 20 feet wide, by eight inches deep.
3. Installation:
 - a. Ensure that subgrade under each temporary stone construction entrance is suitably dense for the intended purpose. Suitably prepare subgrade as required for temporary stone construction entrance.
 - b. Provide on subgrade a layer of geotextile separation fabric, installed in accordance with geotextile separation fabric manufacturer's recommendations for separation.
 - c. Provide stone on installed geotextile separation fabric. Grade the stone for passage of vehicles.
4. Maintenance:
 - a. Maintain temporary stone construction entrance at not less than the minimum required thickness. Add stone as required to maintain thickness.
 - b. When upper layer of temporary stone construction entrance becomes contaminated with soil, remove the contaminated material and replace with clean stone.
 - c. Using water to wash down temporary construction entrance or paved areas onto which soil material has been tracked is unacceptable.

3.5 REMOVAL OF TEMPORARY CONTROLS

A. Removals – General:

1. Upon completion of the Work, remove temporary controls and restore Site to specified condition; if condition is not specified, restore Site to pre-construction condition.
2. After soils are permanently stabilized, remove from the Site temporary erosion and sediment controls.

+ + END OF SECTION + +

SECTION 01 57 33

SECURITY

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes general requirements for security at the Site, including accessing the Site, securing the Work, temporary fencing, and other requirements.
2. CONTRACTOR shall safely guard all the Work, the Project, materials, equipment, and property from loss, theft, damage, and vandalism until Substantial Completion, unless otherwise agreed upon by the parties.
3. CONTRACTOR's duty includes safely guarding OWNER's property in vicinity of the Work and Project, and other private property in the vicinity of the Project from injury and loss in connection with performance of the Project.
4. Employ watchmen as required to provide required security and prevent unauthorized entry.
5. Costs for security required under this Section shall be paid by CONTRACTOR.
6. Make no claim against OWNER for damage resulting from trespass.
7. Remedy damage to property of OWNER and others arising from failure to furnish adequate security.
8. Provide temporary fencing in accordance with the Contract Documents.
9. CONTRACTOR's security measures shall be at least equal to those usually provided by OWNER or facility manager to protect existing facilities during normal operation.

1.3 CONTRACTOR'S SITE ACCESS AND SECURITY PROCEDURES

- A. Comply with Section 01 55 13, Access Roads and Parking Areas.
- B. Comply with OWNER's security procedures and access restrictions at the Site throughout the Project.

PART 2 – PRODUCTS

2.1 TEMPORARY FENCING

- A. When security fencing or barriers are breached or temporarily removed for the Project, provide and maintain temporary security fencing equal to existing, unless otherwise specified, in manner satisfactory to ENGINEER and OWNER.

PART 3 – EXECUTION

3.1 TEMPORARY FENCING

- A. Installation:
 - 1. Provide temporary fencing for site security so that integrity of site security is maintained throughout the Project.
 - 2. Install temporary fencing used for site security in accordance with the Contract Documents and fence manufacturer's instructions.
- B. Maintenance:
 - 1. Maintain temporary fencing throughout the Project.
 - 2. Repair damage to temporary fencing and replace fencing when required to preserve Site security.
- C. Removal:
 - 1. Remove temporary fencing when permanent site security fencing is in place and fully functional, or when otherwise directed or ENGINEER.

+ + END OF SECTION + +

SECTION 01 61 00

COMMON PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. This Section includes:
 - a. Common requirements for materials and equipment.
 - b. Compatibility of materials and equipment.

1.2 REQUIREMENTS FOR MATERIALS AND EQUIPMENT

- A. Unless otherwise indicated in the Contract Documents, furnish materials and equipment that:
 - 1. have not been previously been incorporated into another project or facility; and
 - 2. have not changed ownership after initial shipment from the manufacturer's factory or facility; and
 - 3. if stored since their manufacture or fabrication, have, while in storage, been properly maintained and serviced in accordance with the manufacturer's recommendations for long-term storage; submit documentation as required by ENGINEER that such maintenance and service has been performed; and
 - 4. that the item(s) have not been subject to degradation or deterioration since manufacture; and
 - 5. are the current model(s) or type(s) furnished by the Supplier.
- B. To the extent possible, furnish from a single source those materials and equipment that are of the same generic kind.
- C. Furnish materials and equipment complete with accessories, trim, finish, fasteners, and other items shown, indicated, or required for a complete installation for the indicated use and performance.
- D. Standard Items: When available, and unless custom or nonstandard options are specified or indicated, furnish standard materials and equipment of types that have been produced and used successfully in similar situations on other projects.
- E. Visual Matching: Where required in the Contract Documents, furnish materials and equipment that match (as determined by ENGINEER) referenced existing construction, and mock-ups and Sample(s) approved by ENGINEER.

- F. Where the Contract Documents include the phrase “as selected” for color of materials or equipment, finish pattern, option, or similar phrase, provide materials and equipment selected by ENGINEER as follows:
1. Standard Range: Where the Contract Documents include the phrase “standard range of colors, patterns, textures” or similar wording, provide color, pattern, density, or texture selected by ENGINEER from manufacturer’s product line that does not include premium items.
 2. Full Range: Where the Contract Documents include the phrase “full range of colors, patterns, textures” or similar wording, ENGINEER will select color, pattern, density, or texture from manufacturer’s entire product line, including standard and premium items.

1.3 COMPATIBILITY

- A. Similar materials and equipment by the same Supplier shall be compatible with each other, unless otherwise indicated in the Contract Documents or approved by ENGINEER.
- B. Provide materials and equipment compatible with items previously selected or installed on the Project.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 62 00

PRODUCT OPTIONS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. This Section includes:
 - a. CONTRACTOR's options for selecting materials and equipment.
 - b. Requirements for consideration of "or-equal" materials and equipment.

1.2 PRODUCT OPTIONS

- A. For materials and equipment specified only by reference standard or description, without reference to Supplier, furnish materials and equipment complying with such standard, by a Supplier or from a source that complies with the Contract Documents.
- B. For materials and equipment specified by naming one or more items or Suppliers, furnish the named materials and equipment that comply with the Contract Documents, unless an "or-equal" or substitute item is approved by ENGINEER.
- C. For materials and equipment specified by naming one or more items or Suppliers and the term, "or-equal", when CONTRACTOR proposes a material or equipment item or Supplier as an "or-equal", submit to ENGINEER a request for approval of an "or-equal" item or Supplier.
- D. For materials and equipment specified by naming only one item or manufacturer and followed by words indicating that no substitution is allowed, there is no option and no "or-equals" or substitution will be allowed or approved.

1.3 "OR-EQUAL" ITEMS

- A. Procedure:
 - 1. For proposed materials and equipment not named in the Contract Documents and considered as an "or-equal" in accordance with the General Conditions, CONTRACTOR shall request in writing ENGINEER's approval of the "or-equal".
 - 2. Request for approval of an "or-equal" item shall accompany the Shop Drawing or product data submittal for the proposed item
- B. Requests for approval of "or-equals" shall include:
 - 1. CONTRACTOR's written request that the proposed item be considered as an "or-equal" in accordance with the General Conditions, accompanied by CONTRACTOR's certifications required in the General Conditions.

2. Documentation adequate to demonstrate to ENGINEER that proposed item does not require extensive revisions to the Contract Documents, that proposed item is consistent with the Contract Documents, and that proposed item will produce results and performance required in the Contract Documents, and that proposed item is compatible with other portions of the Work.
3. Detailed comparison of significant qualities of proposed item with the materials and equipment and manufacturers named in the Contract Documents. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements shown or indicated.
4. Evidence that proposed item's manufacturer will furnish warranty equal to or better than that specified, if any.
5. List of similar installations for completed projects with project names and addresses, and names and address of design professionals and owners, when requested.
6. Samples, when requested by ENGINEER.
7. Other information requested by ENGINEER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 65 00

PRODUCT DELIVERY REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes general requirements for preparing for shipping, delivering, and handling materials and equipment to be incorporated into the Work.
2. CONTRACTOR shall make all arrangements for transporting, delivering, and handling of materials and equipment required for prosecution and completion of the Work.
3. When required, move stored materials and equipment without changes to the Contract Price or Contract Times.

1.2 SUBMITTALS

- A. Refer to individual Specifications Sections for submittal requirements relative to delivering and handling materials and equipment.

1.3 PREPARING FOR SHIPMENT

- A. When practical, factory-assemble materials and equipment. Mark or tag separate parts and assemblies to facilitate field-assembly. Cover machined and unpainted parts that may be damaged by the elements or climate with strippable, protective coating.
- B. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage. Mark or tag outside of each package and crate to indicate the associated purchase order number, bill of lading number, contents by name, OWNER's contract designation, CONTRACTOR name, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.
- C. Protect materials and equipment from exposure to the elements and damage by climate, and keep thoroughly dry and dust-free at all times. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Lubricate bearings and other items requiring lubrication in accordance with manufacturer's instructions.
- D. Do not ship materials and equipment until:
1. Related Shop Drawings, Samples, and other submittals required by the Contract Documents have been approved or accepted (as applicable) by

- ENGINEER, including, but not necessarily limited to, all Action Submittals associated with the materials and equipment being delivered.
2. Manufacturer's instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by ENGINEER in accordance with the Specifications.
 3. Results of source quality control testing (factory testing), when required by the Contract Documents for the associated materials or equipment, have been submitted to and accepted by ENGINEER.
 4. Facilities required for handling materials and equipment in accordance with the Contract Documents and manufacturer's instructions are in place and available.
 5. Required storage facilities have been provided.

1.4 DELIVERY

A. Scheduling and Timing of Deliveries:

1. Arrange deliveries of materials and equipment in accordance with the Progress Schedule accepted by ENGINEER and in ample time to facilitate inspection and observation prior to installation.
2. Schedule deliveries to minimize space required for and duration of storage of materials and equipment at the Site or other delivery location, as applicable.
3. Coordinate deliveries to avoid conflicting with the Work and conditions at Site, and to accommodate the following:
 - a. Work of other contractors and OWNER.
 - b. Storage space limitations.
 - c. Availability of equipment and personnel for handling materials and equipment.
 - d. OWNER's use of premises.
4. Deliver materials and equipment to the Site during regular working hours.
5. Deliver materials and equipment to avoid delaying the Work and the Project, including work of other contractors, as applicable. Deliver anchor system materials, including anchor bolts to be embedded in concrete or masonry, in ample time to avoid delaying the Work.

B. Deliveries:

1. Shipments shall be delivered with CONTRACTOR's name, Subcontractor's name (if applicable), Site name, Project name, and contract designation (example: "ABC Construction Co., City of Happy Beach, Idaho, Wastewater Treatment Plant Primary Clarifier Improvements, Contract 25, General Construction") clearly marked.
2. Site may be listed as the "ship to" or "delivery" address; but OWNER shall not be listed as recipient of shipment unless otherwise directed in writing by ENGINEER.
3. Provide CONTRACTOR's telephone number to shipper; do not provide OWNER's telephone number.

4. Arrange for deliveries while CONTRACTOR's personnel are at the Site. CONTRACTOR shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when CONTRACTOR is not present will be refused by OWNER, and CONTRACTOR shall be responsible for the associated delays and additional costs, if incurred.
 5. Comply with Section 01 35 43.13, Environmental Procedures for Hazardous Materials.
- C. Containers and Marking:
1. Have materials and equipment delivered in manufacturer's original, unopened, labeled containers.
 2. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.
- D. Inspection of Deliveries:
1. Immediately upon delivery, inspect shipment to verify that:
 - a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) submittals.
 - b. Quantities are correct.
 - c. Materials and equipment are undamaged and of the required quality.
 - d. Containers and packages are intact and labels are legible.
 - e. Materials and equipment are properly protected.
 2. Promptly remove damaged materials and equipment from the Site and expedite delivery of new, undamaged materials and equipment, and remedy incomplete or lost materials and equipment. Furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.
 3. Advise ENGINEER in writing when damaged, incomplete, or defective materials and equipment are delivered, and advise ENGINEER of the associated impact on the Progress Schedule.

1.5 HANDLING OF MATERIALS AND EQUIPMENT

- A. Provide equipment and personnel necessary to handle materials and equipment, including those furnished by OWNER, by methods that prevent soiling or damaging materials and equipment and packaging.
- B. Provide additional protection during handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and surrounding surfaces.
- C. Handle materials and equipment by methods that prevent bending and overstressing.
- D. Lift heavy components only at designated lifting points.

- E. Handle materials and equipment in safe manner and as recommended by the manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during handling. Hand-carry or use suitable handling equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 66 00

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes general requirements for storing and protecting materials and equipment.
2. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals to store and handle materials and equipment to be incorporated into the Work, and other materials and equipment at the Site.

1.2 STORAGE

A. Store and protect materials and equipment in accordance with manufacturer's recommendations and the Contract Documents.

B. General:

1. CONTRACTOR shall make all arrangements and provisions necessary for, and pay all costs for, storing materials and equipment.
2. Excavated materials, construction equipment, and materials and equipment to be incorporated into the Work shall be placed to avoid injuring the Work and existing facilities and property, and so that free access is maintained at all times to all parts of the Work and to public utility installations in vicinity of the Work.
3. Store materials and equipment neatly and compactly in locations that cause minimum inconvenience to OWNER, facility manager, other contractors, public travel, and owners, tenants, and occupants of adjoining property.
4. Arrange storage in manner to allow easy access for inspection by ENGINEER and Resident Project Representative (RPR).

C. Storage Location:

1. Areas available at the Site for storing materials and equipment are shown or indicated in the Contract Documents, or as acceptable to ENGINEER.
2. Restrictions:
 - a. Do not store materials or equipment in structures being constructed unless approved by ENGINEER in writing.
 - b. Do not use lawns or other private property for storage without written permission of the owner or other person in possession or control of such premises.

D. Protection of Stored Materials:

1. Store materials and equipment to become OWNER's property to ensure

preservation of quality and fitness of the Work, including proper protection against damage by freezing, moisture, and with outdoor ambient air high temperatures as high as 100 degrees F; temperature and humidity inside crates, containers, storage sheds, and packaging may be significantly higher than the outdoor ambient air temperature.

2. Store in indoor, climate-controlled storage areas all materials and equipment subject to damage by moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to OWNER.
3. When placing orders to Suppliers for equipment and controls containing computer chips, electronics, and solid-state devices, CONTRACTOR shall obtain, coordinate, and comply with specific temperature and humidity limitations on materials and equipment, because temperature inside cabinets and components stored in warm temperatures can approach 200 degrees F.
4. CONTRACTOR shall be fully responsible for loss or damage (including theft) to stored materials and equipment.
5. Do not open manufacturer's containers until time of installation, unless recommended by the manufacturer or otherwise specified in the Contract Documents.
6. Comply with requirements of Article 1.3 of this Section.

1.3 PROTECTION – GENERAL

- A. Equipment to be incorporated into the Work shall be boxed, crated, or otherwise completely enclosed and protected during shipping, handling, and storage, in accordance with Section 01 65 00, Product Delivery Requirements.
- B. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.
- C. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged or marred shall be repainted in their entirety in accordance with equipment manufacturer and paint manufacturer requirements, to the satisfaction of ENGINEER.
- D. Protect electrical equipment, controls, and instrumentation against moisture, water damage, humidity, heat, cold, and dust. Space heaters provided in equipment shall be connected and operating at all times until equipment is placed in operation and permanently connected.

1.4 UNCOVERED STORAGE

- A. The following types of materials may be stored outdoors without cover on supports so there is no contact with the ground:
 1. Reinforcing steel.
 2. Precast concrete materials.
 3. Structural steel.
 4. Metal stairs.

5. Handrails and railings.
6. Grating.
7. Checker plate.
8. Metal access hatches.
9. Castings.
10. Fiberglass items.
11. Rigid electrical conduit, except PVC-coated conduit.
12. Piping, except PVC or chlorinated PVC (CPVC) pipe.

1.5 COVERED STORAGE

- A. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:
 1. Grout and mortar materials.
 2. Masonry units.
 3. Rough lumber.
 4. Soil materials and granular materials such as aggregate.
 5. PVC and CPVC pipe.
 6. PVC-coated electrical conduit.
 7. Filter media.
- B. Tie down covers with rope, and install covering properly sloped to prevent accumulation of water.
- C. Store loose granular materials, with covering impervious to water, in well-drained area or on solid surfaces to prevent mixing with foreign matter.

1.6 FULLY PROTECTED STORAGE

- A. Store all material and equipment not indicated in Articles 1.4 and 1.5 of this Section on supports in buildings or trailers that have concrete or wooden flooring, roof, and fully-closed walls on all sides. Covering with visquine plastic sheeting or similar material in space without floor, roof, and walls is unacceptable. Comply with the following:
 1. Provide heated storage for materials and equipment that could be damaged by low temperatures or freezing.
 2. Provide air-conditioned storage for materials and equipment that could be damaged by high temperatures or humidity.
 3. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.
 4. Maintain humidity at levels recommended by manufacturers for electrical and electronic equipment.

1.7 HAZARDOUS MATERIALS AND EQUIPMENT

- A. Prevent contamination of personnel, storage areas, and the Site. Comply with Laws and Regulations, manufacturer's instructions, Section 01 35 43.13, Environmental

Procedures for Hazardous Materials, and other provisions of the Contract Documents.

1.8 MAINTENANCE OF STORAGE

- A. On a scheduled basis, periodically inspect stored materials and equipment to ensure that:
 - 1. Condition and status of storage facilities is adequate to provide required storage conditions.
 - 2. Required environmental conditions are maintained on continuing basis.
 - 3. Materials and equipment exposed to elements are not adversely affected.
- B. Mechanical and Electrical Equipment in Long-Term Storage:
 - 1. Mechanical and electrical equipment requiring long-term storage shall have complete manufacturer's instructions for servicing each item, with notice of enclosed instructions shown on exterior of container or packaging.
 - 2. Comply with manufacturer's instructions on scheduled basis.
 - 3. Space heaters that are part of electrical equipment shall be connected and operated continuously until equipment is placed in service and permanently connected.
 - 4. Affidavits:
 - 1. Submit to ENGINEER affidavit for each time that maintenance and inspection was performed on materials and equipment in long-term storage. Affidavit shall be signed by CONTRACTOR and entity performing the inspection and maintenance on the stored items.
 - 2. Affidavit shall indicate the date of the inspection, personnel and employer of each involved, specific stored items inspected, equipment condition, problems observed, problems corrected, maintenance tasks performed, conditions of storage environment, and other pertinent information.
 - 3. Affidavit shall include signed statement by the manufacturer of the item(s) indicating whether the storage conditions and tasks performed are suitable for continued compliance with manufacturer's warranties.

1.9 MICROPROCESSORS, PANELS, AND INSTRUMENTATION STORAGE

- A. Store control panels, microprocessor-based equipment, electronics, and other devices subject to damage or decreased useful life because of temperatures below 40 degrees F or above 100 degrees F, relative humidity above 90 percent, or exposure to rain or exposure to blowing dust in climate-controlled storage space.
- B. General:
 - 1. OWNER and ENGINEER have the right to observe or inspect materials and equipment during normal working hours.
 - 2. Place inside each control panel or device a desiccant, volatile corrosion inhibitor blocks (VCI), moisture indicator, and maximum-minimum indicating thermometer.

3. Check panels and equipment not less than once per month. Replace desiccant, VCI, and moisture indicator as often as required, or every six months, whichever occurs first.
 4. Certified record of daily maximum and minimum temperature and humidity in storage facility shall be available for inspection by OWNER and ENGINEER. Certified record of monthly inspection, noting maximum and minimum temperature for month, condition of desiccant, VCI, and moisture indicator, shall be made available to OWNER and ENGINEER upon request.
- C. Costs for storing climate-sensitive materials and equipment shall be paid by CONTRACTOR. Replace panels and devices damaged during storage, or for which storage temperatures or humidity range has been exceeded, at no additional cost to OWNER. Delays resulting from such replacement are causes within CONTRACTOR's control.
- D. Do not ship control panels and equipment to the Site until conditions at the Site are suitable for installation, including slabs and floors, walls, roofs, and environmental controls. Failure to have the Site ready for installation shall not relieve CONTRACTOR from complying with the Contract Documents.

1.10 RECORDS

- A. Keep up-to-date account of materials and equipment in storage to facilitate preparation of Applications for Payment, if the Contract Documents provide for payment for materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

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SECTION 01 71 23

FIELD ENGINEERING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes field engineering, surveying, and layouts by CONTRACTOR, and associated requirements. This Section supplements the General Conditions' provisions on reference points and other matters.
2. CONTRACTOR shall provide field engineering services, surveying and layout services, and professional services of the types indicated for the Project, including:
 - a. Furnishing civil, structural, and other professional engineering services specified or required to execute CONTRACTOR's construction methods.
 - b. Developing and making all detail surveys and measurements required for construction; including slope stakes, batter boards, and all other working lines, elevations, and cut sheets.
 - c. Providing materials required for benchmarks, control points, batter boards, grade stakes, structure and pipeline elevation stakes, and other items.
 - d. Keeping a transit, theodolite, or total station (i.e., theodolite with electronic distance measurement device); leveling instrument; and related implements such as survey rods and other measurement devices, at the Site at all times, and having a skilled instrument person available when necessary for laying out the Work.
 - e. Being solely responsible for all locations, dimensions and levels. No data other than Change Order, Work Change Directive, or Field Order shall justify departure from dimensions and levels required by the Contract Documents.
 - f. Rectifying all Work improperly installed because of not maintaining, not protecting, or removing without authorization established reference points, stakes, marks, and monuments.
 - g. Providing such facilities and assistance necessary for ENGINEER and Resident Project Representative (if any) or Owner's Site Representative (if any) to check lines and grade points placed by CONTRACTOR. Do not perform excavation or embankment work until all cross-sectioning necessary for determining payment quantities for Unit Price Work have been completed and accepted by ENGINEER.

B. Coordination:

1. Review requirements of this and other Sections and coordinate installation of items to be installed with or before field engineering, surveying, and layout Work.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Certificates:
 - a. When requested by ENGINEER, submit certificate signed by professional engineer or professional surveyor, as applicable, certifying that elevations and locations of the Work comply with the Contract Documents. Explain each deviation, if any.
2. Field Engineering:
 - a. Submit daily reports as indicated in this Section.
 - b. When requested by ENGINEER, submit documentation verifying accuracy of field engineering.
3. Surveying:
 - a. Complete plan for performing survey work, submitted not less than 10 days prior to beginning survey Work.
 - b. Example of proposed survey field books to be maintained by CONTRACTOR's surveyor. Example shall have sufficient information and detail, including example calculations and notes, to demonstrate that field books will be organized and maintained in a professional manner in accordance with the Contract Documents.
 - c. Submit original field books within two days after completing survey Work.
 - d. Submit certified survey in accordance with this Section.
4. Qualifications Statements:
 - a. Field Engineer: Name, employer, and professional address. When requested by ENGINEER, submit qualifications, including resume'.
 - b. Surveyor: Name, employer, and professional address of firm, and resumes of each professional land surveyor and crew chief that will be engaged in survey Work. Submit not less than 10 days prior to beginning survey Work. During the Project, submit resume for each new registered, licensed land surveyor and crew chief employed by or retained by CONTRACTOR not less than 10 days prior to starting on the survey Work.

1.3 CONTRACTOR'S ENGINEERS

A. Professionals Retained by Contractor (whether or not stationed at the Site):

1. Delegated Professional Design Services:
 - a. Where the Contract Documents require CONTRACTOR to furnish professional engineering or architecture services as delegated professional design, the provisions of the General Conditions regarding delegated professional design services, and the Contract Documents' requirements applicable to the specific delegated professional design, shall apply.

2. Professional Services that are Not Delegated Professional Design of the Completed Work:
 - a. Where the Contract Documents require that CONTRACTOR retain a design professional for to carry out CONTRACTOR's responsibilities for construction means, methods, techniques, sequences and procedures (including temporary construction that will not remain as part of the completed Work), such services shall be performed by a registered professional of the discipline required for specific service on the Project, with valid license in the same jurisdiction as the Site.
 - b. OWNER and ENGINEER shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed by such design professionals.

1.4 CONTRACTOR'S SURVEYOR

A. Qualifications:

1. Employ or retain the services, as needed, at the Site a surveyor with experience and capability of performing surveying and layout tasks required in the Contract Documents and as required for the Work.
2. CONTRACTOR's surveyor shall possess not less than five years of experience performing duties similar in scope and extent to those required of CONTRACTOR's surveyor on this Project.
3. Surveyor shall be a professional land surveyor registered and licensed in the jurisdiction where the Project is located, or a professional engineer registered and licensed as a professional engineer in the jurisdiction where the Project is located and authorized under Laws and Regulations to practice surveying.

B. Responsibilities of Contractor's Surveyor:

1. Providing required surveying equipment, including transit, theodolite, or total station; level; stakes; and surveying accessories.
2. Establishing required lines and grades for constructing all facilities, structures, pipelines, and site improvements, including outdoor electrical equipment and feeders.
3. Preparing and maintaining professional-quality, accurate, well-organized, legible notes of all measurements and calculations made while surveying and laying out the Work.
4. Prior to backfilling operations, survey, locate, and record on a copy of the Contract Documents accurate representation of buried Work and Underground Facilities provided and encountered.
5. Locating on a site plan of the Site the actual location of above-ground Work to be indicated on record documents.
6. Complying with requirements of the Contract Documents relative to surveying and related Work, including requirements of this Section's Articles 1.5 and 3.1.

1.5 RECORDS

A. Records – General:

1. Maintain at the Site a complete and accurate log of control and survey Work as such Work progresses.
- B. Field Books and Records:
1. Survey data and records shall be in accordance with recognized professional surveying standards, Laws and Regulations, and prevailing standards of practice in the locality where the Site is located.
 2. Original field notes, computations, and other surveying data shall be recorded by CONTRACTOR's surveyor in CONTRACTOR-furnished hard-bound field books, and shall be signed and sealed by CONTRACTOR's surveyor.
 3. Completeness and accuracy of survey Work, and completeness and accuracy of survey records, including field books, shall be responsibility of CONTRACTOR.
 4. Failure to organize and maintain survey records in an appropriate manner that allows reasonable and independent verification of calculations, and to allow identification of elevations, dimensions, and grades of the Work, shall be cause for rejecting the survey records, including field books.
 5. Illegible notes or data, and erasures on any page of field books, are unacceptable. Do not submit copied notes or data. Corrections by ruling or lining out errors will be unacceptable unless initialed by the surveyor. Violation of these requirements may require re-surveying the data questioned by ENGINEER.
- C. Certified Survey of Surface Structures:
1. Upon completion of foundation walls and major site improvements, prepare a certified survey, signed and sealed by professional surveyor, showing or indicating dimensions, locations, angles and elevations of construction and locations and elevations of Underground Facilities installed and encountered during the Work.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SURVEYING

- A. Reference Points:
1. Refer the General Conditions, as may be modified by the Supplementary Conditions, for requirements regarding reference points.
 2. OWNER's established reference points that are damaged or destroyed by CONTRACTOR will be re-established by OWNER at CONTRACTOR's expense. OWNER may deduct from payments owed CONTRACTOR such amounts as set-offs in accordance with the Contract Documents.

3. From OWNER-established reference points, establish lines, grades, and elevations necessary to control the Work. Obtain measurements required for executing the Work to tolerances specified in the Contract Documents.
 4. Establish, place, and replace as required, such additional stakes, markers, and other reference points necessary for control, intermediate checks, and guidance of construction operations.
- B. Surveys to Determine Quantities for Payment:
1. For each application for progress payment, perform such surveys and computations necessary to determine quantities of Work performed or placed. Perform surveys necessary for ENGINEER to determine final quantities of Work in place.
 2. Notify ENGINEER not less than 24 hours before performing survey services for determining quantities to be included in Application for Payment. Unless waived in writing by ENGINEER, perform quantity surveys in presence of ENGINEER or Resident Project Representative (if any).
- C. Construction Surveying: Comply with the following:
1. Alignment Staking: Provide alignment stakes at 50-foot intervals on tangent, and at 25-foot intervals on curves.
 2. Slope Staking: Provide slope staking at 50-foot intervals on tangent, and at 25-foot intervals on curves. Re-stake at every ten-foot difference in elevation.
 3. Structure: Stake-out structures, including elevations, and check prior to and during construction.
 4. Pipelines: Stake-out pipelines including elevations, and check prior to and during construction.
 5. Roads, Drives, and Paved Areas: Stake-out roadway, driveway, and paved area elevations at 50-foot intervals on tangent, and at 25-foot intervals on curves.
 6. Cross-sections: Provide original, intermediate, and final staking as required, for site work other locations as necessary for quantity surveys.
 7. Easement Staking: Provide easement staking at 50-foot intervals on tangent, and at 25-foot intervals on curves. Also provide wooden laths with flagging at maximum intervals of 100 feet.
 8. Record Staking: Provide permanent stake at each blind flange and each utility cap provided for future connections. Stakes for record staking shall be material acceptable to ENGINEER.
- D. Accuracy:
1. Establish CONTRACTOR's temporary survey references points for CONTRACTOR's use to not greater than second-order accuracy (e.g., 1:10000). Construction staking used as a guide for the Work shall be set at not greater than third-order accuracy (e.g., 1:5000). Basis on which such orders are established shall provide the absolute margin for error specified below.
 2. Horizontal accuracy of easement staking shall be plus or minus 0.1 feet. Accuracy of other staking shall be plus or minus 0.04 feet horizontally and plus or minus 0.02 feet vertically.

3. Survey calculations shall include an error analysis sufficient to demonstrate required accuracy.

+ + END OF SECTION + +

SECTION 01 71 33

PROTECTION OF THE WORK AND PROPERTY

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes general requirements for safety and protection that augment the requirements of the General Conditions, as may be modified by the Supplementary Conditions. This Section also includes requirements for barricades and warning signals, and protection of trees and plants, existing structures, floors, roofs, installed items, and landscaping.
2. CONTRACTOR shall be responsible for taking all precautions, providing all programs, and taking all actions necessary to protect personnel health and safety, and to protect the Work and all public and private property and facilities from damage, as specified in the General Conditions, Supplementary Conditions, and the Specifications.
3. To prevent damage, injury, or loss, CONTRACTOR's actions shall include the following:
 - a. Provide measures for safety of personnel at the Site, including workers engaged in the Work, delivery personnel, testing and inspection personnel, personnel of authorities having jurisdiction, other visitors to the Site, the public, OWNER's personnel, facility manager's personnel (if different from OWNER), ENGINEER, and Resident Project Representative (if any).
 - b. Storing apparatus, materials, supplies, and equipment in an orderly, safe manner that does not unduly interfere with progress of the Work or work of other contractors, utility owners, and owners of transportation rights-of-way.
 - c. Providing suitable storage facilities for materials and equipment subject to damage or degradation by exposure to climate, temperature, theft, breakage, or other cause.
 - d. Placing upon the Work or any part thereof only loads consistent with the safety and integrity of that portion of the Work and existing construction.
 - e. Frequently removing and disposing of refuse, rubbish, scrap materials, and debris caused by CONTRACTOR's operations so that, at all times, the Site is safe, orderly, and workmanlike in appearance.
 - f. Providing temporary barricades, fencing, and guard rails around the following: openings, scaffolding, temporary stairs and ramps, around excavations, for elevated walkways, and other areas that may present a fall-hazard or hazard to vehicles.
4. Do not, except after written consent from proper parties, enter or occupy privately-owned property or premises with personnel, tools, materials or equipment, except on lands and easements provided by OWNER.

5. CONTRACTOR has full responsibility for preserving public and private property and facilities on and adjacent to the Site. Direct or indirect damage done by, or on account of, any act, omission, neglect, or misconduct by CONTRACTOR in executing the Work, shall be remedied by CONTRACTOR, at his expense, to condition equal to that existing before damage was done.
6. Owner May Remedy:
 - a. Should CONTRACTOR fail to protect and safeguard property and the Work after requests from ENGINEER or OWNER, OWNER may implement measures to protect property and the Work.
 - b. Cost of such OWNER-implemented measures shall be paid by CONTRACTOR. OWNER may deduct from payments due CONTRACTOR such amounts as set-offs in accordance with the Contract Documents.
 - c. Such right, however, shall not result in any obligation by OWNER or ENGINEER to continuously monitor or have responsibility for protection of property and the Work, which responsibility is exclusively CONTRACTOR's.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 BARRICADES AND WARNING SIGNALS

- A. Barricades and Warning Signals – General:
 1. Where the Work is performed on or adjacent to roadway, access road or driveway, right-of-way, or public place:
 - a. Provide temporary barricades, fences, lights, warning signs, danger signals, watchmen, and take other precautionary measures for protecting persons, property, and the Work.
 - b. Use appropriately colored and reflective barricades, or paint barricades accordingly, to be visible at night.
 - c. From sunset to sunrise, provide and maintain not less than one temporary light at each barricade.
 - d. Erect sufficient barricades to keep vehicles from being driven on or into Work under construction.
 - e. Furnish watchmen in sufficient numbers to protect the Work.
 2. Provide temporary barricades to protect personnel and property for Work not in or adjacent to transportation routes and vehicular travel areas, including indoor work, in accordance with Laws and Regulations.
 3. CONTRACTOR's responsibility for maintaining temporary barricades, signs, lights, and for providing watchmen shall continue until the Work is substantially complete in accordance with the Contract Documents, unless other provision for security and protection is agreed to by the parties. After

Substantial Completion, protect Work and property during periods when final Work or corrective Work is underway.

- B. Temporary Fencing: Refer to Section 01 57 33, Security.

3.2 TREE AND PLANT PROTECTION

A. Tree and Plant Protection – General:

1. Protect existing trees, shrubs, and plants on or adjacent to the Site, shown or designated to remain in place, against unnecessary cutting, breaking, damage, or skinning of trunk, branches, bark, and roots.
2. Do not store materials or equipment or park construction equipment and vehicles within foliage drip lines.
3. In areas subject to traffic, provide temporary fencing or temporary barricades to protect trees and plants.
4. Open fires are not allowed onsite.
5. Within the limits of the Work, water trees and plants that are to remain to maintain their health during construction operations.
6. Cover exposed roots with burlap, and keep such burlap continuously wet. Cover exposed roots with earth as soon as possible. Protect root systems from mechanical damage and damage by erosion, flooding, runoff, and noxious materials in solution.
7. If branches or trunks are damaged, prune branches immediately and protect cut or damaged areas with emulsified asphalt compounded specifically for horticultural use, in manner acceptable to ENGINEER.
8. When directed by ENGINEER, remove and dispose of at location away from the Site damaged trees and plants that die or suffer permanent injury, and replace each damaged tree or plant with specimen of equal or better species and quality.

3.3 PROTECTION OF EXISTING STRUCTURES

A. Underground Facilities:

1. Underground Facilities known to OWNER and ENGINEER, except water, gas, sewer, electric, and communications services to individual buildings and properties, are shown. Information shown for Underground Facilities is the best available to OWNER and ENGINEER but, in accordance with the General Conditions, as may be modified by the Supplementary Conditions, is not guaranteed to be correct or complete.
2. CONTRACTOR shall explore ahead of trenching and excavating Work and shall sufficiently uncover Underground Facilities that will or may interfere with the Work to determine their location, to prevent damage to Underground Facilities, and to prevent service interruption to structures and properties served by Underground Facilities. If CONTRACTOR damages an Underground Facility, CONTRACTOR shall restore it to its pre-construction condition, in accordance with requirements of the owner of the damaged facility and the Contract Documents.

3. Necessary changes in the location of the Work may be directed by ENGINEER to avoid Underground Facilities not shown or indicated on the Contract Documents.
 4. If permanent relocation of an existing Underground Facilities is required and is not otherwise shown or indicated in the Contract Documents, CONTRACTOR may be directed in writing to perform the required work. When such relocation Work results in a change in the Contract Price, Contract Times, the associated Contract modification procedures and payment for such Work shall be in accordance with the Contract Documents.
- B. Surface Structures:
1. Surface structures are existing buildings, structures, and other facilities at or above ground surface, including their foundations and any extension below ground surface. Surface structures include, but are not limited to, buildings, tanks, walls, bridges, roads, dams, channels, open drainage routes, exposed piping and utilities, poles, exposed wires, posts, signs, markers, curbs, walks, fencing, and other facilities visible at or above ground surface.
 2. Existing surface facilities, including but not limited to guard rails, posts, guard cables, signs, poles, markers, curbs, and fencing, that are temporarily removed to facilitate the Work shall be replaced and restored to their pre-construction condition at CONTRACTOR's expense.
- C. Protection of Underground Facilities and Surface Structures:
1. CONTRACTOR shall sustain in their places and protect from direct or indirect injury all Underground Facilities and surface structures located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure or facility.
 2. Before proceeding with the Work of sustaining and supporting such structure or facility, CONTRACTOR shall satisfy ENGINEER that methods and procedures to be used have been approved by party owning same.
 3. CONTRACTOR shall bear all risks attending the presence or proximity of all Underground Facilities and surface structures within or adjacent to limits of the Work, in accordance with the Contract Documents.
 4. CONTRACTOR shall be responsible for damage and expense for direct or indirect injury, caused by CONTRACTOR's activities, to structures and facilities. CONTRACTOR shall promptly repair damage caused by CONTRACTOR's activities, to the satisfaction of owner of damaged structure or facility.
 5. Protection of Underground Facilities Under Roads and Parking Areas: Provide temporary, heavy-duty steel roadway plates to protect existing manholes, handholes, valve boxes, vaults, and other Underground Facilities near to or visible at the ground surface.

3.4 PROTECTION OF FLOORS AND ROOFS

A. Protection of Floors and Roofs – General:

1. Use proper protective covering when moving equipment, handling materials or other loads, when painting, handling mortar or grout, and when cleaning walls, ceilings, or structure contents.
2. Use metal pans to collect oil and cuttings from piping, conduits, and rod threading machines, and under metal cutting machines.
3. Do not load concrete floors less than 28 days old without written permission of ENGINEER. Do not load floors, roofs, or slabs in excess of design loading.
4. Do not load roofs without written permission of ENGINEER.
5. Restrict access to roofs, and keep CONTRACTOR personnel off existing roofs, except as required for the Work.
6. If access to roofs is required, roofing, parapets, openings, and all other construction on or adjacent to roof shall be protected with suitable plywood or other acceptable means.

3.5 PROTECTION OF INSTALLED MATERIALS, EQUIPMENT, AND LANDSCAPING

- A. Protect installed Work to prevent damage from subsequent operations. Remove protective items when no longer needed, prior to Substantial Completion of the Work.
- B. Control traffic to prevent damage to equipment, materials, and surfaces.
- C. Coverings:
 1. Provide temporary coverings to protect materials and equipment from damage.
 2. Cover projections, wall corners and jambs, sills, and soffits of openings, in areas used for traffic and for passage of materials and equipment in subsequent work.

+ + END OF SECTION + +

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SECTION 01 73 19

INSTALLATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section describes general requirements for installing materials and equipment. Additional installation requirements are included in the various Specifications Sections in Divisions 02 through 49 and elsewhere in the Contract Documents.
2. CONTRACTOR shall provide all labor, materials, equipment, services, tools, and incidentals required to install materials and equipment.

1.2 QUALITY ASSURANCE

A. General:

1. Provide appropriate quality assurance for installing materials and equipment, and provide quality control over Suppliers, materials and equipment, services, Site conditions, and workmanship, to provide Work of the required quality.

B. Qualifications:

1. Installer:
 - a. Installers shall be experienced in the types of Work required, including, but not limited to, the requirements of Section 01 42 00, References, and the Division 02 through 49 Specifications where the particular element of the Work is specified.

C. Regulatory Requirements: Comply with the following:

1. 29 CFR 1910, OSHA.

PART 2 – PRODUCTS

2.1 EQUIPMENT DRIVE GUARDS

A. Equipment Drive Guards – General:

1. Unless otherwise shown or indicated, provide all-metal guards complying with 29 CFR 1910, Subpart O, with equipment driven by open shafts, belts, chains, pulleys, sheaves, or gears. Guards shall enclose drive and driven mechanism.
2. If material of guards are not otherwise specified, guards shall be galvanized sheet steel, galvanized woven wire, or expanded metal set in a frame of galvanized steel members, as appropriate.

3. Secure guards in position by steel braces or straps, securely fastened to frame of equipment, floor, or wall as required.
4. Fastenings shall allow removal of guards for servicing equipment.

2.2 MISCELLANEOUS MATERIALS

- A. Shims shall be Type 304L stainless steel, clean and free of slag.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General:
 1. Installation Instructions and Requirements:
 - a. Install materials and equipment in accordance with approved Shop Drawings and CONTRACTOR's other submittals approved by ENGINEER, the Contract Documents, and manufacturer's installation instructions. When manufacturer's installation instructions conflict with the Contract Documents, obtain interpretation or clarification from ENGINEER before proceeding.
 - b. Manufacturer's installation instructions include manufacturer's written instructions; drawings; illustrative, wiring and schematic diagrams; diagrams identifying external connections, terminal block numbers and internal wiring; and other such information pertaining to installation of materials and equipment. Included are all of manufacturer's printed installation instructions, including those that may be attached to equipment upon delivery.
 2. Prior to installing materials and equipment, complete preparation of surfaces on which materials and equipment are to be installed. Prior to installing materials and equipment on new concrete, concrete shall achieve sufficient compressive strength to support the materials and equipment.
 3. Maintain the work area in a broom-clean condition while installing materials and equipment.
 4. Use proper tools to assemble materials and equipment. Do not deform or mar surface of shafts, nuts, and other parts.
 5. Do not support rigging from building or structure without written permission of ENGINEER. CONTRACTOR is responsible for and shall repair damage to building or structure resulting from CONTRACTOR's operations, in accordance with Section 01 71 33, Protection of the Work and Property.
 6. During installation, maintain materials and equipment in neutral position and do not exert undue stress on materials and equipment.
 7. Tighten connections requiring gaskets evenly all around to ensure uniform stress over entire gasket.
 8. Use only an oil bath heater to expand couplings, gears, and other mechanical components to be expanded for installation. Do not force or drive couplings,

gears, and other mechanical components onto equipment shafts, or subject such items to open flame or torch.

9. Do not alter or repair materials and equipment and do not burn or weld materials and equipment unless required in the Contract Documents or allowed by ENGINEER.
10. Provide plugs in lubrication holes to prevent entry of foreign matter.

B. Setting and Erection:

1. Install materials and equipment plumb, level, true, and free of rack unless otherwise shown or indicated, and demonstrate plumbness and level to ENGINEER. Bring parts to proper bearing after installation and erection.
2. Anchorages:
 - a. Provide anchorage setting drawings in time to coordinate with fabrication of materials and equipment and the Work.
 - b. Anchorages shall comply with Section 05 05 33, Anchor Systems. Requests for approval of substitute materials or methods of anchorage shall be in accordance with the General Conditions, Supplementary Conditions, and Section 01 25 00, Substitution Procedures.
3. Shimming:
 - a. Wedging is not allowed.
 - b. During installation, use the minimum number of shims required for leveling the equipment.
 - c. Provide shims, filling pieces, keys, packing, grouting of the type required by the Contract Documents, and other materials and equipment necessary to properly align, level, and secure apparatus in place.
4. Installing Equipment onto Foundations:
 - a. Using experienced millwrights, carefully set and align equipment on foundations, after equipment soleplates or baseplates (as applicable) have been shimmed to true alignment at anchorages.
 - b. Set anchorages in place and tighten nuts against shims.
 - c. Check bedplates or wing feet of equipment after securing to foundations and, after confirming alignments, grout soleplates or baseplates (as applicable) in place in accordance with the Contract Documents.
5. Ream misaligned holes. Do not “force” bolts or keys.
6. Where applicable, properly align equipment with associated piping and utility connections, without exerting undue stress on connecting piping and utilities.

C. Alignment and Leveling:

1. Verify that all shafts, couplings, and sheaves are properly aligned and adjust to required tolerances.
2. Align couplings while equipment is free of external loads.
3. Check angular and parallel alignment and record actual alignment and submit to ENGINEER. Alignment shall be within tolerances specified in Contract Documents and as recommended by Supplier of the material or equipment item.
4. Use laser indicators or dial indicators for checking angular and parallel alignment. Using dial indicators requires that, during rotation of half-couplings

in performing testing, dial indicator shall be maintained in same relative position, and dial indicator readings taken at same place on circumference of coupling.

D. Threaded Connections:

1. Apply a molybdenum disulfide, anti-seize compound to threads in mechanical connections such as bolts, studs, cap screws, tubing, and other threads, unless otherwise shown or indicated.

3.2 FIELD QUALITY CONTROL

A. Supplier's Services:

1. When specified, provide competent, qualified representatives of material or equipment Supplier to perform services required, including: supervising installation, checking the completed installation, adjusting, testing of materials and equipment, and where required instructing operations and maintenance personnel in the use and care of materials and equipment.

+ + END OF SECTION + +

SECTION 01 73 24

CONNECTIONS TO EXISTING FACILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes requirements for connections to existing facilities. Requirements for tie-ins and shutdowns necessary to complete the Work are in Section 01 14 16, Coordination with Owner's Operations.
2. CONTRACTOR shall provide labor, materials, tools, equipment, and incidentals shown, specified, and required for performing connections to existing facilities.

B. Coordination:

1. Review installation procedures under other Sections and coordinate Work that will be performed with or before the Work specified in this Section.
2. Notify other contractors in advance of Work for connections to existing facilities to provide other contractors sufficient time for work included in their contracts that will be installed with or before Work specified in this Section.

C. Related Sections:

1. Section 01 14 16, Coordination with Owner's Operations.
2. Section 01 73 29, Cutting and Patching.

D. General:

1. Requirements for shutdowns, tie-ins, and other provisions on connections to existing facilities, are indicated in Section 01 14 16, Coordination with Owner's Operations.
2. Requirements for temporary pumping for connections to existing facilities are in Section 01 14 16, Coordination with Owner's Operations, and Section 01 51 41, Temporary Pumping.
3. Requirements for cutting and patching are in Section 01 73 29, Cutting and Patching.
4. To extent possible, materials, equipment, systems, piping, and appurtenances that will be placed into service upon completion of connection to existing facilities shall be checked, successfully tested, and in condition for operation prior to making connections to existing facilities, if valves, gates, or similar watertight and gastight isolation devices are not provided at the connection point.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes general requirements for cutting and patching Work.
2. CONTRACTOR shall perform cutting and coring, and rough and finish patching of holes and openings in existing construction.
3. Provide cutting, coring, fitting and patching, including attendant excavation and fill, required to complete the Work, and to:
 - a. Remove and replace defective Work;
 - b. Remove samples of installed Work as specified or required for testing;
 - c. Remove construction required to perform required alterations or additions to existing construction;
 - d. Uncover the Work for ENGINEER's observation of covered Work, testing or inspection by testing entities, or observation by authorities having jurisdiction;
 - e. Connect to completed Work not performed in proper sequence;
 - f. Remove or relocate existing utilities and piping that obstruct the Work in locations where connections are to be made;
 - g. Make connections or alterations to existing or new facilities.

B. Coordination:

1. Cutting, coring, and rough patching shall be performed by the prime contractor requiring the opening. Finish patching shall be responsibility of General CONTRACTOR and shall be performed by trade associated with application of the particular finish.
 - a. Existing floor slab is a structural slab. Prime contractor shall mark out location cutting of structural slab and provide ENGINEER a minimum of 14 working days prior to start of work to review locations and sequencing of cuts.
2. Roof work shall be performed by the prime contractor requiring the opening or placement of equipment. Prime contractor shall engage a qualified roofing contractor to perform work.
3. Firestopping shall be performed by the prime contractor making penetration into or through fire rated construction. Prime contractor shall engage a qualified firestopping and sealant contractor to perform work.
4. Joint sealant work shall be performed by the prime contractor making penetration into or through construction. Prime contractor shall engage a qualified sealant contractor to perform work.
5. Duct opening at roof through building envelope shall be performed by G prime contractor in coordination with H prime contractor. G prime contractor is responsible for sealing and making penetrations watertight.

6. Cutting single tees is not allowed without prior approval of ENGINEER.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:

1. Cutting and Patching Request:
 - a. Submit written request to ENGINEER, well in advance of executing cutting or alteration that affects one or more of the following:
 - 1) Design function or intent of Project.
 - 2) Work of OWNER or other contractors.
 - 3) Structural value or integrity of an element of the Project.
 - 4) Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 5) Efficiency, operational life, maintenance, or safety of operational elements.
 - 6) Visual qualities of sight-exposed elements.
 - b. Request shall include:
 - 1) Identification of Project and Contract designation.
 - 2) Description of affected Work of CONTRACTOR and work of others (if any).
 - 3) Necessity for cutting.
 - 4) Effect on work or operations of OWNER, other contractors (if any), and on structural or weatherproof integrity of Project.
 - 5) Description of proposed Work, describing: scope of cutting and patching; trades who will be executing the Work; materials and equipment to be used; extent of refinishing; schedule of operations; alternatives to cutting and patching, if any, and net effect on aesthetics following completion of finishing Work.
 - 7) Designation of entity responsible for cost of cutting and patching, when applicable.
 - 8) Written permission of other prime contractors (if any) whose work will or may be affected.
2. Recommendation Regarding Cutting and Patching:
 - a. Should conditions of work or schedule indicate a change of materials or methods, submit written recommendation to ENGINEER including:
 - 1) Conditions indicating change.
 - 2) Recommendations for alternative materials or methods.
 - 3) Items required with request for approval of substitute, in accordance with the substitution request requirements of the Contract Documents.
3. Product Data:
 - a. Submit manufacturer's data for the protective compound to be applied to core-drilled surfaces and cut concrete surfaces.
 - b. When not required under other Sections, submit manufacturer's data on materials to be used for finishing around the cut or patched area.
 - c. Furnish submittals for patching materials under the associated Specifications Section.

- B. Informational Submittals: Submit the following:
 - 1. Written Notification of Cutting and Patching:
 - a. Submit written indication designating the day and time that the construction associated with cutting and patching will be uncovered to allow for observation. Do not begin cutting or patching operations until submittal is accepted by ENGINEER.
 - 2. X-ray Investigations:
 - a. Proposed method of investigation. Submit and obtain ENGINEER's acceptance prior to performing X-ray inspections.
 - b. Report of X-ray evaluation of slabs, floors, and walls to be cut or core-drilled.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials - General:
 - 1. Use materials that comply with the Contract Documents.
 - 2. If not shown or indicated in the Contract Documents, use materials that are identical to existing materials affected by cutting and patching Work.
 - 3. For exposed surfaces, use materials that visually match existing adjacent surfaces to fullest extent possible. If identical materials are unavailable or cannot be used, use materials whose installed performance will equal or surpass that of existing materials.
 - 4. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using materials that do not void required or existing warranties.
- B. Compound Applied to Core-Drilled Surfaces and Cut Concrete Surfaces:
 - 1. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with solvent-free, two-component, protective, epoxy resin coating.
 - 2. Color shall approximate the finish color of the existing surface to be coated.
 - 3. Product and Manufacturer: Provide one of the following:
 - a. Sikagard 62, by Sika Corporation.
 - b. Or equal.

PART 3 – EXECUTION

3.1 GENERAL

- A. Perform cutting and coring in such manner that limits extent of patching required.
- B. Structural Elements:
 - 1. Do not cut or patch structural elements in manner that would change the element's structural load-carrying capacity as load deflection ratio.

- C. Operating Elements:
 - 1. Do not cut or patch operating elements in manner that would reduce their capacity to perform as intended.
 - 2. Do not cut or patch operating elements or related components in manner that would increase maintenance requirements or decrease operational life or safety.
- D. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using methods that do not void required or existing warranties.

3.2 INSPECTION

- A. Examine surfaces to be cut or patched, and conditions under which cutting or patching will be performed before starting cutting or patching Work.
- B. Report unsatisfactory or questionable conditions to ENGINEER in writing. Do not proceed with cutting or patching Work until unsatisfactory conditions are corrected.

3.3 PREPARATION

- A. Provide temporary support required to maintain structural integrity of facilities, to protect adjacent work from damage during cutting, and to support the element(s) to be cut.
- B. Protection of Existing Construction during Cutting and Patching:
 - 1. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project and facility that will be exposed during cutting and patching operations.
 - 2. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
 - 3. Do not cut existing pipe, conduit, ductwork, or other utilities serving facilities scheduled to be removed or relocated until provisions have been made to bypass them.

3.4 CORING

- A. Use core-drilling to make penetrations through concrete and masonry walls, slabs, or arches, unless otherwise accepted by ENGINEER in writing.
- B. Coring:
 - 1. Perform coring with non-impact rotary tool using diamond core-drills. Size holes for pipe, conduit, sleeves, equipment or mechanical seals, as required, to be installed through the penetration.
 - 2. Do not core-drill through electrical conduit or other utilities embedded in walls or slabs without approval of ENGINEER. To extent possible, avoid cutting reinforcing steel in slabs and walls.
- C. Protection:

1. Protect existing equipment, utilities, and adjacent areas from water and other damage caused by or resulting from core-drilling operations.
2. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Section. Apply protective coating in accordance with manufacturer's instructions.

D. Cleaning:

1. After core-drilling, vacuum or otherwise remove slurry and tailings from the work area.

3.5 CUTTING

A. Cutting – General:

1. Cut existing construction using methods least-likely to damage elements retained and adjoining construction and that provide proper surfaces to receive subsequent installation or repair.
2. In general, use hand tools or small power tools suitable for sawing or grinding. When possible, avoid using hammering and avoid chopping.
3. Cut holes and slots as small as possible, neatly to the size required, and with minimum disturbance of adjacent surfaces.
4. Prior to starting cutting, provide adequate bracing of area to be cut.
5. To avoid marring existing finished surfaces, cut or drill from exposed or finished side into concealed side.
6. Provide equipment of adequate size to remove the cut panel or "coupon".
7. Provide temporary covering over cut openings where not in use.

B. Cutting – Concrete and Masonry:

1. Cut through concrete and masonry using concrete wall saw with diamond saw blades.
2. On both of the element being cut, provide for control of slurry generated during sawing.
3. After cutting concrete and before installing subsequent construction on or through the opening, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Section. Apply protective coating in accordance with manufacturer's instructions.

3.6 PATCHING

A. Patching – General:

1. Patch construction by filling, repairing, refinishing, closing-up, and similar operations following performance of other Work.
2. Patch with durable seams that are as inconspicuous as possible. Provide materials and comply with installation requirements indicated in the Contract Documents.
3. Patch to provide airtight and watertight connections to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
4. Where feasible, test patched areas to demonstrate integrity of installation.

B. Restoration:

1. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in manner that eliminates evidence of patching and refinishing.
2. For continuous surfaces, refinish to nearest intersection.
3. For an assembly, refinish the entire unit that was patched.
4. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 CLEANING

A. Cleaning and Restoration:

1. Clean areas and spaces where cutting, coring, or patching were performed.
2. Clean piping, conduit, and similar constructions before applying paint or other finishing materials.
3. Restore damaged coverings of pipe and other utilities to original condition.

+ + END OF SECTION + +

SECTION 01 74 05

CLEANING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes requirements for keeping the Site free of accumulations of waste materials during construction (“progress cleaning”) and cleaning for Substantial Completion and prior to final inspection (collectively, “closeout cleaning”).
2. CONTRACTOR shall perform cleaning during the Project, including progress cleaning, upon completion of the Work, and as required by the General Conditions, as may be modified by the Supplementary Conditions, and this Section.
3. Maintain in a clean manner the Site, the Work, and areas adjacent to or affected by the Work.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. NFPA 241, Safeguarding Construction, Alteration, and Demolition Operations.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PROGRESS CLEANING

A. General:

1. Clean the Site, work areas, and other areas occupied by CONTRACTOR not less than weekly. Dispose of materials in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and the following:
 - a. Comply with NFPA 241 for removing combustible waste materials and debris.
 - b. Do not hold non-combustible materials at the Site more than three days if the temperature is expected to rise above 80 degrees F. When temperature is less than 80 degrees F, dispose of non-combustible materials within seven days of their generation.
 - c. Provide suitable containers for storage of waste materials and debris.
 - d. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.

- B. Site:
1. Keep outdoor, dust-generating areas wetted down or otherwise control dust emissions.
 2. Not less than weekly, brush-sweep roadways and paved areas at the Site that are used by construction vehicles or otherwise affected by construction activities.
 3. Comply with dust control requirements of Section 01 57 05, Temporary Controls, and Section 01 41 27, Earthmoving Permit and Dust Control.
- C. Work Areas:
1. Clean areas where the Work is in progress to maintain the extent of cleanliness necessary for proper execution of the Work.
 2. Remove liquid spills promptly. Immediately report spills to OWNER, ENGINEER, and authorities having jurisdiction, in accordance with the Contract Documents and Laws and Regulations.
 3. Where dust would impair proper execution of the Work, broom-clean or vacuum entire work area, as appropriate.
 4. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- D. Installed Work:
1. Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of material or equipment installed, using only cleaning agents and methods specifically recommended by material or equipment manufacturer. If manufacturer does not recommend specific cleaning agents or methods, use cleaning agents and methods that are not hazardous to health and property and that will not damage exposed surfaces.
- E. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until Substantial Completion.
- F. Cutting and Patching:
1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, trailings and cuttings, and similar materials.
 2. Thoroughly clean piping, conduits, and similar features before applying patching material, paint, or other finishing materials. Restore damaged coverings on piping, ducting, and similar items to its pre-construction condition.
- G. Cleaning of Hydraulic Structures: Clean hydraulic structures that will contain fluid, such as tanks and channels, in accordance with this Section and Section 01 45 53, Cleaning, Testing, and Disinfecting Hydraulic Structures.
- H. Waste Disposal:
1. Properly dispose of waste materials, surplus materials, debris, and rubbish off the Site.

2. Do not burn or bury rubbish and waste materials at the Site.
 3. Do not discharge volatile or hazardous substances, such as mineral spirits, oil, or paint thinner, into storm sewers or sanitary sewers.
 4. Do not discharge wastes into surface waters or drainage routes.
 5. CONTRACTOR is solely responsible for complying with Laws and Regulations regarding storing, transporting, and disposing of waste generated by CONTRACTOR's operations or brought to the Site by CONTRACTOR.
- I. During handling and installation of materials and equipment, clean and protect construction in progress and adjoining materials and equipment already in place. Apply protective covering where required for protection from damage or deterioration, until Substantial Completion.
- J. Clean completed construction as frequently as necessary throughout the construction period.

3.2 CLOSEOUT CLEANING

- A. Complete the following prior to requesting inspection for Substantial Completion:
1. Clean and remove from the Site rubbish, waste material, debris, and other foreign substances.
 2. Sweep paved areas broom-clean. Remove petrochemical spills, stains, and other foreign deposits.
 3. Hose-clean sidewalks and loading areas.
 4. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 5. Leave surface waterways, drainage routes, storm sewers, and gutters open and clean.
 6. Repair pavement, roads, sod, and other areas affected by construction operations and restore to specified condition; if condition is not specified, restore to pre-construction condition.
 7. Clean exposed exterior and interior hard-surfaced finishes to dirt-free condition, free of spatter, grease, stains, fingerprints, films, and similar foreign substances.
 8. Clean, wax, and polish wood, vinyl, and painted floors.
 9. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, and similar spaces.
 10. In unoccupied spaces, sweep concrete floors broom-clean.
 11. Clean transparent materials, including mirrors and glazing in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
 12. Remove non-permanent tags and labels.
 13. Surface Finishes:

- a. Touch-up and otherwise repair and restore chipped, scratched, dented or otherwise marred surfaces to specified finish and match adjacent surfaces.
 - b. Do not paint over “UL” or similar labels, including mechanical and electrical nameplates.
 - 14. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint, and mortar droppings, and other foreign substances.
 - 15. Clean plumbing fixtures to sanitary condition, free of stains, including stains resulting from water exposure.
 - 16. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - 17. Clean lighting fixtures, lamps, globes, and reflectors to function with full efficiency. Replace temporary lamps provided in permanent fixtures. Replace existing lighting fixture components that are burned out or noticeably dimmed from use during construction. Replace defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - 18. Leave the Site clean, and in neat, orderly condition, satisfactory to OWNER and ENGINEER.
- B. Complete the following prior to requesting final inspection:
- 1. Following completion of the Work on the “punch list” of Work uncompleted at Substantial Completion, clean in accordance with Paragraph 3.2.A of this Section.

+ + END OF SECTION + +

SECTION 01 75 11

CHECKOUT AND STARTUP PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall initially start up and place equipment and systems installed under the Contract into successful operation, in accordance with the equipment manufacturer's written instructions and as instructed by Supplier at the Site.
2. Provide all material, labor, tools, and equipment required to complete equipment checkout and start-up.
3. Provide chemicals, lubricants, and other required operating fluids.
4. Provide fuel, electricity, water, filters, and other expendables required for start-up of equipment, unless otherwise specified.
5. General activities by CONTRACTOR include the following:
 - a. Cleaning, as required under other provisions of the Contract Documents.
 - b. Removing temporary protective coatings.
 - c. Flushing and replacing lubricants, where required by manufacturer.
 - d. Lubrication.
 - e. Checking shaft and coupling alignments and resetting where required.
 - f. Checking and setting motor, pump, and other equipment rotation, safety interlocks, and belt tensions.
 - g. Checking and correcting (as necessary) leveling plates, grout, bearing plates, anchorage devices, fasteners, and alignment of piping, conduits, and ducts that may place stress on the connected equipment.
 - h. Performing all adjustments required.

B. Coordination:

1. Coordinate checkout and start-up with other contractors, as necessary.
2. Do not start up system or subsystem for continuous operation until all components of that system or subsystem, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
3. OWNER will furnish sufficient personnel to assist CONTRACTOR in starting up equipment, but responsibility for proper operation is CONTRACTOR's.
4. Supplier shall be present during checkout, startup, and initial operation, unless otherwise acceptable to ENGINEER.
5. Startup of heating equipment, air conditioning equipment, and other equipment that provides cooling or other temperature control, and systems is dependent upon the time of year. Return to the Site at beginning of next heating or cooling season (as applicable) to recheck and start the appropriate systems.

6. Do not start up system, unit process, or equipment without submitting acceptable preliminary operations and maintenance manuals by CONTRACTOR in accordance with Section 01 78 23, Operations and Maintenance Data.
- C. OWNER's Assumption of Responsibility for Equipment and Systems:
1. OWNER will assume responsibility for the equipment upon Substantial Completion, unless otherwise mutually agreed upon by OWNER and CONTRACTOR or as documented in the certificate of Substantial Completion.
 2. Before turning over to OWNER responsibility for operating and maintaining system or equipment CONTRACTOR shall:
 - a. Provide training of operations and maintenance personnel in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
 - b. Complete performance of equipment and system field quality control testing in accordance with the Contract Documents, to the extent possible.
 - c. Submit acceptable final operations and maintenance manuals in accordance with Section 01 78 23, Operations and Maintenance Data.
 - d. Obtain from ENGINEER final certificate of Substantial Completion for either entire Work or the portion being turned over to OWNER.

1.2 SUBMITTALS

- A. Closeout Submittals: Submit the following:
1. Certifications:
 - a. Supplier's certification of installation in accordance with Paragraph 3.1.B of this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SERVICES OF SUPPLIER

- A. When specified, furnish services of competent, qualified representatives of material and equipment manufacturers, including supervising installation, adjusting, checkout, startup, and testing of materials and equipment.

3.2 MINIMUM STARTUP REQUIREMENTS

- A. Bearings and Shafting:
1. Inspect for cleanliness, and clean and remove foreign matter.
 2. Verify alignment.
 3. Replace defective bearings and those that operate in a rough or noisy manner.
 4. Grease as necessary, in accordance with manufacturer's recommendations.

- B. Drives:
 - 1. Adjust tension in V-belt drives and adjust vari-pitch sheaves and drives for proper equipment speed.
 - 2. Adjust drives for alignment of sheaves and V-belts.
 - 3. Clean and remove foreign matter before starting operation.
- C. Motors:
 - 1. Check each motor for comparison to amperage nameplate value.
 - 2. Correct conditions that produce excessive current flow and conditions that exist due to equipment malfunction.
- D. Pumps:
 - 1. Check glands and seals for cleanliness and adjustment before running pump.
 - 2. Inspect shaft sleeves for scoring.
 - 3. Inspect mechanical faces, chambers, and seal rings, and replace if defective.
 - 4. Verify that piping system is free of dirt and scale before circulating liquid through pump.
- E. Valves:
 - 1. Inspect manual and automatic control valves, and clean bonnets and stems.
 - 2. Tighten packing glands to ensure no leakage, but allow valve stems to operate without galling.
 - 3. Replace packing in valves to retain maximum adjustment after system is determined to be complete.
 - 4. Replace packing on valves that continue to leak.
 - 5. Remove, correct, and replace bonnets that leak.
 - 6. After cleaning, coat packing gland threads and valve stems with surface preparation of "Molycote" or "Fel-Pro".
- F. Verify that control valve seats are free of foreign matter and are properly positioned for intended service.
- G. Pipe Joints and Other Connections:
 - 1. Tighten flanges and other pipe joints after system has been placed in operation.
 - 2. Replace gaskets that show signs of leakage after tightening.
 - 3. Inspect all joints for leakage.
 - 4. Promptly remake each joint that appears to be faulty; do not wait for rust or other corrosion to form.
 - 5. Clean threads on both parts, and apply compound and remake joints.
- H. After system has been placed in operation, clean strainers, drives, pockets, orifices, valve seats, and headers in fluid system to ensure freedom from foreign matter.
- I. Open steam traps and air vents, where used, and remove operating elements. Clean thoroughly, replace internal parts, and place back into operation.

- J. Remove rust, scale, and foreign matter from equipment and renew defaced surfaces.
- K. Set and calibrate draft gauges of air filters and other equipment.
- L. Inspect fan wheels for clearance and balance. Provide factory-authorized personnel for adjustment where needed.
- M. Check each electrical control circuit to verify that operation complies with the Contract Documents.
- N. Inspect each pressure gauge, thermometer, and other instruments for calibration. Replace items that are defaced, broken, or that read incorrectly.
- O. Repair damaged insulation.
- P. Excess Gasses and Fluids:
 - 1. Vent gasses trapped in systems.
 - 2. Verify that liquids are drained from all parts of gas or air systems.

3.3 ATTACHMENTS

- A. The attachment listed below, following this Section's "End of Section" designation, is a part of this Specification Section.
 - 1. Supplier's Installation Certification Form (one page).

+ + END OF SECTION + +

SUPPLIER'S INSTALLATION CERTIFICATION

Contract No. and Name: _____

Equipment Specification Section: _____

Equipment Name: _____

Contractor: _____

Manufacturer of Equipment: _____

The undersigned Supplier of the equipment or system described above hereby certifies that Supplier has checked the installation of the equipment or system and that the equipment or system, as specified in the Contract Documents, has been provided in accordance with the manufacturer's recommendations and the Contract Documents, and that the trial operation of the equipment or system has been satisfactory.

Comments: _____

Date

Supplier Name (print)

Signature of Supplier

Date

Contractor Name (print)

Signature of Contractor

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SECTION 01 77 19

CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.1 GENERAL

- A. Scope:
 - 1. Section Includes.
 - a. Substantial Completion.
 - b. Final inspection.
 - c. Request for final payment and acceptance of the Work.

1.2 SUBSTANTIAL COMPLETION

- A. Substantial Completion – General:
 - 1. Prior to requesting Substantial Completion, perform the following for the substantially completed Work:
 - a. Materials and equipment for which Substantial Completion is requested shall be fully ready for their intended use, including full operating and monitoring capability in automatic and manual modes.
 - b. Complete field quality control Work, including testing at the Site, indicated in Specifications Sections for individual materials and equipment items. Submit results of, and obtain Engineer's acceptance of, field quality control tests required by the Contract Documents.
 - c. Startup and checkout shall be completed in accordance with Section 01 75 11, Startup and Checkout Procedures, and requirements of the Specifications for the various materials and equipment in the substantially completed Work.
 - d. Cleaning for Substantial Completion shall be completed in accordance with Section 01 74 05, Cleaning.
 - e. Spare parts, extra stock materials, and tools shall be delivered and accepted in accordance with Section 01 78 43, Spare Parts and Extra Materials, and the Specifications for the various materials and equipment.
 - f. Training shall be completed in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
 - g. Submit and obtain Engineer's acceptance of final operations and maintenance manuals.
 - h. Obtain and submit to Engineer all required permits, inspections, and approvals of authorities having jurisdiction for the substantially completed Work to be occupied and used by Owner.
 - i. Complete other tasks that the Contract require be completed prior to Substantial Completion.

2. Procedures for requesting and documenting Substantial Completion are in the General Conditions, as may be modified by the Supplementary Conditions.
3. Sample letter for Contractor to request inspection for Substantial Completion is attached to this Specifications Section as Exhibit A. Use the model language of the sample letter, modified to suit the Project.
4. Unless decided otherwise by Owner and Engineer, form of certificate of Substantial Completion will be EJCDC® C-625, "Certificate of Substantial Completion" (2018 edition), prepared by Engineer.
5. Refer to the Agreement and Section 01 29 76, Progress Payment Procedures, for requirements regarding consent of surety to partial release of or reduction in retainage.

1.3 FINAL INSPECTION

A. Final Inspection – General:

1. Prior to requesting final inspection, verify that all the Work is fully complete and ready for final payment. A Partial checklist for this purpose is attached to this Specifications Section as Exhibit B.
2. Sample letter for Contractor to request final inspection is attached to this Specifications Section as Exhibit C. Use the model language of the sample letter, modified to suit the Project.
3. Procedures for requesting and documenting the final inspection are in the General Conditions, as may be modified by the Supplementary Conditions, and as augmented in this Section.

1.4 REQUEST FOR FINAL PAYMENT AND ACCEPTANCE OF THE WORK

A. Procedure:

1. Submit request for final payment in accordance with the Agreement and General Conditions, as may be modified by the Supplementary Conditions, and using procedure specified in Section 01 29 76, Progress Payment Procedures, and this Section.
2. Acceptance of the Work:
 - a. Upon Engineer's receipt of the final Application for Payment, accompanied by other required Contract closeout documentation in accordance with the Contract Documents, Engineer will issue to Owner and Contractor a notice of acceptability of the Work, in accordance with the General Conditions, as may be modified by the Supplementary Conditions.
 - b. Nothing other than receipt of such notice of acceptability from Engineer constitutes acceptance of the Work.
 - c. Unless decided otherwise by Owner and Engineer, form of acceptance will be EJCDC® C-626, "Notice of Acceptability of Work", (2018 edition).

- B. Request for final payment shall include:
1. Documents required for progress payments in Section 01 29 76, Progress Payment Procedures.
 2. Documents required in the General Conditions, as may be modified by the Supplementary Conditions.
 3. List of all disputes that Contractor believes are unsettled, presented on Contractor's letterhead. If there are no such disputes or Claims, so indicate in writing.
 4. Consent of Surety to Final Payment:
 - a. Acceptable form includes AIA® G707™, "Consent of Surety to Final Payment" (1994 or later edition), or other form acceptable to Owner.
 5. Releases of Liens:
 - a. Submit "complete and legally effective releases (satisfactory to Owner) of all Liens filed in connection with the Work, regardless of whether such Lien was filed by Contractor or any Subcontractor or Supplier.
 - b. Each release of Lien shall be signed by an authorized representative of the entity submitting the release of Lien, and shall include Contractor's, Subcontractor's, or Supplier's (as applicable) corporate seal, when applicable.
 6. Waivers of Lien Rights:
 - a. Submit legally-binding waivers of rights to file Liens (acceptable to Owner), from Contractor and each Subcontractor and Supplier that provided Contractor, Subcontractor, or Supplier with labor, material, or equipment totaling \$(-1--) or more for the Work.
 - b. Furnish final list of Subcontractors and Suppliers, using the form included in Section 01 29 76, Progress Payment Procedures, indicating final amount of the associated subcontract or purchase order for each. Include on the list all lower-tier Subcontractors and Suppliers retained by higher-tier Subcontractors and Suppliers.
 - c. Each waiver of Lien rights shall be signed by an authorized representative of the entity submitting waiver of Lien rights, and shall include Contractor's, Subcontractor's, or Supplier's (as applicable) corporate seal, when applicable.
 - d. Waiver of Lien rights may be conditional upon receipt of final payment.
 - e. Required Affidavits: Submit the following:
 - 1) Affidavit of payment of debts and claims, submitted by Contractor. Acceptable form includes AIA® G706™, "Contractor's Affidavit of Payment of Debts and Claims" (1994 or later edition), or other form acceptable to Owner, and;
 - 2) Affidavit of release of Liens, submitted by Contractor. Acceptable form includes AIA® G706A™, "Affidavit of Release of Liens" (1994 or later edition).
 - f. Waivers of Lien rights and affidavits and supporting documents furnished under this Paragraph 1.4.B.6 shall comply with the requirements of the General Conditions, as may be modified by the Supplementary Conditions.

- g. Each affidavit furnished shall be signed by an authorized representative of the entity furnishing the affidavit, and shall include issuing entity's corporate seal, when applicable.
- h. Where all required waivers of Lien rights and affidavits are not submitted:
 - 1) Submit letter on Contractor's letterhead indicating the Subcontractor(s) and Suppliers for whom such waivers or releases were not obtained, amount owed to such entity, reason(s) why such amount was not previously paid and indicate how Contractor intends to fulfill its obligations and assure Owner that associated debts and claims are paid.
 - 2) In lieu of the releases or waivers of Liens specified in Paragraphs 1.4.B.5 and 1.4.B.6 of this section, and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied.
 - 3) If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.
- 7. Evidence satisfactory to Owner that all title issues (not otherwise addressed by releases of Liens, waivers of Lien rights, and related documentation required in Paragraphs 1.4.B.5 and 1.4.B.6 of this section) have been resolved and that title will pass to Owner free and clear of other title defects, or will so pass upon final payment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 EXHIBITS

- A. The documents listed below, following this Section's "End of Section" designation, are part of this Specifications Section:
 - 1. Exhibit A - Sample letter for Contractor's use in requesting inspection for Substantial Completion (two pages).
 - 2. Exhibit B - Sample partial checklist to identify readiness for final inspection (four pages).
 - 3. Exhibit C - Sample letter for Contractor's use in requesting final inspection (one page).
- B. In the model language of the attached sample letters for the Contractor to request inspection for Substantial Completion and the final inspection, italicized language in brackets, e.g., "[*insert date*]" indicates instructions to the drafter of the letter and often indicates specific information to be inserted by Contractor; do not include bracketed, italicized text in the final version of the letter(s) prepared for the Project. Non-italicized language in brackets is optional language; use the appropriate language to complete the actual letter for the Project and edit where required to suit the specific circumstances.

+ + END OF SECTION + +

**EXHIBIT A - SAMPLE LETTER FOR CONTRACTOR'S USE IN
REQUESTING INSPECTION FOR SUBSTANTIAL COMPLETION**

[Date]

[Name of Engineer's contact person]

ARCADIS U.S., Inc.

[Street address]

[City, state, postal code]

Subject:

[Project name, Contract designation]

Request for Inspection for Substantial Completion

Dear [addressee]:

In our opinion, [all of] [or] [a portion of] the Work under the above-referenced Contract is substantially complete as of [insert month, day, year on which Substantial Completion was achieved]. [The specific portion of the Work that we believe is substantially complete is [insert identification of that portion of the Work that is substantially complete].]

Enclosed is our listing of uncompleted Work items ("punch list"). In accordance with Paragraph 15.03.A of the General Conditions, we hereby request: 1) That the Engineer schedule and perform the inspection for Substantial Completion as soon as possible, and 2) Issuance of the certificate of Substantial Completion.

In accordance with Paragraph 15.03.D of the General Conditions, upon Substantial Completion, we propose the following relative to apportionment of responsibilities between the Owner and the Contractor:

1. Security, Protection, Insurance:
 - a. Site Security: [insert proposal; address whether Owner or Contractor will be responsible for security of the Site].
 - b. Protection of the Substantially Completed Work: [insert proposal; address whether Owner or Contractor will be responsible for protection].
 - c. Property Insurance: [insert proposal; typically, Owner assumes responsibility for property insurance upon Substantial Completion]
2. Operation and Maintenance:
 - a. Operation: [insert proposal; address whether Owner or Contractor will be responsible for operating the substantially completed Work].

- b. Maintenance: *[insert proposal; address whether Owner or Contractor will be responsible for maintaining the substantially completed Work]*.
- 3. Utilities: *[for each of the following, indicate whether Owner or Contractor will be responsible for utilities and services, or whether responsibility will be shared; if shared, indicate proposed cost-sharing]*
 - a. Electricity: *[insert proposal]*.
 - b. Natural Gas/Fuel/Heating: *[insert proposal]*.
 - c. Water Supply: *[insert proposal]*.
 - d. Wastewater: *[insert proposal]*.
 - e. Communications (Telephone, Internet, Video): *[insert proposal]*.

In accordance with Paragraph 15.08.A of the General Conditions, we understand that the Contract's correction period for the Work covered by the certificate of Substantial Completion commences on the Substantial Completion date documented in said certificate. *[Drafter: Also see Paragraph 15.08.C of the General Conditions and, where necessary, edit this paragraph of the letter accordingly.]*

Should you have questions or comments regarding this notice, please contact [the undersigned] *[or] [insert other contact person's name]*, at *[insert telephone number and e-mail address]*.

Sincerely,

[Contractor's company name]

[Signatory name]

[Signatory's title]

Attachments:

Preliminary list of uncompleted Work items ("punch list"; [##] pages)

Copies:

[Owner's project manager]

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EXHIBIT B - SAMPLE PARTIAL CHECKLIST TO IDENTIFY READINESS FOR FINAL INSPECTION

Project: _____

Contract: _____

Contractor: _____

Item No./Description	Completed/Date	In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
1. All Shop Drawings, Samples, and Submittals approved by Engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
2. Final services completed by Suppliers, including submittal of "Supplier Installation Certification" in Section 01 75 11, Checkout and Startup Procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
3. Final Work completed by Subcontractors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
4. Permits closed out and regulatory compliance transitioned from construction to operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						

Item No./Description	Completed/Date	In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
5. All outstanding change issues are addressed and all Change Proposals submitted	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
6. All Claims are resolved	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
7. All defective Work of which Contractor is aware has been corrected in accordance with the Contract Documents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
8. Issues related to Constituents of Concern and potential Hazardous Environmental Condition have been fully addressed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
9. All spare parts, tools, and extra stock materials have been furnished in accordance with the Contract Documents, and documentation thereof submitted to Engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
10. All final Operations & Maintenance manuals have been	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

Item No./Description	Completed/Date	In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
submitted and accepted by Engineer						
Remarks:						
11. Manufacturer warranties and software license(s) furnished	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
12. Instruction and training of operations and maintenance personnel is complete and records of training submitted	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
13. MBE/WBE/DBE compliance report(s) submitted (when applicable)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
14. All field engineering submittals, including survey data, furnished	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
15. All Work on "punch list" is complete in accordance with the Contract Documents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
16. All record documents submitted to and accepted by Engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						

Item No./Description	Completed/Date	In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
17. Contractor is fully demobilized from Site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
18. All Site restoration is complete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
19. Final cleaning of all work areas is complete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
20. Lien waivers or affidavits of payment obtained from Subcontractors and Suppliers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
21. Evidence of Contractor liability insurance furnished for correction period	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						
22. All other required Contract closeout documents obtained	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Remarks:						

**EXHIBIT C - SAMPLE LETTER FOR CONTRACTOR'S USE IN
REQUESTING FINAL INSPECTION**

**SENT VIA E-MAIL AND U.S. CERTIFIED MAIL/RETURN RECEIPT
REQUESTED**

[Date]

[Name of Engineer's contact person]

ARCADIS U.S., Inc.

[Street address]

[City, state, postal code]

Subject:

[Project name, Contract designation]

Request for Final Inspection

Dear [addressee]:

In our opinion, all of the Work under the above-referenced Contract is complete and ready for final payment as of [insert month, day, year on which final completion was achieved]. In accordance with Paragraph 15.05.A of the General Conditions, we hereby request that the Engineer schedule and perform the final inspection as soon as possible. Upon successful completion of the final inspection, we will submit our final Application for Payment accompanied by the required Contract closeout documentation in accordance with the Contract Documents.

Should you have questions or comments regarding this notice, please contact [the undersigned] [or] [insert other contact person's name], at [insert telephone number and e-mail address].

Sincerely,

[Contractor's company name]

[Signatory name]

[Signatory's title]

Attachments:

None

Copies:

[Owner's project manager]

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SECTION 01 78 23

OPERATIONS AND MAINTENANCE DATA

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes requirements for manufacturers' operations and maintenance manuals and related data to be furnished by CONTRACTOR.
2. CONTRACTOR shall submit operation and maintenance data, in accordance with this Section and in accordance with requirements elsewhere in the Contract Documents, as instructional and reference manuals by operations and maintenance personnel at the Site.
3. Required operation and maintenance data groupings are listed in table(s) in Article 1.2 of this Section. At minimum, submit operation and maintenance data for:
 - a. All equipment and systems.
 - b. Laboratory fume hood.
 - c. HVAC equipment.
 - d. Electrical equipment.
4. For each operation and maintenance manual, submit the following:
 - a. Preliminary Submittal: Printed and bound copy of entire operation and maintenance manual, except for test data, service reports by Supplier, and submit electronic copies.
 - b. Final Submittal: Printed and bound copy of complete operations and maintenance manual, including test data and service reports by Supplier, and submit electronic copies.

1.2 SUBMITTALS

A. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data:
 - a. Submit the operations and maintenance data indicated in the Contract Documents, grouped into submittals as indicated in Table 01 78 23-A:

TABLE 01 78 23-A, REQUIRED OPERATIONS AND MAINTENANCE DATA

Name of O&M Manual/Data	For Materials or Equipment Specified in Section(s)
Laboratory Equipment	11 53 00
Fume Hood	12 35 53
HVAC Equipment	Division 23
Electrical Equipment	Division 26

B. Quantity Required and Timing of Submittals:

1. Preliminary Submittal:
 - a. Printed Copies: 2 copies, exclusive of copies required by CONTRACTOR.
 - b. Electronic Copies: In accordance with Section 01 31 26, Electronic Communication Protocols.
 - b. Electronic Copies: 2 copies.
 - c. Submit to ENGINEER by the earlier of: 90 days following approval of Shop Drawings and product data submittals, or 10 days prior to starting training of operations and maintenance personnel, or 10 days prior to field quality control testing at the Site.
 - d. Furnish preliminary operation and maintenance data submittal in acceptable form and content, as determined by ENGINEER, before associated materials and equipment will be eligible for payment.
2. Final Submittal: Furnish final submittal prior to Substantial Completion, unless submittal is specified as required prior to an interim Milestone.
 - a. Printed Copies: 4 copies.
 - b. Electronic Copies: In accordance with Section 01 31 26, Electronic Communication Protocols.

1.3 FORMAT OF PRINTED COPIES

A. Binding and Cover:

1. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy as required. Binders shall be not less than one inch wide and maximum of three inches wide. Binders for each copy of each volume shall be identical.
2. Binders shall be locking three-ring/"D"-ring type, or three-post type. Three-ring binders shall be riveted to back cover and include plastic sheet lifter (page guard) at front of each volume.
3. Do not overfill binders.
4. Covers shall be oil-, moisture-, and wear-resistant, including identifying information on cover and spine of each volume.
5. Provide the following information on cover of each volume:
 - a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - b. Name or type of material or equipment covered in the manual.
 - c. Volume number, if more than one volume is required, listed as "Volume ___ of ___", with appropriate volume-designating numbers filled in.
 - d. Name of Project and, if applicable, Contract name and number.
 - e. Name of building or structure, as applicable.
6. Provide the following information on spine of each volume:
 - a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - b. Name or type of material or equipment covered in the manual.
 - c. Volume number, if more than one volume is required, listed as "Volume ___ of ___", with appropriate volume-designating numbers filled in.
 - d. Project name and building or structure name.

B. Pages:

1. Print pages in operations and maintenance manual on 30-pound (minimum) paper, 8.5 inches by 11 inches in size.
2. Reinforce binding holes in each individual sheet with plastic, cloth, or metal. When published, separately-bound booklets or pamphlets are part of the manual, reinforcing of pages within booklet or pamphlet is not required.
3. Furnish each page with binding margin not less than one inch wide. Punch each page with holes suitable for the associated binding.

C. Drawings:

1. Bind into the operation and maintenance manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing specified for pages.
2. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Include not more than three drawing sheets per pocket.

D. Copy Quality and Document Clarity:

1. Contents shall be original-quality copies. Documents in the operations and maintenance manual shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color. Manuals that contain copies that are unclear, not completely legible, off-center, skewed, or where text or drawings are cut by binding holes, are unacceptable. Pages that contain approval or date stamps, comments, or other markings that cover text or drawing are unacceptable. Faxed copies are unacceptable.
2. Clearly mark in ink to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished or cross out inapplicable content. Using highlighters to so indicate options furnished is unacceptable.

E. Organization:

1. Table of Contents:
 - a. Provide table of contents in each volume of each operations and maintenance manual.
 - b. In table of contents and not less than once in each chapter or section, identify materials and equipment by their functional names. Thereafter, abbreviations and acronyms may be used if their meaning is clearly indicated in a table bound at or near beginning of each volume. Using material or equipment model or catalog designations for identification is unacceptable.
2. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

1.4 FORMAT OF ELECTRONIC COPIES

- A. Electronic Copies of Operation and Maintenance Manuals:
 - 1. Each electronic copy shall include all information included in the corresponding printed copy.
 - 2. Submit electronic copies in accordance with Section 01 31 26, Electronic Communications Protocols.
 - 3. File Format:
 - a. Files shall be in “portable document format” (PDF). Files shall be electronically searchable.
 - b. Submit separate file for each separate document in the printed copy.
 - c. Within each file, provide bookmarks for the following:
 - 1) Each chapter and subsection listed in the corresponding printed copy document’s table of contents.
 - 2) Each figure.
 - 3) Each table.
 - 4) Each appendix.
- B. Copies of Programming and Configuration Files:
 - 1. Furnish on CD or portable USB “thumb drive” copy of all software programming, such as programmable logic controller programs, prepared specifically for the Project. Third-party, licensed, commercially available software is excluded from requirements of this Article; submit copies of commercially-available, licensed, third-party software, where required, in accordance with the Contract Documents.
 - 2. Submit programming and configuration files concurrently with electronic copies of operation and maintenance data.

1.5 CONTENT

- A. General:
 - 1. Prepare each operations and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-built drawings as applicable, bills of materials, technical bulletins, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.
 - 2. Completeness and Accuracy:
 - a. Operation and maintenance manuals that include language stating or implying that the manual’s content may be insufficient or stating that the manual’s content is not guaranteed to be complete and accurate are unacceptable.
 - b. Operations and maintenance manuals shall be complete and accurate.
 - c. Operation and maintenance manuals shall indicate the specific

- alternatives and features furnished, and the specific operation and maintenance provisions for the material or equipment furnished.
3. Submit complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.
- B. Submit written explanations of safety considerations relating to operation and maintenance procedures.
- C. Submit complete, detailed, written preventive maintenance instructions including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:
1. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning. Include pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns.
 2. Recommended schedule for each preventive maintenance task.
 3. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
 4. Table of alternative lubricants.
 5. Troubleshooting instructions.
 6. List of required maintenance tools and equipment.
- D. Submit complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:
1. Manufacturer's name, address, telephone number, fax number, and Internet website address.
 2. Manufacturer's local service representative's or local parts supplier's name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.
 3. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.
 4. For each part or piece include the following information:
 - a. Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
 - b. Part name or description.
 - c. Manufacturer's part number.
 - d. Quantity of each part used in each assembly.
 - e. Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.

- E. Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number) that will expedite the ordering process.
- F. Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.
- G. Submit manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. Avoid submitting catalog excerpts unless they are the only document available showing identification or description of particular component of the equipment. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.
- H. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.
- I. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.
- J. Submit copy of warranty bond and service contract as applicable.
- K. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 78 36

WARRANTIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This section describes general requirements for warranties required in the various Specifications.
2. Provisions on the Contract's correction period, CONTRACTOR'S general warranty and guarantee, and CONTRACTOR's warranty of title are in the General Conditions, as may be modified by the Supplementary Conditions.
2. This section includes general requirements for:
 - a. Suppliers' standard warranties.
 - b. Suppliers' special warranties.
 - c. Implied warranties.
 - d. Commencement and duration of warranties.

1.2 SUBMITTALS

A. General:

1. For each item of equipment furnished under the Contract, submit Supplier's standard warranty, regardless of whether such warranty or submittal thereof is required by the associated Specifications for that item. Submit such warranties for materials where such submittal is required in the Specifications for the material.
2. For each item of material or equipment where Supplier's special (or extended) warranty is required by the Contract Documents, submit appropriate special warranty that complies with the Contract Documents.
3. Supplier's warranties shall be specifically endorsed solely to OWNER by the entity issuing such warranty.
4. Submit Suppliers' standard warranties and special warranties as submittals in accordance with Schedule of Submittals accepted by ENGINEER.

1.3 SUPPLIERS' WARRANTIES FOR MATERIALS AND EQUIPMENT

A. Warranty Types:

1. Required by the General Conditions:
 - a. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, CONTRACTOR's general warranty and guarantee and requirements for the Contract's correction period.
 - b. Disclaimers and limitations in specific materials and equipment warranties do not limit CONTRACTOR's general warranty and

guarantee, nor does such affect or limit CONTRACTOR's performance obligations under the correction period.

2. Material or equipment manufacturer's standard warranty is pre-printed, written warranty published by item's manufacturer and specifically endorsed by manufacturer to OWNER.
3. Special warranty is written warranty that either extends the duration of material or equipment manufacturer's standard warranty or provides other, increased rights to OWNER. Where the Contract Documents indicate specific requirements for warranties that differ from the manufacturer's standard warranty for that item, special warranty is implied.

B. Requirements for Special Warranties:

1. Submit written special warranty document that contains appropriate provisions and identification, ready for execution by material or equipment manufacturer and OWNER. Submit draft warranty with submittals required prior to fabrication and shipment of the item from the Supplier's facility.
2. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed by product manufacturer and other entities as appropriate.
3. Specified Form: When specified forms for special warranties are included in the Contract Documents, prepare written document, properly executed by item manufacturer and OWNER, using the required form.
4. Refer to the Specifications for content and requirements for submitting special warranties.

1.4 IMPLIED WARRANTIES

A. Warranty of Title and Intellectual Property Rights:

1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.
2. Provisions on intellectual property rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.

B. Warranty of Merchantability:

1. Notwithstanding any other provision of the Contract to the contrary, implied warranties of merchantability required by Laws and Regulations apply to the the materials and equipment incorporated into the Work.

C. Warranty of Fitness-for-Purpose:

1. Implied warranty of fitness-for-use for materials and equipment to be incorporated into the Work, as indicated in Laws and Regulations, remains in full force and effect.
2. When Supplier is aware of, or has reason to be aware of, specified materials or features of the Work that are contrary to the intended use, purpose, service, application, or environment in which the material or equipment item will be

used, submit request for interpretation in accordance with Section 01 26 00, Contract Modification Procedures. Where appropriate, such request for interpretation shall indicate the apparent discrepancy and propose appropriate, alternative materials or equipment.

1.5 COMMENCEMENT AND DURATION OF WARRANTIES

A. Commencement of Warranties:

1. Contract correction period and CONTRACTOR's general warranty commence as indicated in the General Conditions, as may be modified by the Supplementary Conditions.
2. Suppliers' general warranties and special warranties commence running on the date that the associated item is certified by ENGINEER as substantially complete. In no event shall special warranties commence running prior to ENGINEER's review and acceptance of special warranty submittal for the item.
3. Implied warranties commence in accordance with Laws and Regulations.

C. Duration of Warranties:

1. Duration of correction period is in accordance with the General Conditions, as may be modified by the Supplementary Conditions.
2. Duration of CONTRACTOR's general warranty and guarantee is in accordance with Laws and Regulations.
3. Duration of Suppliers' general warranties is in accordance with the applicable general warranty document accepted by ENGINEER.
4. Duration of required Suppliers' special warranties shall be in accordance with the requirements of the Contract Documents for the subject item.
5. Duration of implied warranties shall be in accordance with Laws and Regulations.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes requirements for Project record documents, to supplement the requirements of the General Conditions, as may be modified by the Supplementary Conditions.
2. Contractor shall provide all labor, materials, equipment, and services to maintain and submit to Engineer Project record documents in accordance with the Contract Documents.

B. Maintenance of Record Documents:

1. Maintain in Contractor's field office, in clean, dry, legible condition, complete sets of the following record documents: Drawings, Specifications, and Addenda; Shop Drawings, Samples, and other Contractor submittals, including records of test results, approved or accepted as applicable, by Engineer; Change Proposals, Proposal Requests, Change Orders, Work Change Directives, Field Orders, copies of all interpretations and clarifications issued, photographic documentation, survey data, and all other documents pertinent to the Work.
2. Provide files and racks for proper storage and easy access to record documents. File record documents in accordance with the latest edition of the Construction Specification Institute's *MasterFormat*TM used for organizing the Project Manual, unless otherwise accepted by Engineer.
3. Promptly make record documents available for observation and review upon request of Engineer or Owner. Requirements for review of record documents status as a condition precedent to progress payments is in Section 01 29 73, Schedule of Values, and Section 01 29 76, Progress Payment Procedures.
4. Do not use record documents for any purpose other than serving as Project record. Do not remove record documents from Contractor's field office without Engineer's approval.

1.2 SUBMITTALS

A. Closeout Submittals: Submit the following:

1. Record Documents:
 - a. Submit the following Project record documents:
 - 1) Drawings.
 - 2) Project manual including Specifications and Addenda (bound).
 - b. Prior to readiness for final payment, submit to Engineer one copy of Project's final record documents and obtain Engineer's acceptance of

- same. Submit complete record documents; do not make partial submittals.
- c. Submit both printed record documents and electronic record documents, in accordance with Section 01 31 26, Electronic Document Protocol.
 - d. Submit record documents with transmittal letter on Contractor letterhead in accordance with requirements in Section 01 33 00, Submittal Procedures.
2. Certifications:
- a. Record documents submittal shall include certification, with original signature of official authorized to execute legal agreements on behalf of Contractor, reading as follows:
“*[Insert Contractor’s corporate name]* has maintained and submitted Project record documentation in accordance with the General Conditions and Supplementary Conditions, Section 01 78 39, Project Record Documents, and other elements of Contract Documents, for the (--1--), (--2--), (--3--). We certify that each record document submitted is complete, accurate, and legible relative to the Work performed under our Contract, and that the record documents comply with the requirements of the Contract Documents.

[Provide signature, print name, print signing party’s corporate title, and date]”

1.3 RECORDING CHANGES

A. Recording Changes – General:

- 1. At the start of the Project, label each record document to be submitted as, “PROJECT RECORD” using legible, printed letters. Letters on record copy of the Drawings shall be two inches high.
- 2. Keep record documents current consistent with the progress of the Work. Make entries on record documents within two working days of receipt of information required to record the change.
- 3. Do not permanently conceal the Work until required information has been recorded for Project record documents.
- 4. Accuracy of record documents shall be such that future searches for items shown on the record documents may rely reasonably on information obtained from Engineer-accepted record documents.
- 5. Marking of Entries:
 - a. Use erasable, colored pencils (not ink or indelible pencil) for marking changes, revisions, additions, and deletions to record documents.
 - b. Clearly describe the change by graphic line and make notations as required. Use straight-edge to mark straight lines. Writing shall be legible and sufficiently dark to allow scanning of record documents into legible electronic files in portable document format (“.PDF”).
 - c. Date each entry on record documents.
 - d. Indicate changes by drawing a “cloud” around the change(s) indicated.

- e. Mark initial revisions in red. In the event of overlapping changes, use different colors for subsequent changes.

B. Drawings:

1. Record changes on copy of the Drawings. Submittal of Contractor-originated or -produced drawings as a substitute for recording changes on a copy of the Drawings is unacceptable.
2. Record changes on plans, sections, elevations, schematics, schedules, and details as required for clarity, making reference dimensions and elevations (to Project datum) for complete record documentation.
3. Record actual construction including:
 - a. Depths of various elements of foundation relative to Project datum.
 - b. Horizontal and vertical location of Underground Facilities referenced to permanent surface improvements and project elevation datum. For each Underground Facility, including pipe fittings, show and indicate dimensions to not less than two permanent, visible surface improvements.
 - c. Location of exposed utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure and, where applicable, to Project elevation datum.
 - d. Changes in structural and architectural elements of the Work, including changes in reinforcing.
 - e. Field changes of dimensions, arrangements, and details.
 - f. Changes made in accordance with Addenda, Change Orders, Work Change Directives, and Field Orders.
 - g. Changes in details on the Drawings. Submit additional details prepared by Contractor when required to document such changes.
4. Recording Changes for Schematic Layouts:
 - a. Where arrangements of conduits, circuits, piping, ducts, and similar items are shown schematically and are not intended to portray physical layout the final physical arrangement shall be determined by Contractor subject to acceptance by Engineer.
 - b. Record on the Project record documents all revisions to schematics on the Drawings, including: piping schematics, ducting schematics, process and instrumentation diagrams, control and circuitry diagrams, electrical one-line diagrams, motor control center layouts, and other schematics when included in the Drawings. Show and indicate actual locations of equipment, lighting fixtures, in-place grounding system, and other pertinent data.
 - c. When dimensioned plans and dimensioned sections or elevations on the Drawings show the Work schematically, indicate on the record documents, by dimensions accurate to within one inch in the field, centerline location of items of Work such as conduit, piping, ducts, and similar items
 - 1) Clearly identify each item of the Work by accurate notations such as “cast iron drain”, “rigid electrical conduit”, “copper waterline”, and similar descriptions.

- 2) Show by symbol or by note the vertical location of each item of the Work; for example, “embedded in slab”, “under slab”, “in ceiling plenum”, “exposed”, and similar designations. For piping not embedded, also indicate elevation dimension relative to Project elevation datum.
 - 3) Descriptions shall be sufficiently detailed to be related to the Specifications.
 - d. Engineer may furnish written waiver of requirements relative to schematic layouts shown on plans, sections, and elevations when, in Engineer’s judgment, dimensioned layouts of Work shown schematically will serve no useful purpose. Do not rely on such waiver(s) being issued.
- 5. Supplemental Drawings:
 - a. In some cases, drawings produced during construction by Engineer or Contractor supplement the Drawings; these shall be included with Project record documents submitted by Contractor. Supplemental record drawings shall include drawings or sketches that are part of Change Orders, Work Change Directives, and Field Orders and that cannot be incorporated into the Drawings because of space limitations.
 - b. Supplemental drawings submitted with record drawings shall be integrated with the Drawings and include necessary cross-references between drawings. Supplemental record drawings shall be on sheets the same size as the Drawings.
 - c. When supplemental drawings developed by Contractor using computer-aided drafting/design (CADD) software are to be included in record drawings, submit electronic files for such drawings in accordance with Section 01 31 26, Electronic Document Protocol, as part of record drawing submittal. Label such files, “Supplemental Record Drawings”, including with Contractor’s name, Project name, and Contract designation.

C. Specifications and Addenda:

- 1. Mark each Specifications Section to record:
 - a. Manufacturer, trade name, catalog number, and Supplier of each material and equipment item actually provided.
 - b. Changes made by Addendum, Change Orders, Work Change Directives, and Field Orders.

1.4 ELECTRONIC FILES FURNISHED BY ENGINEER

- A. CADD files of the Drawings will be furnished by Engineer upon the following conditions:
 - 1. Contractor shall submit to Engineer a letter on Contractor letterhead requesting CADD files of the Drawings and indicating specific definition(s) or description(s) of how such files will be used, and specific description of benefits to Owner (including credit proposal, if applicable) if the request is granted.

2. Contractor shall execute Engineer's standard agreement for release of electronic files and shall abide by the provisions of such agreement for release of electronic files. A copy is attached as Exhibit A.
3. Layering system incorporated in CADD files shall be maintained as transmitted by Engineer. CADD files transmitted by Engineer containing cross-referenced files shall not be bound by Contractor. Drawing cross-references and paths shall be maintained. If Contractor alters layers or cross-reference files, Contractor shall restore all layers and cross-references prior to submitting record documents to Engineer.
4. Contractor shall submit record drawings to Engineer in same CADD format that files were furnished to Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXHIBITS

- A. Engineer's Electronic File Release Agreement is attached as Exhibit A following this Section's "End of Section" designation, and is part of this Specifications Section:

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SECTION 01 79 23

INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish services of Supplier's operation and maintenance training specialists to instruct OWNER's and facility manager's personnel in recommended operating and maintenance procedures for materials and equipment furnished, in accordance with the Contract Documents.
2. Supplier shall provide a combination of classroom and field training at the Site, unless otherwise required elsewhere in the Contract Documents.
3. OWNER or facility manager reserves the right to record training sessions on video for OWNER's later use in instructing OWNER's or facility manager's personnel.

B. Scheduling of Training Sessions:

1. General:

- a. CONTRACTOR shall coordinate training services with start-up and initial operation of materials and equipment on days and times, and in manner, acceptable to OWNER, in accordance with the Contract Documents.
- b. Training may be required outside of normal business hours to accommodate schedules of operations and maintenance personnel. Furnish training services at the required days and times at no additional cost to OWNER.

2. Prerequisites to Training:

- a. Training of facility operations and maintenance personnel shall commence after preliminary operation and maintenance data has been submitted and accepted by ENGINEER, and Work required in Section 01 75 11, Checkout and Startup Procedures, (--1--) is complete.
- b. At option of OWNER or ENGINEER, training may be allowed to take place before, during, or after equipment startup.

3. Training Schedule Submittal:

- a. Training Schedule Required: CONTRACTOR shall prepare and submit proposed training schedule for review and acceptance by ENGINEER and OWNER. Proposed training schedule shall show and indicate all training required in the Contract Documents, and shall demonstrate compliance with specified training requirements relative to number of hours of training for various elements of the Work, number of training sessions, and scheduling.
- b. Training Schedule Coordination: When Project has multiple prime contracts, prime contractors shall comply with this Section. All prime

- contractors shall coordinate with the General CONTRACTOR in developing a single training schedule submittal for the entire Project, to be submitted by General CONTRACTOR. All prime contractors shall implement training in accordance with the approved training schedule.
- c. Timing of Training Schedule Submittal: Submit initial training schedule not less than 60 days before scheduled start of first training session. Submit final training schedule, incorporating revisions in accordance with ENGINEER's comments, not later than 30 days prior to starting the first training session.
 - d. OWNER reserved the right to modify personnel availability for training in accordance with process or emergency needs at the facility.

1.2 QUALITY ASSURANCE

A. Qualifications:

- 1. Manufacturer's Instructors:
 - a. Shall be factory-trained by manufacturer of material or equipment.
 - b. Manufacturer's instructors shall be proficient and experienced in performing training of the type required.
 - c. Instructors shall be proficient in spoken and written English language.
 - d. Qualifications of instructors are subject to acceptance by ENGINEER. If ENGINEER does not accept qualifications of proposed instructor, furnish services of replacement instructor with acceptable qualifications.
- 2. Attendance is mandatory for the following:
 - a. CONTRACTOR's project manager.
 - b. CONTRACTOR's Site superintendent.
 - c. Project manager of Subcontractors responsible for furnishing materials and equipment for which training of operations and maintenance personnel is required.
 - d. Manufacturers and other Suppliers invited by CONTRACTOR.
 - f. ENGINEER.
 - g. Facility manager's staff responsible for training coordination, and staff responsible for scheduling operations and maintenance personnel.
- 3. If additional information must be developed to adequately cover agenda items, reconvene conference as soon as possible.
- 4. CONTRACTOR shall prepare minutes summarizing the discussions of conference, decisions made, and agreements and disagreements, and submit the minutes to each conference attendee.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

- 1. Training Schedule: Detailed schedule of training sessions, demonstrating compliance with number of training sessions, hours required in the Contract Documents, and complying with the Contract Times. Submit training schedule submittals in accordance with time frames specified in this Section.

- B. Informational Submittals: Submit the following:
1. Lesson Plan: Acceptable lesson plan for training on each material or equipment item, in accordance with Table 01 79 23-A and the Contract Documents. Lesson plan shall comply with requirements of this Section as may be supplemented by Specifications Sections where materials and equipment are specified. Include with lesson plan copy of handouts that will be used during training sessions. Furnish lesson plan submittals in accordance with time frames specified in this Section.
 2. Qualifications:
 - a. Credentials of manufacturer's proposed operations and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Section and shall include brief resume' and specific details of instructor's operating, maintenance, and training experience relative to the specific material and equipment for which instructor will provide training.
- C. Closeout Submittals: Submit the following:
1. Trainee sign-in sheets for each training session. Submit to OWNER's training coordinator with copy to ENGINEER.

1.4 LESSON PLAN

- A. Supplier's lesson plan shall describe specific instruction topics, system components for which training will be furnished, and training procedures. Handouts, if any, to be used in training shall be included with the lesson plan. Describe in lesson plan "hands-on" demonstrations planned for training sessions.
- B. Submit acceptable lesson plan not less than 14 days prior to starting associated training.
- C. Indicate in lesson plan estimated duration of each training segment.
- D. Lesson plan shall include the following:
1. Material and Equipment Overview (required for all types of operations and maintenance training):
 - a. Describe material and equipment's operating (process) function and performance objectives.
 - b. Describe material and equipment's fundamental operating principles and dynamics.
 - c. Identify equipment's mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem's interaction with other subsystems.
 - d. Identify all support materials and equipment associated with operation of subject equipment, such as air intake filters, valve actuators, motors, and other appurtenant items and equipment.

- e. Identify and describe safety precautions and potential hazards related to operation.
- f. Identify and describe in detail safety and control interlocks.
- 2. Mechanical Maintenance Training:
 - a. Material and Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.
 - b. Material and Equipment Preventive Maintenance:
 - 1) Describe preventative maintenance inspection procedures required to:
 - a) Inspect materials and equipment in operation.
 - b) Identify potential trouble symptoms and anticipate breakdowns.
 - c) Forecast maintenance requirements (predictive maintenance).
 - 2) Define recommended preventative maintenance intervals for each component.
 - 3) Describe lubricant and replacement part recommendations and limitations.
 - 4) Describe appropriate cleaning practices and recommend intervals.
 - 5) Identify and describe use of special tools required for maintenance of materials and equipment.
 - 6) Describe component removal, installation, and disassembly and assembly procedures.
 - 7) Perform “hands-on” demonstrations of preventive maintenance procedures.
 - 8) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
 - 9) Define recommended torquing, mounting, calibrating, and aligning procedures and settings, as appropriate.
 - 10) Describe recommended procedures to check and test equipment following corrective maintenance.
 - c. Equipment Troubleshooting:
 - 1) Define recommended systematic troubleshooting procedures.
 - 2) Provide component-specific troubleshooting checklists.
 - 3) Describe applicable materials and equipment testing and diagnostic procedures to facilitate troubleshooting.
 - 4) Describe common corrective maintenance procedures with “hands-on” demonstrations.

1.5 TRAINING AIDS

- A. Manufacturer’s instructor shall incorporate training aids as appropriate to assist in the instruction. Furnish handouts of text, tables, graphs, and illustrations as required. Other appropriate training aids include:
 - 1. Audio-visual aids, such as videos, Microsoft PowerPoint presentations, overhead transparencies, posters, drawings, diagrams, catalog sheets, or other items.
 - 2. Equipment cutaways and samples, such as spare parts and damaged equipment.

3. Tools, such as repair tools, customized tools, and measuring and calibrating instruments.
- B. Handouts:
1. Manufacturer's instructor shall distribute and use descriptive handouts during training. Customized handouts developed especially for training for the Project are encouraged.
 2. Photocopied handouts shall be good quality and completely legible.
 3. Handouts should be coordinated with the instruction, with frequent references made to the handouts.
 4. Provide not less than 15 copies of each handout for each training session.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 TRAINING DELIVERY

- A. Training Delivery – General:
1. Instructors shall be fully prepared for the training sessions. Training delivery shall be communicative, clear, and proceed according to lesson plan accepted by ENGINEER, with lesson content appropriate for trainees. If OWNER or ENGINEER deems that training delivery does not to comply with the Contract Documents, training shall be postponed, rescheduled, and re-performed in acceptable manner at no additional cost to OWNER.
 2. Trainee Sign-in Sheets: In format acceptable to OWNER, furnish sign-in sheet for trainees for each session. Sign-in sheets shall include the Project name, equipment or system for which training was furnished, and type of training (e.g., operations, mechanical maintenance, instrumentation/controls maintenance, or other), and name of each trainee. Upon completion of training, submit copy of each sign-in sheet as indicated in Article 1.3 of this Section.
- B. “Hands-on” Demonstrations:
1. Manufacturer's instructor shall present “hands-on” demonstrations of operations and maintenance of materials and equipment for each training session, in accordance with lesson plan accepted by ENGINEER.
 2. CONTRACTOR and manufacturer shall furnish tools necessary for demonstrations.

3.2 TRAINING SCHEDULE

- A. Manufacturer shall furnish not less than the hours of training and number of sessions indicated in Table 01 79 23-A of this Section. Travel time and expenses are responsibility of manufacturer and are excluded from required training time indicated in the Contract Documents.

B. Shifts and Training Sessions Required:

1. Operations at the Site take place 24 hours per day, divided into three shifts as follows: day, evening, and night shift.
2. Training Sessions per Shift:
 - a. Mechanical Maintenance: Provide two identical training sessions during day shift, each session in a separate week, for indicated equipment. Maximum training per day is four hours; sessions longer than four hours shall be spread over multiple, preferably consecutive, days.
 - b. Electrical Maintenance: Provide two identical training sessions during day shift, each session in a separate week, for indicated equipment. Maximum training per day is four hours; sessions longer than four hours will be spread over multiple, preferably consecutive, days.

TABLE 01 79 23-A, TRAINING SUMMARY TABLE

Material or Equipment	Specification Section	Total Training Time (hours)	Training Sessions Required		
			Operations	Mechanic Maint.	Instrument/ Controls & Electrical Maint.
Lab and Fume Hood	11 53 000 & 12 35 53	4	2	0	0
HVAC	Div 23	4	0	2	0
Electrical	Div 26	4	0	1	0
Total		12	2	3	0

++ END OF SECTION ++

SECTION 02 41 00

DEMOLITION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required for demolition, removal, and disposal Work.
2. The Work under this Section includes, but is not necessarily limited to:
 - a. Demolition and removal of existing materials and equipment as shown or indicated in the Contract Documents. The Work includes demolition of walls, doors, windows, metals, roofs, masonry, attachments, appurtenances, piping, electrical and mechanical systems and equipment, paving, curbs, sidewalks, and similar existing facilities.
3. Demolitions and removals specified under other Sections shall comply with requirements of this Section.
4. Perform demolition Work within areas shown or indicated.
5. Pay all costs associated with transporting and, as applicable, disposing of materials and equipment resulting from demolition.

B. Coordination:

1. Comply with Section 01 41 16, Coordination with Owner's Operations.
2. Review procedures under this and other Sections and coordinate the Work that will be performed with or before demolition and removals.
3. Notify other contractors in advance of demolition and removals Work to provide other contractors with sufficient time for performing work and coordinating items included in their contracts that will be performed before or in conjunction with demolition and removals Work.

1.2 QUALITY ASSURANCE

A. Qualifications:

1. Electrical Removals: Entity and personnel performing electrical removals shall be electrician legally qualified to perform electrical construction and electrical work in the jurisdiction where the Site is located.
2. Plumbing Removals: Entity and personnel performing plumbing removals shall be plumber legally qualified to perform plumbing construction and plumbing work in the jurisdiction where the Site is located.

B. Regulatory Requirements:

1. Demolition, removal, and disposal Work shall be in accordance with 29 CFR 1926.850 through 29 CFR 1926.860 (Subpart T - Demolition), and all other Laws and Regulations.
2. Comply with requirements of authorities having jurisdiction.

1.3 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Procedure Submittals:
 - a. Demolition and Removal Plan: Not less than ten days prior to starting demolition Work, submit acceptable plan for demolition and removal Work, including:
 - 1) Plan for coordinating shut-offs, capping, temporary services, and continuing utility services.
 - 2) Other proposed procedures as applicable.
 - 3) Equipment proposed for use in demolition operations.
 - 4) Recycling/disposal facility(ies) proposed, including facility owner, facility name, location, and processes. Include copy of appropriate permits and licenses, and compliance status.
 - 5) Planned demolition operating sequences.
 - 6) Detailed schedule of demolition Work in accordance with the accepted Process Schedule.
2. Notification of Intended Demolition Start: Submit in accordance with Paragraph 3.1.A of this Section.
3. Qualifications Statements:
 - a. Name and qualifications of entity performing electrical removals, including copy of licenses required by authorities having jurisdiction.
 - b. Name and qualifications of entity performing plumbing removals, including copy of licenses required by authorities having jurisdiction.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION

A. Notification:

1. At least 48 hours prior to commencing demolition or removal, notify ENGINEER in writing of planned start of demolition Work. Do not start removals without permission of ENGINEER.

B. Protection of Surrounding Areas and Facilities:

1. Perform demolition and removal Work in manner that prevents damage and injury to property, structures, occupants, the public, and facilities. Do not

- interfere with use of, and free and safe access to and from, structures and properties.
2. Closing or obstructing of roads, drives, sidewalks, and passageways adjacent to the Work is not allowed unless indicated otherwise in the Contract Documents. Conduct the Work with minimum interference to vehicular and pedestrian traffic.
 3. Provide temporary barriers, lighting, sidewalk sheds, and other necessary protection.
 4. Repair damage to facilities that are to remain.
- C. Existing Utilities: In addition to requirements of the General Conditions, Supplementary Conditions, and Division 01 Specifications, do the following:
1. Should uncharted or incorrectly charted Underground Facilities be encountered, CONTRACTOR responsibilities shall be in accordance with the General Conditions as may be modified by the Supplementary Conditions. Cooperate with utility owners in keeping adjacent services and facilities in operation.
 2. Sanitary Sewer: Before proceeding with demolition, locate and cap all sewer lines and service laterals discharging from the building or structure being demolished.
 3. Storm Water: Existing storm water system shall remain in place until demolitions of existing building or structure is completed. Upon completing demolition, cut and cap storm sewer laterals at locations shown on the Drawings. Remove existing storm water piping and related structures between points of cutting, and backfill, restore to grade, and stabilize the area over the removed facilities.
 4. Water Piping: Before proceeding with demolition, locate and cap all potable and non-potable waterlines and service laterals serving the building or structure being demolished.
 5. Other Utilities: Before proceeding with demolition, locate and cap as required all other utilities, such as fuel and gas; heating, ventilating, and air conditioning; electric; and communications; and service laterals serving the building or structure being demolished.
 6. Shutdown of utility services shall be coordinated by CONTRACTOR, assisted by OWNER as required relative to contacting utility owners.
- D. Remediation:
1. Site has been remediated prior to this project.

3.2 DEMOLITION – GENERAL

- A. Locate construction equipment used for demolition Work and remove demolished materials and equipment to avoid imposing excessive loading on supporting and adjacent walls, floors, framing, facilities, and Underground Facilities.
- B. Pollution Controls:

1. Use water sprinkling, temporary enclosures, and other suitable methods to limit emissions of dust and dirt to lowest practical level. Comply with Section 01 57 05, Temporary Controls, and Laws and Regulations.
 2. Do not use water when water may create hazardous or objectionable conditions such as icing, flooding, or pollution.
 3. Clean adjacent structures, facilities, properties, and improvements of dust, dirt, and debris caused by demolition Work, in accordance with the General Conditions and Section 01 74 05, Cleaning.
- D. Comply with Section 01 73 29, Cutting and Patching.
- E. Salvage and Ownership:
1. Refer to Section 01 12 13 Summary of Work, for requirements on salvage, ownership, and handling of equipment and materials removed during demolition and removal Work.
 2. Materials and equipment to remain OWNER's property shall be carefully removed and appropriately handled by CONTRACTOR to avoid damage and invalidation of warranties in effect, and shall be cleaned and stored at the Site (or other site specified in the Contract Documents) at place designated by ENGINEER or OWNER.
- F. Finishing of Surfaces Exposed by Removals: Unless otherwise shown or indicated in the Contract Documents, surfaces of walls, floors, ceilings, and other areas exposed by removals, and that will remain as finished surfaces, shall be repaired and re-finished with materials that match existing adjacent surface, or as otherwise approved by ENGINEER.

3.3 STRUCTURAL REMOVALS

- A. Remove structures to lines and grades shown or indicated, unless otherwise directed by ENGINEER. Where limits are not shown or indicated, limits shall be four inches outside item to be installed. Removals beyond limits shown or indicated shall be at CONTRACTOR's expense and such excess removals shall be reconstructed to satisfaction of ENGINEER without additional cost to OWNER.
- B. Recycling and Reuse of Demolition Materials:
1. All concrete, brick, tile, masonry, roofing materials, reinforcing steel, structural metals, miscellaneous metals, plaster, wire mesh, and other items contained in or upon building or structure to be demolished shall be removed, transported, and disposed of away from the Site, unless otherwise approved by ENGINEER.
 2. Do not use demolished materials as fill or backfill adjacent to structures, in pipeline trenches, or as subbase under structures or pavement.
- C. After removing concrete and masonry walls or portions thereof, slabs, and similar construction that ties in to the Work or to existing construction, neatly repair the junction point to leave exposed only finished edges and finished surfaces.

- D. Where parts of existing structures are to remain in service following demolition, remove the portions shown or indicated for removal, repair damage, and leave the building or structure in proper condition for the intended use.
1. Remove concrete and masonry to the lines shown or indicated by sawing, drilling, chipping, and other suitable methods. Leave the resulting surfaces true and even, with sharp, straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended.
 2. Do not damage reinforcing bars beyond the area of concrete and masonry removal. Do not saw-cut beyond the area to be removed.
 3. Reinforcing bars that are exposed at surfaces of removed concrete and masonry that will not be covered with new concrete or masonry shall be removed to 1.5 inches below the final surface. Repair the resulting hole, with repair mortar for concrete and grout for masonry, to be flush with the surface.
 4. Where existing reinforcing bars are shown or indicated to extend into new construction, remove existing concrete so that reinforcing bars are clean and undamaged.
- E. Where equipment or material anchored to concrete or masonry are removed and anchors are not to be re-used, remove the anchors to not less than 1.5 inches beneath surface of concrete or masonry member. Repair the resulting hole, using repair mortar for concrete and grout for masonry, to be flush with the surface. Alternately, when the anchor is stainless steel, the anchor may be cut flush with the surface of the concrete or masonry, when so approved by ENGINEER.
- E. Jambs, sills and heads of windows, passageways, doors, or other openings (as applicable) cut-in to the Work or to existing construction shall be dressed with masonry, concrete, or metal to provide smooth, finished appearance.
- F. Where anchoring materials, including bolts, nuts, hangers, welds, and reinforcing steel, are required to attach the Work to existing construction, provide such materials under this Section, unless specified elsewhere in the Contract Documents.

3.4 MECHANICAL REMOVALS

- A. Mechanical demolition and removal Work includes dismantling and removing existing piping, ductwork, pumps, equipment, tanks, and appurtenances as shown, indicated, and required for completion of the Work. Mechanical removals include cutting and capping as required, except that cutting of existing piping and ductwork to make connections is included under Section 01 14 16, Coordination with Owner's Operations; Section 01 73 29, Cutting and Patching.

- B. Demolition and Removals of Piping, Ductwork, and Similar Items:
1. Purge piping (as applicable) of chemicals or fuel (as applicable) and make safe for removal and capping. Remove to the extent shown or indicated existing process, water, waste and vent, chemical, gas, fuel, and other piping. Remove piping to the nearest solid piping support, and provide caps on ends of remaining piping. Where piping to be demolished passes through existing walls to remain, cut off and cap pipe on each side of the wall.
 2. Remove waste and vent piping, and ductwork to extent shown and cap as required. Where demolished vent piping, stacks, and ductwork passes through existing roofing, patch the roof with the same or similar materials. Completed patch shall be watertight and comply with roofing manufacturer's recommendations.
 3. Modifications to potable water piping and other plumbing and heating system work shall comply with Laws and Regulations. All portions of potable water system that have been modified or opened shall be hydrostatically tested and disinfected in accordance with the Contract Documents, and Laws and Regulations. Hydrostatically test other, normally-pressurized, plumbing piping and heating piping.
- C. Equipment Demolition and Removals:
1. To the extent shown or indicated, remove existing process equipment; pumps; storage tanks; hoisting and conveying equipment; heating, ventilating, and air conditioning equipment; generators; and other equipment.
 2. Where required, disassemble equipment to avoid imposing excessive loading on supporting walls, floors, framing, facilities, and Underground Facilities. Disassemble equipment as required for access through and egress from building or structure. Disassembly shall comply with Laws and Regulations. Provide required means to remove equipment from building or structure.
 3. Remove control panels, operator stations, and instruments associated with equipment being removed, unless shown or indicated otherwise.
 4. Remove fuel appurtenances as applicable, including fuel storage tanks. Dispose of tank contents in accordance with Laws and Regulations.
 5. Remove equipment supports as applicable, anchorages, base, grout, and piping. Remove anchorage systems in accordance with the "Structural Removals" Article in this Section. Remove small-diameter piping back to header unless otherwise indicated.
 6. Remove access platforms, ladders, and stairs related to equipment being removed, unless otherwise shown or indicated.

3.5 ELECTRICAL REMOVALS

- A. Electrical demolition Work includes removing existing transformers, distribution switchboards, control panels, motors, starters, conduit and raceways, cabling, poles and overhead cabling, panelboards, lighting fixtures, switches, and miscellaneous electrical equipment, as shown, specified, or required.

- B. Remove existing electrical equipment and fixtures to avoid damaging systems to remain, to keep existing systems in operation, and to maintain integrity of grounding systems.
- C. Remove or modify motor control centers and switchgear as shown or indicated. Modified openings shall be cut square and dressed smooth to dimensions required for installation of equipment.
- D. Disconnect and remove motors, control panels, and other electrical gear where shown or indicated. Motors, microprocessors and electronics, other electrical gear to be reused shall be stored in accordance with Section 01 66 00, Product Storage and Handling Requirements.
- E. Cables in conduits to be removed shall be removed back to the power source or control panel, unless otherwise shown or indicated. Verify the function of each cable before disconnecting and removing.
- F. Conduits, raceways, and cabling shall be removed where shown or indicated. Abandoned conduits concealed in floor, ceiling slabs, or in walls shall be cut flush with the slab or wall (as applicable) at point of entrance, suitably capped, and the area repaired in a flush, smooth manner acceptable to ENGINEER. Exposed conduits, junction boxes, other electrical appurtenances, and their supports shall be disassembled and removed. Repair all areas of the Work to prevent rusting on exposed surfaces.
- G. Lighting fixtures, wall switches, receptacles, starters, and other miscellaneous electrical equipment, not designated as remaining as OWNER's property, shall be removed and properly disposed off-Site as required.

3.6 DISPOSAL OF DEMOLITION DEBRIS

- A. Remove from the Site all debris, waste, rubbish, and material resulting from demolition operations and equipment used in demolition Work. Comply with the General Conditions, Supplementary Conditions, and Section 01 74 05, Cleaning.
- B. Transportation and Disposal:
 - 1. Non-hazardous Material: Properly transport and dispose of non-hazardous demolition debris at appropriate landfill or other suitable location, in accordance with Laws and Regulations. Non-hazardous material does not contain Asbestos, PCBs, Petroleum, Hazardous Waste, Radioactive Material, or other material designated as hazardous in Laws and Regulations.
 - 2. Hazardous Material: When handling and disposal of hazardous materials is included in the Work, properly transport and dispose of hazardous materials in accordance with the Contract Documents and Laws and Regulations.
- C. Submit to ENGINEER information required in this Section on proposed facility(ies) where demolition material will be recycled. Upon request, ENGINEER or OWNER, shall be allowed to visit recycling facility(ies) to verify adequacy and compliance

status. During such visits, recycling facility operator shall cooperate and assist ENGINEER and OWNER.

+ + END OF SECTION + +

SECTION 03 00 05

CONCRETE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete, reinforcing, and related materials.
2. The Work includes:
 - a. Providing concrete consisting of portland cement, fine and coarse aggregates, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured.
 - b. Fabricating and placing reinforcing, including ties and supports.
 - c. Design, erection, and removal of formwork.
 - d. Building into the concrete all sleeves, frames, anchorage devices, inserts, and other items required to be embedded in concrete.
 - e. Providing openings in concrete as required to accommodate Work under this and other Sections.

B. Coordination:

1. Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work.

C. Classifications of Concrete:

1. Class “A” concrete shall be steel-reinforced and includes all concrete unless otherwise shown or indicated.
2. Class “B” concrete shall be placed without forms or with simple forms, with little or no reinforcing and includes the following:
 - a. Concrete fill.
 - b. Duct banks.
 - c. Unreinforced encasements.
 - d. Curbs and gutters.
 - e. Sidewalks.
 - f. Thrust blocks.

D. Related Sections:

1. Section 05 05 33, Anchor Systems.
2. Section 07 92 00, Joint Sealants.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ACI 224R, Control of Cracking in Concrete Structures.
2. ACI 301, Specifications for Structural Concrete for Buildings.
3. ACI 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
4. ACI 305R, Specification for Hot Weather Concreting.
5. ACI 306R, Cold Weather Concreting.
6. ACI 309R, Guide for Consolidation of Concrete.
7. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
8. ACI 347, Guide to Formwork for Concrete.
9. ACI SP-66, ACI Detailing Manual.
10. ASTM A82/A82M, Specification for Steel Wire, Plain, for Concrete Reinforcement.
11. ASTM A185/A185M, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
12. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
13. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.
14. ASTM C33/C33M, Specification for Concrete Aggregates.
15. ASTM C39/C39M, Test Method for Compressive Strength of Cylindrical Concrete Specimens.
16. ASTM C42/C42M, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
16. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
17. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
18. ASTM C143/C143M, Test Method for Slump of Hydraulic-Cement Concrete.
19. ASTM C150/C150M, Specification for Portland Cement.
20. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
21. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
22. ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
23. ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
24. ASTM C494/C494M, Specification for Chemical Admixtures for Concrete.
25. ASTM C579, Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
26. ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
27. ASTM D1752, Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
28. ASTM E96/E96M, Test Methods for Water Vapor Transmission of Materials
29. ASTM E1745, Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
30. CRD-C 572, U. S. Army Corps of Engineers Specification for Polyvinylchloride Waterstops.

31. CRSI 1MSP, Manual of Standard Practice.

1.3 QUALITY ASSURANCE

A. Laboratory Trial Batch:

1. Employ independent testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.
2. Each concrete mix design specified shall be verified by laboratory trial batch, unless indicated otherwise.
3. Perform the following testing on each trial batch:
 - a. Aggregate gradation for fine and coarse aggregates.
 - b. Slump.
 - c. Air content.
 - d. Compressive strength based on three cylinders each tested at seven days and at 28 days.
4. Submit for each trial batch the following information:
 - a. Project identification name and number (if applicable).
 - b. Date of test report.
 - c. Complete identification of aggregate source of supply.
 - d. Tests of aggregates for compliance with the Contract Documents.
 - e. Scale weight of each aggregate.
 - f. Absorbed water in each aggregate.
 - g. Brand, type, and composition of cementitious materials.
 - h. Brand, type, and amount of each admixture.
 - i. Amounts of water used in trial mixes.
 - j. Proportions of each material per cubic yard.
 - k. Gross weight and yield per cubic yard of trial mixtures.
 - l. Measured slump.
 - m. Measured air content.
 - n. Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28-day test, and for each design mix.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. List of concrete materials and concrete mix designs proposed for use. Include results of tests performed to qualify the materials and to establish the mix designs. Do not start laboratory trial batch testing until this submittal is approved by ENGINEER.
 - b. Laboratory Trial Batch Reports: Submit laboratory test reports for concrete cylinders, materials, and mix design tests.
 - c. Concrete placement drawings showing the location and type of all joints.
 - d. Drawings for fabricating, bending, and placing concrete reinforcing. Comply with ACI SP-66. For walls and masonry construction, provide

elevations to a minimum scale of 1/4-inch to one foot. Show bar schedules, stirrup spacing, adhesive dowels, splice lengths, diagrams of bent bars, arrangements, and assemblies, as required for fabricating and placing concrete reinforcing.

2. Product Data:
 - a. Manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
 3. Samples:
 - a. Samples: Submit samples of materials as specified and as otherwise requested by ENGINEER, including names, sources, and descriptions.
- B. Informational Submittals: Submit the following:
1. Delivery Tickets: Copies of all delivery tickets for each load of concrete delivered to or mixed at the Site. Each delivery tickets shall contain the information in accordance with ASTM C94/C94M along with project identification name and number (if any), date, mix type, mix time, quantity and amount of water introduced.
 2. Site Quality Control Submittals:
 - a. Report of testing results for testing of field concrete cylinders for each required time period. Submit within 24 hours after completion of associated test. Test report shall include results of all testing required at time of sampling.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Transportation, Delivery, and Handling:
1. Deliver concrete reinforcing products to Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings on approved Shop Drawings.
 2. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.
 3. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
 4. Deliver grout materials from manufacturers in unopened containers that bear intact manufacturer labeling.
 5. Comply with Section 01 65 00, Product Delivery Requirements.
- B. Storage:
1. Store formwork materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective, waterproof covering. Provide for adequate air circulation or ventilation under cover.
 2. Store concrete reinforcing materials to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground. Space framework or blocking supports to prevent excessive deformation of stored materials.

3. Store concrete joint materials on platforms or in enclosures or covered to prevent contact with ground and exposure to weather and direct sunlight.
4. For storage of concrete materials, provide bins or platforms with hard, clean surfaces.
5. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type II.
- B. Aggregates: ASTM C33/C33M.
 1. Fine Aggregate: Clean, sharp, natural sand free of loam, clay, lumps, and other deleterious substances. Dune sand, bank run sand, and manufactured sand are unacceptable.
 2. Coarse Aggregate:
 - a. Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter.
 - b. Coarse aggregate shall comply with the following:
 - 1) Crushed stone, processed from natural rock or stone.
 - 2) Washed gravel, either natural or crushed. Slag, pit gravel, and bank-run gravel are not allowed.
 - c. Coarse Aggregate Size: ASTM C33/C33M, Nos. 57 or 67, unless otherwise approved by ENGINEER.
- C. Water: Clean, potable.
- D. Admixtures:
 1. Air-Entraining Admixture: ASTM C260.
 2. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 3. Water Reducing and Set-Adjusting Admixtures: ASTM C494/C494M, Types D and E.
 4. High Range Water-Reducing Admixture: ASTM C494/C494M, Type F/G.
 5. Use only admixtures that have been tested and approved in the mix designs.
 6. Do not use calcium chloride or admixtures containing chloride ions.
 7. Hydration Control Admixtures, ASTM C494, Type D may be used to extend the time of proper workability. That time period will be agreed upon at the pre-installation meeting:
 - a) Eucon DS or Stasis by The Euclid Chemical Company
 - b) MasterSet Delvo by Master Builders Solutions

2.2 CONCRETE MIX

- A. General:
 1. Normal weight: 145 pounds per cubic foot.

2. Use air-entraining admixture in all concrete. Provide not less than four percent, nor more than eight percent, entrained air for concrete exposed to freezing and thawing, and provide from three to five percent entrained air for other concrete.
- B. Proportioning and Design of Class “A” Concrete Mix:
1. Minimum compressive strength at 28 days: 4,500 psi.
 2. Maximum water-cement ratio by weight: 0.42.
 3. Minimum cement content: 564 pounds per cubic yard.
- C. Proportioning and Design of Class “B” Concrete Mix:
1. Minimum compressive strength at 28 days: 3,000 psi.
 2. Maximum water-cement ratio by weight: 0.50.
 3. Minimum cement content: 517 pounds per cubic yard.
- D. Slump Limits:
1. Proportion and design mixes to result in concrete slump at point of placement of not less than two inches and not more than four inches.
 2. When using high-range water reducers, slump prior to addition of admixture shall not exceed three inches. Slump after adding admixture shall not exceed nine inches at point of placement.
- E. Adjustment of Concrete Mixes:
1. Concrete mix design adjustments may be requested by CONTRACTOR when warranted by characteristics of materials, Site conditions, weather, test results, or other, similar circumstances.
 2. Submit for ENGINEER’s approval laboratory test data for adjusted concrete mix designs, including compressive strength test results.
 3. Implement adjusted mix designs only after ENGINEER’s approval.
 4. Adjustments to concrete mix designs shall not result in additional costs to OWNER.

2.3 FORM MATERIALS

- A. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection. CONTRACTOR shall be responsible for designing the formwork system to resist all applied loads including pressures from fluid concrete and construction loads.
- B. Smooth Form Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces in accordance with ACI 301.
- C. Unexposed Concrete Surfaces: Material to suit project conditions.
- D. Provide 3/4-inch chamfer at all external corners. Chamfer is not required at re-entrant corners unless otherwise shown or indicated.

E. Form Ties:

1. Provide factory-fabricated, removable, or snap-off metal form ties, that prevent form deflection and prevent spalling of concrete surfaces upon removal. Materials used for tying forms are subject to approval of ENGINEER.
2. Unless otherwise shown or indicated, provide ties so that portion remaining within concrete after removal of exterior parts is at least 1.5 inches from outer surface of concrete. Unless otherwise shown or indicated, provide form ties that, upon removal, will leave a uniform, circular hole not larger than one-inch diameter in the concrete surface.
3. Ties for exterior walls, below-grade walls, and walls subject to hydrostatic pressure shall be provided with waterstops.
4. Wire ties are unacceptable.

2.4 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed bars.
- B. Welded Wire Fabric: ASTM A185/A185M.
- C. Steel Wire: ASTM A82/A82M.
- D. Provide supports for reinforcing including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing in place.
1. Use wire bar-type supports complying with CRSI MSP1 recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.
 2. For slabs on grade, use precast concrete blocks, four inches square minimum with compressive strength equal to or greater than the surrounding concrete, or supports with sand plates or horizontal runners where base materials will not support chair legs.
 3. For all concrete surfaces where legs of supports are in contact with forms, provide supports having either hot-dip galvanized, plastic-protected, or stainless steel legs in accordance with CRSI MSP1.
 4. Provide precast concrete supports over waterproof membranes.
- E. Adhesive Dowels:
1. Dowels:
 - a. Dowel reinforcing bars shall comply with ASTM A615, Grade 60.
 2. Adhesive:
 - a. For requirements for adhesive, refer to Section 05 05 33, Anchor Systems.

2.5 RELATED MATERIALS

- A. Waterstops:
1. PVC Waterstops:
 - a. Manufacturers: Provide products of one of the following:

- 1) W.R. Meadows, Inc.
- 2) Greenstreak Plastic Products Company.
- 3) Or equal.
- b. Waterstops shall comply with CRD-C 572. Do not use reclaimed or scrap material.
- c. Minimum Thickness: 3/8-inch.
- d. Provide waterstops with minimum of seven ribs equally spaced at each end on each side with the first rib located at the edge. Each rib shall be minimum 1/8-inch in height.
- e. Construction Joints: Waterstops shall be six-inch wide flat-strip type.
- f. Expansion Joints: Waterstops shall be nine-inch wide centerbulb type.
2. Hydrophilic Waterstops:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Duroseal Gasket, by BBZ USA, Inc.
 - 2) Adeka Ultraseal MC-2010M, by Asahi Denka Kogyo K.K.
 - 3) Hydrotite, by Greenstreak Plastic Products Company.
 - 4) Or equal.
 - b. Hydrophilic waterstop materials shall be bentonite-free and shall expand by minimum of 80 percent of dry volume in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.
 - c. Waterstop material shall be composed of resins and polymers that absorb water and cause a completely reversible and repeatable increase in volume.
 - d. Waterstop material shall be dimensionally stable after repeated wet-dry cycles with no deterioration of swelling potential.
 - e. Select material in accordance with manufacturer's recommendations for type of liquid to be contained.
 - f. Minimum cross-sectional dimensions: 3/16-inch by 3/4-inch.
 - g. Location of hydrophilic waterstops shall be as shown or indicated on the Drawings, or where approved by ENGINEER.
- B. Membrane-Forming Curing Compound: ASTM C309, Type I.
- C. Epoxy Bonding Agent:
 1. Two-component epoxy resin bonding agent.
 2. Products and Manufacturers: Provide one of the following:
 - a. Sikadur 32, Hi-Mod LPL, by Sika Corporation.
 - b. Eucopoxy LPL, by the Euclid Chemical Company.
 - c. Or equal.
- D. Epoxy-Cement Bonding Agent:
 1. Three-component blended epoxy resin-cement bonding agent.
 2. Products and Manufacturers: Provide one of the following:
 - a. Sika Armatec 110 EpoCem, by Sika Corporation.
 - b. Duralprep A.C., by Euclid Chemical Company.
 - c. Or equal.

- E. Preformed Expansion Joint Filler:
 - 1. Provide preformed expansion joint filler complying with ASTM D1752, Type I (sponge rubber) or Type II (cork).
- F. Joint Sealant and Accessories:
 - 1. For joint sealants and accessories used on isolation joints, control joints, and expansion joints, refer to Section 07 92 00, Joint Sealants.

2.6 GROUT

- A. Non-shrink Grout:
 - 1. Pre-packaged, non-metallic, cementitious grout requiring only the addition of water at the Site.
 - 2. Minimum 28-day Compressive Strength: 7,000 psi.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. NS Grout by Euclid Chemical Company.
 - b. Set Grout by Master Builders, Inc.
 - c. NBEC Grout by Five Star Products, Inc.
 - d. Or equal.
- B. Epoxy Grout:
 - 1. Pre-packaged, non-shrink, non-metallic, 100 percent solids, solvent-free, moisture-insensitive, three-component epoxy grouting system.
 - 2. Minimum Seven-day Compressive Strength: 14,000 psi, when tested in accordance with ASTM C579.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. Euco High Strength Grout, by Euclid Chemical Company.
 - b. Sikadur 42, Grout Pak, by Sika Corporation.
 - c. Five Star Epoxy Grout, by Five Star Products, Inc.
 - d. Or equal.
- C. Grout Fill:
 - 1. Grout mix shall consist of cement, fine and coarse aggregates, water, and admixtures complying with requirements specified in this Section for similar materials in concrete.
 - 2. Proportion and mix grout fill as follows:
 - a. Minimum Cement Content: 564 pounds per cubic yard.
 - b. Maximum Water-Cement Ratio: 0.45.
 - c. Maximum Coarse Aggregate size: 1/2-inch, unless otherwise indicated.
 - d. Minimum 28-day Compressive Strength: 4,000 psi.

PART 3 – EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the substrate and the conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory

conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 FORMWORK

- A. Construct formwork in accordance with ACI 347 such that concrete members and structures are of correct size, shape, alignment, elevation, and position.
- B. Provide openings in formwork to accommodate the Work of other trades. Accurately place and securely support items required to be built into formwork.
- C. Clean and adjust forms prior to placing concrete. Apply form release agents or wet forms as required. Re-tighten forms during and after concrete placing, when required, to eliminate cement paste leaks.
- D. Removing Formwork:
 - 1. Comply with ACI 301 and ACI 347, except as otherwise indicated in the Contract Documents.
 - 2. Do not remove formwork and shoring until supported concrete members have acquired minimum of 90 percent of specified compressive strength. Results of suitable quality control tests of field-cured specimens may be submitted to ENGINEER for review as evidence that concrete has attained sufficient strength for removal of supporting formwork and shoring prior to removal times indicated in the Contract Documents.
 - 3. Removal time for formwork is subject to ENGINEER's acceptance.
 - 4. Repair form tie-holes following in accordance with ACI 301.

3.3 REINFORCING, JOINTS, AND EMBEDDED ITEMS

- A. Comply with the applicable recommendations of Laws and Regulations and standards referenced in this Section, including CRSI MSP1, for details and methods of placing and supporting reinforcing.
- B. Clean reinforcing to remove loose rust and mill scale, earth, ice, and other materials which act to reduce or destroy bond between reinforcing material and concrete.
- C. Position, support, and secure reinforcing against displacement during formwork construction and concrete placing. Locate and support reinforcing by means of metal chairs, runners, bolsters, spacers, and hangers, as required.
 - 1. Place reinforcing to obtain minimum concrete coverages as shown on the Drawings and as required in ACI 318. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcing accurately in position during concrete placing. Set with ties so that twisted ends are directed away from exposed concrete surfaces.
 - 2. Do not secure reinforcing to formwork using wire, nails or other ferrous metal. Metal supports subject to corrosion shall not be in contact with formed or exposed concrete surfaces.

- D. Provide sufficient quantity of supports of strength required to carry reinforcing. Do not place reinforcing more than two inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- E. Splices: Provide standard reinforcing splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown or indicated for minimum lap of spliced bars, in accordance with the requirements of ACI 318.
- F. Install welded wire fabric in lengths as long as practical, lapping adjoining sections a minimum of one full mesh.
- G. Do not place concrete until reinforcing is inspected and ENGINEER indicates that conditions are acceptable for placing concrete. Concrete placed in violation of this paragraph will be rejected. Notify ENGINEER in writing at least two working days prior to proposed concrete placement.
- H. Construction Joints:
 - 1. Comply with requirements of ACI 301 and the Contract Documents.
 - 2. Locate and install construction joints as shown or indicated on the Drawings. Where not shown or indicated, locate joints to not impair strength of the structure; position joints at points of minimum shear. Location of joints shall be approved by ENGINEER. In addition to joints shown or indicated on the Drawings, locate construction joints as follows:
 - a. In foundation mats, locate joints at spacing of approximately 40 feet. Joints shall be located within middle third of element span, unless otherwise shown or indicated on the Drawings. Element span shall be considered distance between piles or, as determined by ENGINEER, distance between bearing elements, such as columns, exterior walls and interior walls. Place concrete in strip pattern, unless otherwise shown or indicated on the Drawings.
 - b. In walls, locate joints at a maximum spacing of 40 feet. Locate joints away from wall intersections a minimum of one-quarter of the clear span distance between wall intersections measured horizontally.
 - c. In structural slabs and beams, joints shall be located within middle third of element span and shall be located in compliance with ACI 301, unless otherwise shown or indicated on the Drawings.
 - d. In slabs on grade, locate joints at spacing of approximately 40 feet. Place concrete in strip pattern, unless otherwise shown or indicated on the Drawings.
 - 3. Horizontal Joints:
 - a. Roughen concrete at interface of construction joints by abrasive blasting, hydroblasting, or using surface retardants and water jets to expose aggregate and remove accumulated concrete on projecting rebar immediately subsequent to form stripping, unless otherwise approved by ENGINEER. Immediately before placing fresh concrete, thoroughly clean existing contact surface using stiff brush or other tools and stream of pressurized water. Surface shall be clean and wet, and free from

- pools of water at time of placing fresh concrete.
 - b. Remove laitance, waste mortar, and other substances that may prevent complete adhesion. Where joint roughening was performed more than seven days prior to concrete placing or where dirt or other bond reducing contaminants are on surface, perform additional light abrasive blasting or hydroblasting to remove laitance and all bond-reducing materials just prior to concrete placement.
 - 4. Vertical Joints:
 - a. Apply roughener to the form in thin, even film by brush, spray, or roller in accordance with manufacturer's instructions. After roughener is dry, concrete may be placed.
 - b. When concrete has been placed, remove joint surface forms as early as necessary to allow for removal of surface retarded concrete. Forms covering member surfaces shall remain in place. Wash loosened material off with high-pressure water spray to obtain roughened surface subject to approval by ENGINEER. Alternately, surface shall be roughened by abrasive blasting or hydroblasting to expose aggregate. Outer one-inch of each side of joint face shall be masked and protected from blasting to avoid damaging member surface.
 - 5. Where construction joints are indicated to be roughened, intentionally roughen surfaces of previously-placed concrete to amplitude of 1/4-inch.
- I. Expansion Joints:
- 1. Comply with requirements of ACI 301 and the Contract Documents.
 - 2. Locate and install expansion joints as shown and indicated in the Contract Documents. Install joint filler in accordance with manufacturer's instructions. Install sealants as specified in this Section.
- J. Control Joints:
- 1. Provide control joints in non-water bearing slabs on grade as shown or indicated on the Drawings. Where control joints are not shown or indicated on the Drawings, space control joints at 24 to 36 times thickness of slab in both directions. Locate control joints only at places approved by ENGINEER.
 - 2. A groove, with depth of at least 25 percent of the member thickness, shall be tooled, formed, or saw-cut in concrete. Groove shall be filled with joint sealant material in accordance with Section 07 92 00, Joint Sealants.
 - 3. Where control joint is formed by sawcutting, make sawcut in presence of ENGINEER immediately after concrete has set sufficiently to support the saw and be cut without damage to concrete. Keep concrete continually moist during cutting. Joints shall be approximately 1/8-inch wide.
 - 4. Control joints may be formed with tool or by inserting joint forming strip. After concrete has achieved design strength, remove upper portion of joint forming strip and fill void with sealant.
- K. Isolation Joints:
- 1. Provide isolation joint where sidewalk or other slab on grade abuts a concrete structure and slab on grade is not shown doveled into that structure. Form

isolation joint by 1/2-inch joint filler with upper 1/2-inch of joint filled with sealant.

- L. Installation of Embedded Items: Set and build into the Work anchorage devices and embedded items required for other Work that is attached to, or supported by, cast-in-place concrete. Use setting diagrams, templates, and instructions provided under other Sections and, when applicable, for locating and setting. Refer to Paragraph 1.1.B of this Section. Do not embed in concrete uncoated aluminum items. Where aluminum items are in contact with concrete surfaces, coat aluminum to prevent direct contact with concrete.
- M. Adhesive Dowels:
1. Adhesive dowels shall be reinforcing bar dowels set in an adhesive in hole drilled into hardened concrete. Comply with adhesive system manufacturer's installation instructions regarding hole diameter, drilling method, embedment depth required to fully develop required tensile strength, and hole cleaning and preparation instructions. Unless more-stringent standards are required by adhesive system manufacturer, comply with the following.
 2. Drill holes to adhesive system manufacturer's recommended diameter and depth to develop required tensile strength. Where indicated on the drawings, hole depths greater than required for tensile development shall be provided. Hammer-drill holes. Cored holes are not allowed.
 3. Embedment depths shall be based on concrete compressive strength of 4,000 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.
 4. Determine location of existing reinforcing steel in vicinity of proposed holes prior to drilling. Adjust location of holes to be drilled to avoid drilling through or damaging existing reinforcing bars only when approved by ENGINEER.
 5. Before setting adhesive dowel, hole shall be free of dust and debris using method recommended by adhesive system manufacturer. Hole shall be brushed, with manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
 6. Inject adhesive into hole through injection system mixing nozzle and necessary extension tubes, placed to bottom of hole. Withdraw discharge end as adhesive is placed, but keep end of tube immersed to prevent forming air pockets. Fill hole to depth that ensures that excess material is expelled from hole during dowel placement.
 7. Twist dowels during insertion into partially-filled hole to guarantee full wetting of bar surface with adhesive. Insert bar slowly to avoid developing air pockets.

3.4 CONCRETE PLACING

- A. Site Mixing: Use drum-type batch machine mixer, mixing not less than 1.5 minutes for one cubic yard or smaller capacity. Increase required mixing time by minimum of 15 seconds for each additional cubic yard or fraction thereof.

- B. Ready-Mixed Concrete: Comply with ASTM C94/C94M.
- C. Concrete Placing:
 - 1. Place concrete in a continuous operation within planned joints or sections in accordance with ACI 304R.
 - 2. Do not begin placing concrete until work of other trades affecting concrete is completed.
 - 3. Wet concrete and subgrade surfaces to saturated surface dry condition immediately prior to placing concrete.
 - 4. Deposit concrete as near its final location as practical to avoid segregation due to re-handling or flowing.
 - 5. Avoid separation of the concrete mixture during transportation and placing. Concrete shall not free-fall for distance greater than four feet during placing.
 - 6. Complete concrete placing within 90 minutes of addition of water to the dry ingredients. The use of hydration control admixtures can extend this time period. Approval from the ENGINEER is required.
- D. Consolidate placed concrete in accordance with ACI 309R using mechanical vibrating equipment supplemented with hand rodding and tamping, such that concrete is worked around placing and other embedded items and into all parts of formwork. Insert and withdraw vibrators vertically at uniformly-spaced locations. Do not use vibrators to transport concrete within the formwork. Vibration of formwork or placing is not allowed.
- E. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing.
 - 1. In hot weather comply with ACI 305R.
 - 2. In cold weather comply with ACI 306R.

3.5 QUALITY OF CONCRETE WORK

- A. Make concrete solid, compact, smooth, and free of laitance, cracks, and cold joints.
- B. Concrete for liquid-retaining structures and concrete in contact with earth, water, or exposed directly to the elements shall be watertight.
- C. Cut out and properly replace to extent directed by ENGINEER, or repair to satisfaction of ENGINEER, surfaces that contain cracks or voids, are unduly rough, or are in defective in any way. Patches or plastering are unacceptable.
- D. Repair, removal and replacement of defective concrete directed by ENGINEER shall be at no additional cost to OWNER.

3.6 CURING

- A. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue

curing by using moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until formwork is removed. Provide protection, as required, to prevent damage to exposed concrete surfaces. Total curing period shall not be less than seven days. Curing methods and materials shall be compatible with scheduled finishes.

3.7 FINISHING

A. Slab Finish:

1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently. Use a wood float only. Check and level surface plane to a tolerance not exceeding 1/4-inch in ten feet when tested with a ten foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float the surface to a uniform, smooth, granular texture. Slab surfaces shall receive a float finish. Provide additional trowel finishing as required in this Section.
2. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over the surface.
3. Consolidate concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten-foot straightedge. Grind smooth surface defects that would telegraph through applied floor covering system.
4. Use trowel finish for the following:
 - a. Interior exposed slabs, unless otherwise shown or indicated.
 - b. Apply non-slip broom finish, after troweling, to exterior concrete slab and elsewhere as shown.

B. Apply liquid sealer/densifier to exposed interior concrete floor areas when cured and dry, in accordance with manufacturer's instructions.

C. Formed Finish:

1. Provide smooth form concrete finish at exposed surfaces. Use largest practical form panel sizes to minimize form joints. Exposed surfaces include interior water-contacting surfaces of tanks, whether or not directly visible. All surfaces shall be considered as exposed, unless buried or covered with permanent structural or architectural material. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/8-inch in height. Where surface will be coated or will receive further treatment, remove all fins flush with concrete surface.
2. Provide rough form finish at all unexposed surfaces. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/2-inch in height.

3.8 GROUT PLACING

- A. Place grout as shown and indicated, and in accordance with grout manufacturer's instructions and recommendations. If grout manufacturer's instructions conflict with the Contract Documents, notify ENGINEER and not proceed until obtaining ENGINEER's clarification.
- B. Dry-packing is not allowed, unless otherwise indicated.
- C. Manufacturers of proprietary grout materials shall make available upon 72 hours notice the services of qualified, full-time, factory-trained employee to aid in ensuring proper use of grout materials at the Site.
- D. Placing grout shall comply with temperature and weather limitations described in Article 3.4 of this Section.

3.9 FIELD QUALITY CONTROL

- A. Site Testing Services:
 - 1. CONTRACTOR shall employ independent testing laboratory to perform field quality control testing for concrete. ENGINEER will direct where samples are obtained.
 - 2. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.
- B. Quality Control Testing During Construction:
 - 1. Perform sampling and testing for field quality control during concrete placing, as follows:
 - a. Sampling Fresh Concrete: ASTM C172.
 - b. Slump: ASTM C143/C143M; one test for each concrete load at point of discharge.
 - c. Concrete Temperature: ASTM C1064/C1064M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.
 - d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.
 - e. Unit Weight: ASTM C138/C138M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
 - f. Compression Test Specimens:
 - 1) In accordance with ASTM C31/C31M, make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by ENGINEER.
 - 2) Cast, store, and cure specimens in accordance with ASTM C31/C31M.
 - g. Compressive Strength Tests:

- 1) In accordance with ASTM C39/C39M; one specimen tested at seven days, and three specimens tested at 28 days.
 - 2) Concrete that does not comply with strength requirements will be considered as defective Work.
- h. Submit test results from certified by testing laboratory to ENGINEER within 24 hours of completion of test.
 - i. When there is evidence that strength of in-place concrete does not comply with the Contract Documents, CONTRACTOR shall employ the services of concrete testing laboratory to obtain cores from hardened concrete for compressive strength determination. Cores and tests shall comply with ASTM C42/C42M and the following:
 - 1) Obtain at least three representative cores from each concrete member or suspect area of concrete at locations directed by ENGINEER.
 - 2) Strength of concrete for each series of cores will be acceptable if average compressive strength is at least 85 percent of specified compressive strength and no single core is less than 75 percent of required 28-day required concrete compressive strength.
 - 3) Testing laboratory shall submit test results to ENGINEER on same day that tests are completed. Include in test reports Project name and number (if any), date of sampling and testing, CONTRACTOR name, name of concrete testing laboratory, exact location of test core in the Work, type or class of concrete represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength, and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plane of concrete as placed, and moisture condition of the core at time of testing.
 - j. Fill core holes solid with non-shrink grout in accordance with this Section and finish to match adjacent concrete surfaces.
 - k. If results of core tests are unacceptable or if it is impractical to obtain cores, perform static load test and evaluations complying with ACI 318 and ACI 350, as directed by ENGINEER.
2. CONTRACTOR Will employ testing laboratory to perform field quality testing of adhesive dowels at the Site.
 - a. Testing shall comply with ASTM E488.
 - b. After adhesive system manufacturer's recommended curing period and prior to placing connecting reinforcing, proof-test for pullout ten percent of adhesive dowels installed. If one or more dowels fail the test, CONTRACTOR shall pay cost to test all dowels of same diameter and type installed on the same day as the failed dowel.
 - c. Test dowels to 60 percent of specified yield strength. ENGINEER will direct which dowels are to be tested.
 - d. Apply test loads with hydraulic ram.
 - e. Displacement of dowels shall not exceed $D/10$, where D is nominal diameter of dowel.

- f. Dowels that fail shall be reinstalled and retested at CONTRACTOR's expense.

+ + END OF SECTION + +

SECTION 03 01 30

REPAIR AND REHABILITATION OF CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to repair or rehabilitate, as required, all existing concrete shown or indicated in the Contract Documents as being repaired or rehabilitated.
2. CONTRACTOR shall repair all damage to new concrete construction as specified in this Section except for repair Work specified in Section 03 00 05, Concrete.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the Work that must be installed with or before repair and rehabilitation of concrete.
2. Notify other contractors in advance of repair and rehabilitation of concrete Work to provide them with sufficient time for installing and coordinating items included in their contracts that must be installed in conjunction with repair and rehabilitation of concrete Work.

C. Related Sections:

1. Section 03 00 05, Concrete.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
2. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
3. ASTM D1042, Test Method for Linear Dimensional Changes of Plastics Under Accelerated Service Conditions.
4. ASTM D3574, Test Methods for Flexible Cellular Materials – Slab, Bonded, and Molded Urethane Foams.
5. ASTM G109, Test Method for Determining the Effects of Chemical Admixtures on the Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Product Data: Information on all products proposed for use, including manufacturer's brochures, technical data, specifications, and other applicable data.
- B. Informational Submittals: Submit the following:
 - 1. Manufacturer's Instructions: Manufacturer's recommended procedures for installing materials proposed for use.
 - 2. Site Quality Control Submittals: Results of specified Site quality control testing.
 - 3. Special Procedure Submittals: When requested by ENGINEER, submit information on methods for supporting during demolition and repair Work existing structures, pipes, and other existing facilities affected by the Work.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling of Materials:
 - 1. Conform to Section 01 65 00, Product Delivery Requirements, and this Section.
 - 2. Clearly mark on containers manufacturer's name and label, name or title of material, manufacturer's stock number, and date of manufacture.
 - 3. Handle materials carefully to prevent inclusion of foreign matter.
 - 4. Do not open containers or mix components until necessary preparatory Work has been completed and application Work is to start immediately.
- B. Storage of Materials:
 - 1. Conform to Section 01 66 00, Product Storage and Handling Requirements, and this Section.
 - 2. Store only approved materials at the Site.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. All repair and rehabilitation materials that can or will come into contact with potable water or that will be treated to become potable shall be listed in ANSI/NSF 61.

2.2 REPAIR MORTAR

- A. Product Description: Repair mortar shall be prepackaged, cement-based product specifically formulated for repairing concrete surface defects.
- B. Products and Manufacturers: Provide one of the following:
 - 1. SikaTop 122 Plus, SikaTop 123 Plus, or SikaTop 126 Plus, by Sika Corporation.
 - 2. DuralTop Gel, DuralTop Flowable Mortar by Euclid Chemical Company.

3. Or equal.

C. Materials:

1. Provide a two-component, polymer-modified, Portland cement, fast-setting, trowel-grade mortar. Repair mortar shall be enhanced with penetrating corrosion inhibitor, and shall have the following properties:

Physical Property	Value	ASTM Standard
Minimum Compressive Strength at One Day	2,000 psi	C109
Minimum Compressive Strength at 28 Days	6,000 psi	C109
Minimum Bond Strength at 28 Days	1,800 psi	C882*
* Modified for use with repair mortars.		

2. Where the least dimension of the placement in width or thickness exceeds four inches, extend repair mortar by adding aggregate as recommended by repair mortar manufacturer.

2.3 EXPANSION JOINT REPAIR SYSTEM

A. System Description: Joint repair system shall consist of two components: an epoxy resin adhesive and hypalon sheeting.

B. Products and Manufacturers: Provide one of the following:

1. Sikadur Combiflex, by Sika Corporation.
2. Or equal.

C. Materials:

1. Epoxy Resin Adhesive: Provide two-component epoxy resin as follows:
 - a. Component "A" shall be modified epoxy resin of epichlorohydrin bisphenol-A type containing suitable viscosity control agents and pigments. Resin shall not contain butyl glycidyl ether.
 - b. Component "B" shall be primarily a reaction product of selected amine blend with epoxy resin of epichlorohydrin bisphenol-A type containing suitable viscosity control agents, pigments, and accelerators.
2. Hypalon Sheeting:
 - a. Provide sheeting of hypalon rubber, perforated along bonding edge to provide mechanical key. Sheeting shall have ability to be vulcanized with hydrocarbon solvent for adhesion to an epoxy resin adhesive.
 - b. Provide sheeting in 12-inch width with thickness of 40 mils.
 - c. Sheeting shall be able to be lapped or seamed by heat or by anaromatic hydrosolvent strip.
 - d. Provide sheeting with removable center expansion strip.

2.4 REPAIR OF EXPOSED REINFORCING STEEL

- A. System Description: System for repair of exposed reinforcing steel shall consist of two components: an initial application of corrosion inhibitor and subsequent application of protective slurry mortar.
- B. Corrosion Inhibitor:
 - 1. Corrosion inhibitor shall penetrate the hardened concrete surface and form a protective layer on reinforcing steel.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sika FerroGard 903, by Sika Corporation.
 - b. Or equal.
 - 3. Corrosion inhibitor shall:
 - a. Not change the substrate's color, appearance, or texture.
 - b. Penetrate independently of orientation (horizontal, vertical, overhead) at rate up to 1/10 to 4/5 inches per day, depending on density of concrete, measured using secondary neutron mass spectroscopy.
 - c. Form on reinforcing steel a protective layer of high integrity of at least 100 angstroms thickness, measured using x-ray photon spectroscopy and secondary ion mass spectroscopy.
 - d. Demonstrate reduction in corrosion currents after treatment as determined using cracked beam corrosion tests of concrete, as adapted from ASTM G109.
 - e. Be capable of reducing active corrosion rates by at least 65 percent. Reduction shall be demonstrated by project references and an independent corrosion engineer using linear polarization resistance.
 - f. Penetrate up to three inches in 28 days, measured using secondary neutron mass spectroscopy.
- C. Protective Slurry Mortar:
 - 1. Material shall be two-component, polymer-modified, cementitious waterproofing and protective slurry mortar. Provide two coats at coverage of 50 square feet per gallon per coat.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sikatop Seal 107, by Sika Corporation.
 - b. Or equal.

2.5 CRACK INJECTION MATERIALS

- A. Structural Crack Repair System:
 - 1. Epoxy for injection shall be low-viscosity, high-modulus moisture insensitive type.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sikadur 35, Hi-Mod L.V. and Sikadur 31, Hi-Mod Gel, by Sika Corporation.
 - b. Eucopoxy Injection Resin, by Euclid Chemical Company.
 - c. Or equal.

- B. Non-structural Crack Repair System:
1. Hydrophobic Polyurethane Chemical Grout:
 - a. Provide hydrophobic polyurethane that forms a flexible gasket.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) SikaFix HH LV, by Sika Chemical Company.
 - 2) Hydro Active Flex SLV, by De Neef Construction Chemicals, Inc.
 - 3) Or equal.
 - c. Shrinkage limit shall not exceed 4.0 percent in accordance with ASTM D1042.
 - d. Minimum elongation of 250 percent in accordance with ASTM D3574.
 - e. Minimum tensile strength of 150 psi in accordance with ASTM D3574.
 2. Hydrophilic Acrylate-Ester Resin:
 - a. Hydrophilic crack repair system shall be acrylate-ester resin that forms a flexible gasket and increase in volume by at least 50 percent when in contact with water.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Duroseal Multigel 850, manufactured by BBZ USA, Inc.
 - 2) Superflex AR, by De Neef Construction Chemicals, Inc.”
 - 3) Or equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which the repair Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation:
1. Initial Surface Preparation: Remove by chipping, abrasive blasting, or hydro blasting all laitance, foreign material, and unsound concrete from entire area to be repaired. Further roughen surface as specified in this Section. Where non-shrink grout or repair mortar is used, perform additional surface preparation, if any, recommended by product manufacturer.
 2. Wetting Procedure: Where repair concrete, shotcrete, or cement grout is used, and bonding agent is not required, or where repair mortar or non-shrink grout manufacturer recommends wet or saturated surface, perform the following:
 - a. Continuously apply water for at least four hours to surface being repaired. Where large surface areas are to be repaired, use fog-spray nozzles, mounted on stands, in sufficient number so that entire surface to be repaired is contacted by fog spray cloud.
 - b. Prevent concrete from drying until after repair is completed. Re-wet surfaces not yet repaired using water sprays at least a daily; should more

- than four days elapse without re-wetting surfaces not yet repaired, repeat the original saturating procedure.
- c. Remove standing water in areas to be repaired before placing repair material. Provide means to remove excess water from structure.
3. Preparation for Epoxy Bonding Agent: Where repair material manufacturer recommends use of epoxy-bonding agent, conform to recommendations of both repair material manufacturer and bonding agent manufacturer.

3.3 INSTALLATION, GENERAL

- A. Construction Tolerances: Shall be as specified in Section 03 00 05, Concrete, except as specified in this Section and elsewhere in the Contract Documents.
- B. Care shall be taken to fully consolidate repair material, completely filling all portions of space to be filled.
- C. Bring surface being repaired into alignment with adjacent surfaces, providing uniform, even surface. Surface repaired shall match adjacent existing surfaces in texture and shall receive coatings or surface treatments, if any, provided for the existing surface adjacent to repaired surface.
- D. Curing:
 1. Curing of repair mortar and non-shrink grout shall be in accordance with manufacturer's recommendations, except that minimum cure period shall be three days.
 2. Curing of other materials shall be in accordance with requirements of Section 03 00 05, Concrete.

3.4 REPAIR OF SURFACE DEFECTS

- A. Surface defects are depressions in a concrete surface that do not extend all the way through the concrete. Surface defects can result from removal of an embedded item, removal of an intersecting concrete member, physical damage, or unrepaired rock pockets created during original placement. For spalls that result from corroded reinforcing steel or other embedment refer to Article 3.7 of this Section.
- B. Preparation: Perform the following in addition to requirements of Article 3.2 of this Section:
 1. Remove by chipping all loose, damaged concrete to sound material.
 2. Where existing reinforcing is exposed, remove concrete to minimum of one-inch around exposed bars. If existing bars are cut through, cracked, or cross sectional area is reduced by more than 25 percent from original, immediately notify ENGINEER.
 3. Score-cut perimeter of area to be repaired to minimum depth of 1/2-inch and maximum depth that will not cut existing reinforcing steel. Chip out existing concrete to the score line so that minimum thickness of repair mortar will be 1/2-inch.

C. Repair Material:

1. Completely fill the surface defect with specified repair material, in accordance with material manufacturer's instructions and the Contract Documents.
2. Perform, with repair mortar, repairs of surface defects in concrete normally in contact with water or soil, and interior surfaces of structures that contain water.
3. Repair of other surface defects may be by applying repair mortar, repair concrete, shotcrete, or cement grout, as appropriate.

3.5 REPAIR OF DETERIORATED CONCRETE

A. This Article pertains to deteriorated concrete which has been damaged due to corrosion of reinforcing steel, physical damage due to abrasion, or damage due to chemical attack. Use repair mortar, as specified in this Article, for repairing deteriorated concrete. Where repaired surface will be subsequently covered with plastic liner material, coordinate finishing with requirements for installing plastic liner material.

B. Surface Preparation: In addition to requirements of Article 3.2 of this Section, perform the following surface preparation:

1. Remove loose, broken, softened, and acid-contaminated concrete by abrasive blasting and chipping to sound, uncontaminated concrete.
2. Upon completion of removal of deteriorated concrete, notify ENGINEER in writing. Allow two weeks for ENGINEER to evaluate the surface, perform testing for acid contamination if required, determine if additional concrete shall be removed, and to develop special repair details (if any) required. Should ENGINEER determine that additional concrete be removed to reach sound, uncontaminated concrete, allow another two-week period for further evaluation and testing following the additional removal.
3. Surface preparation shall conform to recommendations of repair mortar manufacturer.
4. Repair and rehabilitate isolated areas of exposed reinforcing bars in accordance with Article 3.4 of this Section. If extensive areas of reinforcing steel are uncovered after removal of deteriorated concrete, ENGINEER will determine the repair methods required.

C. Repair Mortar Placing:

1. Conform to manufacturer's recommended procedures for mixing and placing repair mortar.
2. After initial mixing of repair mortar, addition of water is not allowed.
3. Minimum Thickness:
 - a. Install repair mortar to not less than minimum thickness recommended by manufacturer, and not less than 1/2-inch.
 - b. Where removal of deteriorated concrete results in repair thickness of less than minimum required thickness to return to original concrete surface in isolated areas totaling less than ten percent of total repair surface area, remove additional concrete to obtain at least the required minimum thickness.

- c. Where surface area with repair thickness less than minimum required thickness exceeds ten percent of total repair area, notify ENGINEER.
 - d. Provide repair mortar so that minimum cover over existing reinforcing steel is two inches. Do not place repair mortar creating locally raised areas.
 - e. Where transitioning to or from wall surfaces not requiring repair, do not feather-out repair mortar at transition. Instead, form the transition by saw cutting a score line to not less than minimum required repair mortar depth and chip out concrete to the saw cut line. Do not cut or otherwise damage reinforcing steel.
4. Place repair mortar to an even, uniform plane to restore concrete member to its original surface. Out-of-plane tolerance shall be such that the gap between 12-inch long straight edge and repair mortar surface does not exceed 1/8-inch, and gap between a four-foot long straight edge and repair mortar surface shall not exceed 1/4-inch. Tolerances specified in this paragraph apply to straight edges placed in any orientation at any location.

D. Finishing:

- 1. Provide smooth, steel trowel finish to repair mortar.
- 2. When completed, there shall be no sharp edges. Provide exterior corners, such as at penetrations, one-inch radius. Interior corners shall be square, except corners to receive plastic lining which shall be made with two-inch fillet in repair mortar.

3.6 REPAIR OF EXPANSION JOINTS

- A. Surface Preparation: Remove the following from surfaces to be repaired: laitance, foreign material, and unsound concrete. Remove by chipping, abrasive blasting, or hydro blasting. Additional surface preparation, if required, shall be as recommended by expansion joint repair system manufacturer.
- B. Installation: Installation shall be as recommended by expansion joint repair system manufacturer.

3.7 REPAIR OF EXPOSED REINFORCING

- A. Remove, by abrasive blasting or hydro blasting, all corrosion, foreign materials, and unsound concrete from area to be repaired.
- B. Surface shall be visually dry before applying corrosion inhibitor. Liberally apply corrosion inhibitor to achieve coverage of 100 square feet per gallon in two or more coats, by allowing corrosion inhibitor to soak into substrate. Time between coats shall be the longer of: one hour, or as recommended by corrosion inhibitor manufacturer. Apply using rollers, brushes, or hand-pressure spray equipment.
- C. After applying final coat of corrosion inhibitor, minimum cure time of 24 hours is required.
- D. Provide high-pressure wash to surfaces to be repaired to remove filmy residue from corrosion inhibitor.

- E. For mortar coating, conform to Paragraphs 3.5.B, 3.5.C, 3.5.D of this Section.

3.8 CRACK INJECTION

- A. Examine areas under which injection Work will be installed and locate cracks that require injection. Identify and inject cracks greater than 0.010-inch wide in structures that retain or contain water, wastewater, or similar liquid.
- B. Install injection material in accordance with crack injection manufacturer's requirements.
- C. If proper penetration of crack cannot be achieved, submit to ENGINEER a proposed alternate approach for modifying the specified injection procedure to properly seal the crack. In new concrete and in concrete cracked as a result of CONTRACTOR's operations, perform modifications to crack injection procedure and fully repair the crack without additional cost to OWNER or extension of the Contract Times.

3.9 SITE QUALITY CONTROL

- A. CONTRACTOR will employ and pay for services of testing laboratory for Site quality control testing. ENGINEER will direct the number of tests and specimens required, including providing necessary materials for making and facility for storing test specimens. CONTRACTOR shall make standard compression test specimens as specified in this Section under the observation of ENGINEER. CONTRACTOR shall provide:
 - 1. Necessary assistance required by ENGINEER.
 - 2. All labor, material, and equipment required, including rods, molds, thermometer, curing in heated storage box, and all other incidentals required, subject to approval by ENGINEER.
 - 3. All necessary storage, curing, and transportation required for testing.
 - 4. CONTRACTOR will be charged for cost of additional testing and investigation, if any, for Work performed that is not in accordance with the Contract Documents or is otherwise defective.
- B. Site Tests of Cement-based Grouts and Repair Mortar:
 - 1. Obtain compression test specimens during construction from first placement of each type of mortar or grout, and at intervals thereafter as selected by ENGINEER, to verify compliance with the Contract Documents. Specimens will be made by ENGINEER or ENGINEER's representative.
 - 2. Compression tests and fabrication of specimens for repair mortar and non-shrink grout will be performed in accordance with ASTM C109. Set of three specimens will be made for each test. Tests will be made at seven days, 28 days, and additional time periods as deemed appropriate by ENGINEER.
 - 3. Material, already placed, failing to conform to the Contract Documents, is defective.

- C. Repair Concrete: Repair concrete shall be tested as required in Section 03 00 05, Concrete.

++ END OF SECTION ++

SECTION 04 01 21

MASONRY RESTORATION AND CLEANING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install masonry restoration and cleaning.
2. Extent of masonry restoration and cleaning is shown.
3. Types of restoration and cleaning required include the following:
 - a. Repairing unit masonry, including replacing units.
 - b. Painting steel uncovered during the work.
 - c. Reanchoring veneers.
 - d. Repointing joints.
 - e. Replacing steel lintels.
 - f. Replacing sealants.
 - g. Installing and replacing flashing.
 - h. Cleaning exposed unit masonry surfaces.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the masonry restoration and cleaning Work.
2. Notify other contractors in advance of the installation of the hollow metal doors and cleaning to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the masonry restoration and frames Work.

C. Related Sections:

1. Section 04 05 05, Unit Masonry Construction.
2. Section 04 05 11, Masonry Mortaring and Grouting.
3. Section 04 05 19, Masonry Anchorage and Reinforcing.
4. Section 04 21 13, Brick Masonry.
5. Section 05 50 13, Miscellaneous Metal Fabrications.
6. Section 07 19 16, Silane Water Repellents.
7. Section 07 62 00, Sheet Metal Flashing and Trim.
8. Section 07 92 00, Joint Sealants.

1.2 REFERENCES

A. References below:

1. ASTM C 5: Specification for Quicklime for Structural Purposes.
2. ASTM A36/A36M: Specification for Carbon Structural Steel.
3. ASTM C 62: Specification for Building Brick (Solid Masonry Units Made from Clay or Shale).

4. ASTM C 67: Test Methods for Sampling and Testing Brick and Structural Clay Tile.
5. ASTM C 144: Specification for Aggregate for Masonry Mortar.
6. ASTM C 150: Specification for Portland Cement.
7. ASTM C 207: Specification for Hydrated Lime for Masonry Purposes.
8. ASTM C 216: Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
9. ASTM C 270: Specification for Mortar for Unit Masonry
10. ASTM C 295: Guide for Petrographic Examination of Aggregates for Concrete.
11. ASTM C 1330: Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
12. ASTM C 1489: Specification for Lime Putty for Structural Purposes.
13. BIA, The Brick Industry Association. Technical Notes on Brick Construction
14. 40 CFR 59, Subpart D: National Volatile Organic Compound Emission Standards for Architectural Coatings.
15. The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings.
16. SSPC-Paint 20: Paint Specification No. 20: Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic).
17. SSPC-Paint 29: Paint Specification No. 29: Zinc Dust Sacrificial Primer, Performance-Based.
18. SSPC-SP 2: Surface Preparation Specification No. 2: Hand Tool Cleaning.
19. SSPC-SP 3: Surface Preparation Specification No. 3: Power Tool Cleaning.
20. SSPC-SP 6/NACE No. 3: Joint Surface Preparation Standard SSPC-SP 6/NACE No. 3: Commercial Blast Cleaning.

1.3 DEFINITIONS

- A. Very Low-Pressure Spray: Under 100 psi.
- B. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.
- C. Medium-Pressure Spray: 400 to 800 psi; 4 to 6 gpm.
- D. High-Pressure Spray: 800 to 1200 psi; 4 to 6 gpm.
- E. Saturation Coefficient (CB Ratio): Ratio of the weight of water absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of masonry units to freezing and thawing.

1.4 QUALITY ASSURANCE

- A. Field Supervision: Restoration specialist firms shall maintain experienced full-time supervisors on Project site during times that clay masonry restoration and cleaning work is in progress. Supervisors shall not be changed during Project except for causes beyond the control of restoration specialist firm.
- B. Restoration Worker Qualifications: Persons who are experienced and specialize in restoration work of types they will be performing. When masonry units are being

patched, assign at least one worker among those performing patching work who is trained and certified by manufacturer of patching compound to apply its products.

- C. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-trained representatives who are available for consultation and Project-site inspection and assistance at no additional cost.
- D. Source Limitations: Obtain each type of material for masonry restoration (face brick, cement, sand, etc.) from one source with resources to provide materials of consistent quality in appearance and physical properties.
- E. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage due to worker fatigue.
- F. Restoration Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of restoration work including protection of surrounding materials and Project site.
 - 1. Include methods for keeping pointing mortar damp during curing period.
 - 2. If materials and methods other than those indicated are proposed for any phase of restoration work, add to the Quality-Control Program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project and worker's ability to use such materials and methods properly.
- G. Cleaning Program: Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used, protection of surrounding materials, and control of runoff during operations.
 - 1. If materials and methods other than those indicated are proposed for any phase of restoration work, add to the Quality-Control Program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project and worker's ability to use such materials and methods properly.
- H. Cleaning and Repair Appearance Standard: Cleaned and repaired surfaces are to have a uniform appearance as viewed from 20 feet away by ENGINEER. Perform additional paint and stain removal, general cleaning, and spot cleaning of small areas that are noticeably different, so that surface blends smoothly into surrounding areas.
- I. Mockups: Prepare mockups of restoration and cleaning to demonstrate aesthetic effects and set quality standards for materials and execution and for fabrication and installation.
 - 1. Masonry Repair: Prepare sample areas for each type of masonry material indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than 2 adjacent whole units or approximately 48 inches in least dimension. Erect sample areas in existing walls unless otherwise indicated, to demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

- a. Replacement:
 - 1) Four brick units replaced.
 - b. Reanchoring Veneers: Install three masonry repair anchors in mockup wall assembly of each anchor type required.
 - c. Patching: Three small holes at least 1 inch in diameter for each type of masonry material indicated to be patched, so as to leave no evidence of repair.
2. Repointing: Rake out joints in 2 separate areas, each approximately 36 inches high by 48 inches wide for each type of repointing required and repoint one of the areas.
 3. Cleaning: Clean an area approximately 25 sq. ft. for each type of masonry and surface condition.
 - a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not use cleaners and methods known to have deleterious effect.
 - b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.
 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless ENGINEER specifically approves such deviations in writing.
 5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

J. Preconstruction Testing

1. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on masonry units as follows.
 - a. Provide test specimens as indicated and representative of proposed materials and construction.
 - b. Existing Brick: Test each type of existing masonry unit indicated for replacement, according to testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction). Carefully remove five existing units from locations designated by ENGINEER. Take testing samples from these units.
 - c. Existing Mortar: Test according to ASTM C 295, modified as agreed by testing service and ENGINEER for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Use X-ray diffraction, infrared spectroscopy, and differential thermal analysis as necessary to supplement microscopical methods. Carefully remove existing mortar from within joints at five locations designated by ENGINEER.
 - d. Temporary Patch: As directed by ENGINEER, provide temporary materials at locations from which existing samples were taken.
 - e. Replacement Brick: Test each proposed type of replacement masonry unit, according to sampling and testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings: For the following:

- a. Full-size patterns with complete dimensions for new specially molded brick shapes and brick arches and their jointing, showing relation of existing to new units.
- b. Provisions for expansion joints or other sealant joints.
- c. Provisions for flashing, lighting fixtures, conduits, and weep holes as required.
- d. Replacement and repair anchors. Include details of anchors within individual masonry units, with locations of anchors and dimensions of holes and recesses in units required for anchors.

2. Product Data: For each type of product indicated. Include recommendations for application and use. Include test data substantiating that products comply with requirements.

3. Samples:

- a. Pointing Mortar: Submit sets of mortar for pointing in the form of sample mortar strips, 6 inches long by 1/4 inch wide, set in aluminum or plastic channels.
 - 1) Have each set contain a close color range of at least three Samples of different mixes of colored sands and cements that produce a mortar matching the cleaned masonry when cured and dry.
 - 2) Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each Sample was made.
- b. Patching Compound: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of masonry representative of the range of masonry colors on the building.
 - 1) Have each set contain a close color range of at least three Samples of different mixes of patching compound that matches the variations in existing masonry when cured and dry.
- c. Sealant Materials: See Section 07 92 00, Joint Sealants.
- d. Include similar Samples of accessories involving color selection.
- e. Each type of masonry unit to be used for replacing existing units. Include sets of Samples as necessary to show the full range of shape, color, and texture to be expected.
 - 1) For each brick type, provide straps or panels containing at least four bricks. Include multiple straps for brick with a wide range.
- f. Each type of sand used for pointing mortar; minimum 1 lb of each in plastic screw-top jars.
 - 1) For blended sands, provide Samples of each component and blend.
 - 2) Identify sources, both supplier and quarry, of each type of sand.

B. Informational Submittals: Submit the following:

1. Qualification Data: For restoration specialists, including field supervisors and restoration workers, chemical-cleaner manufacturer, and testing service.
2. Quality-Control Program.
3. Restoration Program.

4. Cleaning Program.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver masonry units to Project site strapped together in suitable packs or pallets or in heavy-duty cartons.
- B. Deliver other materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.
- E. Store lime putty covered with water in sealed containers.
- F. Store sand where grading and other required characteristics can be maintained and contamination avoided.

1.11 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit masonry restoration and cleaning work to be performed according to manufacturers' written instructions and specified requirements.
- B. Repair masonry units and repoint mortar joints only when air temperature is between 40 and 90 deg F and is predicted to remain so for at least 7 days after completion of the Work unless otherwise indicated.
- C. Cold-Weather Requirements: Comply with the following procedures for masonry repair and mortar-joint pointing unless otherwise indicated:
 - 1. When air temperature is below 40 deg F heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F.
 - 2. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for 7 days after repair and pointing.
- D. Hot-Weather Requirements: Protect masonry repair and mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F and above unless otherwise indicated.
- E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

- F. Clean masonry surfaces only when air temperature is 40 deg F and above and is predicted to remain so for at least 7 days after completion of cleaning.

1.12 COORDINATION

- A. Coordinate masonry restoration and cleaning with plant operation patterns at Project site. Plan and execute the Work accordingly.

1.13 SEQUENCING AND SCHEDULING

- A. Order replacement materials at earliest possible date to avoid delaying completion of the Work.
- B. Order sand and gray portland cement for pointing mortar immediately after approval of samples and mockups. Take delivery of and store at Project site a sufficient quantity to complete Project.
- C. Perform masonry restoration work in the following sequence:
 - 1. Remove plant growth.
 - 2. Inspect for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
 - 3. Remove paint.
 - 4. Clean masonry surfaces.
 - 5. Where water repellents, specified in Section 071900, Silate Water Repellents, are to be used on or near masonry work, delay application of these chemicals until after pointing.
 - 6. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
 - 7. Repair masonry, including replacing existing masonry with new masonry materials.
 - 8. Rake out mortar from joints to be repointed.
 - 9. Point mortar and sealant joints.
 - 10. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
 - 11. Inspect for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
 - 12. Remove paint.
 - 13. Clean masonry surfaces.
- D. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units to comply with Masonry Unit Patching Article. Patch holes in mortar joints to comply with Repointing Masonry Article.

PART 2 - PRODUCTS

2.1 MASONRY MATERIALS

- A. Face Brick: Refer to Section 04 21 13, Brick Masonry.
- A. Face Brick: Provide face brick, including specially molded, ground, cut, or sawed shapes where required to complete masonry restoration work.
 - 1. Provide units with colors, color variation within units, surface texture, size, and shape to match existing brickwork and with physical properties within 10 percent of those determined from preconstruction testing of selected existing units as listed below:
 - a. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.
 - 2. Provide units with colors, color variation within units, surface texture, and physical properties to match ENGINEER's sample. Match existing units in size and shape.
 - 3. Special Shapes:
 - a. Provide specially molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position and where shapes produced by sawing would result in sawed surfaces being exposed to view.
 - b. Provide specially ground units, shaped to match patterns, for arches and where indicated.
 - c. Mechanical chopping or breaking brick, or bonding pieces of brick together by adhesive, are not acceptable procedures for fabricating special shapes.
 - 4. Tolerances as Fabricated: Comply with tolerance requirements in ASTM C 216:
 - a. Type FBX.
 - b. Type FBS.
- B. Building Brick: Provide building brick complying with ASTM C 62, of same vertical dimension as face brick, for masonry work concealed from view.
 - 1. Grade SW where in contact with earth.
 - 2. Grade SW, MW, or NW for concealed backup.
- C. Salvaged Brick: Obtain salvaged brick from Owner from location shown on Drawings. Clean off residual mortar.

2.2 MORTAR MATERIALS

- A. Refer to Section 04 05 11, Masonry Mortaring and Grouting.

2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II, white or gray or both where required

for color matching of exposed mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Factory-Prepared Lime Putty: ASTM C 1489.
- D. Mortar Sand: ASTM C 144 unless otherwise indicated.
1. Color: Provide natural sand [or ground marble, granite, or other sound stone] of color necessary to produce required mortar color.
 2. For pointing mortar, provide sand with rounded edges.
 3. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
- E. Mortar Pigments: Natural and synthetic iron oxides, compounded for mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars.
- F. Water: Potable.

2.3 MANUFACTURED REPAIR MATERIALS

- A. Masonry Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching masonry.
1. Product and manufacturer: Provide one of the following:
 - a. Jahn M100 Terra Cotta and Brick Repair Mortar by Cathedral Stone Products, Incorporated.
 - b. Custom System 45 by Edison Coatings, Incorporated.
 - c. Or Equal.
 2. Use formulation that is vapor- and water permeable (equal to or more than the masonry unit), exhibits low shrinkage, has lower modulus of elasticity than the masonry units being repaired, and develops high bond strength to all types of masonry.
 3. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.
 4. Formulate patching compound used for patching brick in colors and textures to match each masonry unit being patched. Provide sufficient number of colors to enable matching the color, texture, and variation of each unit.

2.4 PAINT REMOVERS

- A. Alkaline Paste Paint Remover: Manufacturer's standard alkaline paste formulation for removing paint coatings from masonry.
1. Product and manufacturer: Provide one of the following:
 - a. Multi-Layer Paint Remover or 606X Extra Thick Multi-Layer Paint Remover 606 by Diedrich Technologies, Incorporated.
 - b. Enviro Klean Safety Peel 2, Sure Klean Heavy-Duty Paint Stripper, or Sure Klean Heavy-Duty Paint Stripper D by PROSOCO, Incorporated.

- c. Or Equal.
- B. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard covered or skin-forming alkaline formulation for removing paint coatings from masonry.
 - 1. Product and manufacturer: Provide one of the following:
 - a. 606 Multi-Layer Paint Remover or 606X Extra Thick Multi-Layer Paint Remover with pull-off removal system by Diedrich Technologies Incorporated.
 - b. Enviro Klean Safety Peel 1 or Enviro Klean Safety Peel 3, with Enviro Klean Overcoat by PROSOCO, Incorporated.
 - c. Or Equal.
- C. Solvent-Type Paint Remover: Manufacturer's standard water-rinsable, solvent-type gel formulation for removing paint coatings from masonry.
 - 1. Product and manufacturer: Provide one of the following:
 - a. 505 Special Coatings Stripper by Diedrich Technologies, Incorporated.
 - b. Sure Klean Fast Acting Stripper by PROSOCO, Incorporated.
 - c. Or Equal.
- D. Low-Odor, Solvent-Type Paint Remover: Manufacturer's standard low-odor, water-rinsable solvent-type gel formulation, containing no methanol or methylene chloride, for removing paint coatings from masonry.
 - 1. Product and manufacturer: Provide one of the following:
 - a. S-301, S-303, or S-305 by Cathedral Stone Products, Incorporated.
 - b. Enviro Klean Safety Peel 1 or Enviro Klean Safety Peel 3 by PROSOCO, Incorporated.
 - c. Or Equal.

2.5 CLEANING MATERIALS

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of 140 to 160 deg F.
- C. Job-Mixed Detergent Solution: Solution prepared by mixing 2 cups of tetrasodium polyphosphate, 1/2 cup of laundry detergent, and 20 quarts hot water for every 5 gal. of solution required.
- D. Job-Mixed Mold, Mildew, and Algae Remover: Solution prepared by mixing 2 cups of tetrasodium polyphosphate, 5 quarts of 5 percent sodium hypochlorite (bleach), and 15 quarts of hot water for every 5 gal. of solution required.
- E. Nonacidic Gel Cleaner: Manufacturer's standard gel formulation, with pH between 6 and 9, that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces.
 - 1. Product and manufacturer: Provide one of the following:
 - a. Price Marble Cleaner Gel by Price Research, Ltd.
 - b. Sure Klean 942 Limestone and Marble Cleaner by PROSOCO, Incorporated.
 - c. Or Equal.

- F. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.
1. Product and manufacturer: Provide one of the following:
 - a. Diedrich 910PM Polished Marble Cleaner by Diedrich Technologies Inc.
 - b. Enviro Klean 2010 All Surface Cleaner By PROSOCO, Incorporated.
 - c. Or Equal.
- G. Two-Part Chemical Cleaner: Manufacturer's standard system consisting of potassium or sodium hydroxide based, alkaline prewash cleaner and acidic afterwash cleaner that does not contain hydrofluoric acid.
1. Product and manufacturer: Provide one of the following:
 - a. Diedrich 808 Limestone Pre-Wash or Diedrich 808X Black Encrustation Remover - Super Strong followed by 707N Limestone Neutralizer After-Rinse by Diedrich Technologies, Incorporated.
 - b. Enviro Klean BioKlean followed by Sure Klean Limestone & Masonry Afterwash or Sure Klean 766 Limestone Prewash followed by SureKlean Limestone & Masonry Afterwash by PROSOCO, Incorporated.
 - c. Or Equal.

2.6 ACCESSORY MATERIALS

- A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.
1. Product and manufacturer: Provide one of the following:
 - a. Rubber Mask by ABR Products, Inc.
 - b. Sure Klean Strippable Masking by PROSOCO, Incorporated.
 - c. Or Equal.
- B. Masonry Repair Anchors, Expansion Type: Mechanical fasteners designed for masonry veneer stabilization consisting of 1/4-inch-diameter, Type 316 stainless-steel rod with brass expanding shells at each end and water-shedding washer in the middle. Expanding shells shall be designed to provide positive mechanical anchorage to veneer on one end and backup masonry on the other.
1. Product and manufacturer: Provide one of the following:
 - a. Sleeve-All sleeve anchor by Simpson Strong-Tie Company Inc.
 - b. BL-523 Restoration Anchor by Hohmann Barnard, Incorporated.
 - c. Or Equal.
- C. Masonry Repair Anchors, Spiral Type: Type 316 stainless-steel spiral rods designed to anchor to backing and veneer. Anchors are flexible in plane of veneer but rigid perpendicular to it.
2. Provide driven-in anchors designed to be installed in drilled holes and relying on screw effect rather than adhesive to secure them to backup and veneer.
 3. Product and manufacturer: Provide one of the following:
 - a. Heli-Tie by Simpson Strong-Tie Company Inc.
 - b. Helix Spira-Lok by Hohmann & Barnard, Incorporated.

- c. Or Equal.
- D. Masonry Repair Anchors, Rod/Screen Tube Type: Stainless-steel screen tube with or without Type 316 stainless-steel rod, adhesive installed by injection with manufacturer's standard epoxy adhesive, complete with other devices required for installation.
 - 1. Product and manufacturer: Provide one of the following:
 - a. Chem-Lok by BLOK-LOK Limited.
 - b. #520 Series by Hohmann & Barnard, Incorporated.
 - c. Or Equal.
- E. Steel Lintels: ASTM A36/A36M; hot-dip galvanized and factory primed.
- F. Sealant Materials:
 - 1. Provide manufacturer's standard chemically curing, elastomeric sealant(s) of base polymer and characteristics indicated below that comply with applicable requirements in Section 07 92 00, Joint Sealants.
 - a. Single-component, nonsag urethane sealant.
 - 2. Colors: Provide colors of exposed sealants to match colors of masonry adjoining installed sealant unless otherwise indicated.
 - 3. Ground-Mortar Aggregate: Custom crushed and ground pointing mortar sand or existing mortar retrieved from joints. Grind to a particle size that matches the adjacent mortar aggregate and color. Remove all fines passing the 100 sieve.
- G. Joint-Sealant Backing:
 - 1. Cylindrical Sealant Backings: ASTM C 1330, Type C, closed-cell material with a surface skin or Type B, bicellular material with a surface skin, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - 2. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where acceptable.
- H. Sheet Metal Flashing and Trim: Match the existing flashing in type, size, and thickness.
- I. Setting Buttons: Resilient plastic buttons, nonstaining to masonry, sized to suit joint thicknesses and bed depths of masonry units without intruding into required depths of pointing materials.
- J. Masking Tape: Non-staining, nonabsorbent material, compatible with pointing mortar, joint primers, sealants, and surfaces adjacent to joints; that will easily come off entirely, including adhesive.
- K. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.
 - 1. Product and manufacturer: Provide one of the following:

- a. Series V10 99 by Tnemec, Incorporated.
 - b. Carbocoat 150 by Carboline, an RPM Company.
 - c. Or Equal.
- 2. Use coating with a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- L. Miscellaneous Products: Select materials and methods of use based on the following, subject to approval of a mockup:
 - 1. Previous effectiveness in performing the work involved.
 - 2. Little possibility of damaging exposed surfaces.
 - 3. Consistency of each application.
 - 4. Uniformity of the resulting overall appearance.
 - 5. Do not use products or tools that could do the following:
 - a. Remove, alter, or in any way harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.
 - b. Leave a residue on surfaces.

2.7 MORTAR MIXES

- A. Preparing Lime Putty: Slake quicklime and prepare lime putty according to appendix to ASTM C 5 and manufacturer's written instructions.
- B. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
- C. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without ENGINEER's approval.
 - 1. Mortar Pigments: Where mortar pigments are indicated, do not exceed a pigment-to- cement ratio of 1:10 by weight.
- D. Do not use admixtures in mortar unless otherwise indicated.
- E. Mortar Proportions: Mix mortar materials in the following proportions:
 - 1. Pointing Mortar for Brick: 1 part portland cement, 2 parts lime, and 6 parts sand.
 - a. Add mortar pigments to produce mortar colors required.
 - 2. Rebuilding (Setting) Mortar: Comply with ASTM C 270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime.

2.8 CHEMICAL CLEANING SOLUTIONS

- A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended by chemical-cleaner manufacturer.
- B. Acidic Cleaner Solution for Brick: Dilute with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended by chemical-cleaner manufacturer.

PART 3 – EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the substrate and conditions under which masonry restoration and cleaning is to be installed and notify ENGINEER, in writing, of any conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from masonry restoration work.
 - 1. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of restoration and cleaning work.
- B. Comply with chemical-cleaner manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical-cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
 - 1. Cover adjacent surfaces with materials that are proven to resist chemical cleaners used unless chemical cleaners being used will not damage adjacent surfaces. Use materials that contain only waterproof, UV-resistant adhesives. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
 - 2. Keep wall wet below area being cleaned to prevent streaking from runoff.
 - 3. Do not clean masonry during winds of sufficient force to spread cleaning solutions to unprotected surfaces.
 - 4. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.
 - 5. Dispose of runoff from cleaning operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- C. Prevent mortar from staining face of surrounding masonry and other surfaces.
 - 1. Cover sills, ledges, and projections to protect from mortar droppings.
 - 2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
 - 3. Immediately remove mortar in contact with exposed masonry and other surfaces.
 - 4. Clean mortar splatters from scaffolding at end of each day.

3.3 UNUSED ANCHOR REMOVAL

- A. Remove masonry anchors, brackets, wood nailers, and other extraneous items no

longer in use unless identified as historically significant or indicated to remain.

1. Remove items carefully to avoid spalling or cracking masonry.
2. Where directed, if an item cannot be removed without damaging surrounding masonry, do the following:
 - a. Cut or grind off item approximately 3/4 inch beneath surface and core drill a recess of same depth in surrounding masonry as close around item as practical.
 - b. Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.
3. Patch the hole where each item was removed unless directed to remove and replace the masonry unit.

3.4 BRICK REMOVAL AND REPLACEMENT

- A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated [or are to be reused]. Carefully demolish or remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.
 1. When removing single bricks, remove material from center of brick and work toward outside edges.
- B. Support and protect remaining masonry that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.
- C. Notify ENGINEER of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.
- D. Remove in an undamaged condition as many whole bricks as possible.
 1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
 2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
 3. Store brick for reuse. Store off ground, on skids, and protected from weather.
 4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.
- E. Clean bricks surrounding removal areas by removing mortar, dust, and loose particles in preparation for replacement.
- F. Replace removed damaged brick with other removed brick[and salvaged brick] in good quality, where possible, or with new brick matching existing brick, including size. Do not use broken units unless they can be cut to usable size.
- G. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
 1. Maintain joint width for replacement units to match existing joints.

2. Use setting buttons or shims to set units accurately spaced with uniform joints.
- H. Lay replacement brick with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
 2. Rake out mortar used for laying brick before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing masonry, and at same time as repointing of surrounding area.
 3. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.

3.5 REANCHORING VENEERS

- A. Install masonry repair anchors in horizontal mortar joints and according to manufacturer's written instructions. Install at not more than 16 inches o.c. vertically and 32 inches o.c. horizontally unless otherwise indicated. Install at locations to avoid penetrating flashing.
- B. Recess anchors at least 5/8 inch from surface of mortar joint and fill recess with pointing mortar.

3.6 PAINTING STEEL UNCOVERED DURING THE WORK

- A. Inspect steel exposed during masonry removal. Where ENGINEER determines that it is structural, or for other reasons cannot be totally removed, prepare and paint it as follows:
1. Remove paint, rust, and other contaminants according to SSPC-SP 2, Hand Tool Cleaning; SSPC-SP 3 Power Tool Cleaning; or SSPC-SP 6/NACE No. 3, Commercial Blast Cleaning, as applicable to meet paint manufacturer's recommended preparation.
 2. Immediately paint exposed steel with two coats of primer, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).
- B. If on inspection and rust removal, the cross section of a steel member is found to be reduced from rust by more than 1/16 inch, notify ENGINEER before proceeding.

3.7 MASONRY UNIT PATCHING

- A. Patch the following masonry units unless another type of replacement or repair is indicated:
1. Units indicated to be patched.
 2. Units with holes.
 3. Units with chipped edges or corners.
 4. Units with small areas of deep deterioration.

- B. Remove and replace existing patches unless otherwise indicated or approved by ENGINEER.
- C. Patching Bricks:
 - 1. Remove loose material from masonry surface. Carefully remove additional material so patch will not have feathered edges but will have square or slightly undercut edges on area to be patched and will be at least 1/4 inch thick, but not less than recommended by patching compound manufacturer.
 - 2. Mask adjacent mortar joint or rake out for repointing if patch will extend to edge of masonry unit.
 - 3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
 - 4. Rinse surface to be patched and leave damp, but without standing water.
 - 5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
 - 6. Place patching compound in layers as recommended by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer.
 - 7. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the masonry unit. Shape and finish surface before or after curing, as determined by testing, to best match existing masonry unit.
 - 8. Keep each layer damp for 72 hours or until patching compound has set.

3.8 WIDENING JOINTS

- A. Do not widen a joint, except where indicated or approved by ENGINEER.
- B. Location Guideline: Where an existing masonry unit abuts another or the joint is less than 1/8 inch, widen the joint for length indicated and to depth required for repointing after obtaining ENGINEER's approval.
- C. Carefully perform widening by cutting, grinding, routing, or filing procedures demonstrated in an approved mockup.
- D. Widen joint to width equal to or less than predominant width of other joints on building. Make sides of widened joint uniform and parallel. Ensure that edges of units along widened joint are in alignment with joint edges at unaltered joints.

3.9 CLEANING MASONRY, GENERAL

- A. Proceed with cleaning in an orderly manner; work from bottom to top or top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water will not wash over cleaned, dry surfaces.
- B. Use only those cleaning methods indicated for each masonry material and location.
 - 1. Do not use wire brushes or brushes that are not resistant to chemical cleaner being used. Do not use plastic-bristle brushes if natural-fiber brushes will resist chemical

- cleaner being used.
2. Use spray equipment that provides controlled application at volume and pressure indicated, measured at spray tip. Adjust pressure and volume to ensure that cleaning methods do not damage masonry.
 - a. Equip units with pressure gages.
 3. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with cone-shaped spray tip.
 4. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 15 degrees.
 5. For high-pressure water-spray application, use fan-shaped spray tip that disperses water at an angle of at least 40 degrees.
 6. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.
 7. For steam application, use steam generator capable of delivering live steam at nozzle.
- C. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces.
- D. Water Application Methods:
1. Water-Soak Application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.
 2. Water-Spray Applications: Unless otherwise indicated, hold spray nozzle at least 6 inches from surface of masonry and apply water in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage. Provide pressure spray and temperature as indicated by product literature or instructions and manufacturer's written recommendations.
- E. Steam Cleaning: Apply steam to masonry surfaces at the very low pressures indicated for each type of masonry material. Hold nozzle at least 6 inches from surface of masonry and apply steam in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.
- F. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces to comply with chemical-cleaner manufacturer's written instructions; use brush[or spray] application. Do not spray apply at pressures exceeding 50 psi. Do not allow chemicals to remain on surface for periods longer than those indicated or recommended by manufacturer.
- G. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

- H. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

3.10 PRELIMINARY CLEANING

- A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing to dry as long as possible before removal. Remove loose soil and debris from open masonry joints to whatever depth they occur.
- B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to cleaning methods being used. Extraneous substances include paint, calking, asphalt, and tar.
 - 1. Carefully remove heavy accumulations of material from surface of masonry with a sharp chisel. Do not scratch or chip masonry surface.
 - 2. Remove paint and calking with alkaline paint remover.
 - a. Comply with requirements in Paint Removal Article.
 - b. Repeat application up to two times if needed.
 - 3. Remove asphalt and tar with solvent-type paint remover.
 - a. Comply with requirements in Paint Removal Article.
 - b. Apply paint remover only to asphalt and tar by brush without prewetting.
 - c. Allow paint remover to remain on surface for 10 to 30 minutes.
 - d. Repeat application if needed.

3.11 PAINT REMOVAL

- A. Paint Removal with Alkaline Paste Paint Remover:
 - 1. Remove loose and peeling paint using pressure spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
 - 2. Apply paint remover to dry, painted masonry with brushes.
 - 3. Allow paint remover to remain on surface for period recommended by manufacturer.
 - 4. Rinse with water applied by -pressure spray to remove chemicals and paint residue.
 - 5. Repeat process if necessary to remove all paint.
 - 6. Apply acidic cleaner or manufacturer's recommended afterwash to masonry, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended by chemical cleaner or afterwash manufacturer.
 - 7. Rinse with cold water applied by pressure spray to remove chemicals and soil.
- B. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:
 - 1. Remove loose and peeling paint using pressure spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
 - 2. Apply paint remover to dry, painted masonry with trowel, spatula, or as recommended by manufacturer.
 - 3. Apply cover, if required by manufacturer, per manufacturer's written instructions.
 - 4. Allow paint remover to remain on surface for period recommended by

- manufacturer or as determined in test panels.
5. Scrape off paint and remover and collect for disposal.
 6. Rinse with water applied by pressure spray to remove chemicals and paint residue.
 7. Use alkaline paste paint remover, according to "Paint Removal with Alkaline Paste Paint Remover" Paragraph, if necessary to remove remaining paint.
 8. Apply acidic cleaner or manufacturer's recommended afterwash to masonry, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended by chemical-cleaner or afterwash manufacturer.
 9. Rinse with cold water applied by pressure spray to remove chemicals and soil.
- C. Paint Removal with Solvent-Type Paint Remover:
1. Remove loose and peeling paint using pressure spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
 2. Apply thick coating of paint remover to painted masonry with natural-fiber cleaning brush, deep-nap roller, or large paint brush.
 3. Allow paint remover to remain on surface for period recommended by manufacturer. Agitate periodically with stiff-fiber brush if recommended by the Manufacturer.
 4. Rinse with water applied by pressure spray to remove chemicals and paint residue.

3.12 CLEANING BRICKWORK

- A. Cold-Water Soak:
1. Apply cold water by intermittent spraying to keep surface moist.
 2. Use perforated hoses or other means that will apply a fine water mist to entire surface being cleaned.
 3. Apply water in cycles with at least 30 minutes between cycles.
 4. Continue spraying until surface encrustation has softened sufficiently to permit its removal by water wash, as indicated by cleaning tests.
 5. Continue spraying for 72 hours.
 6. Remove soil and softened surface encrustation from masonry with cold water applied by low-pressure spray.
- B. Cold-Water Wash: Use cold water applied by pressure spray.
- C. Hot-Water Wash: Use hot water applied by pressure spray.
- D. Steam Cleaning: Apply steam at very low pressures not exceeding 30 psi. Remove dirt softened by steam with wood scrapers, stiff-nylon or -fiber brushes, or cold-water wash, as indicated by cleaning tests.
- E. Detergent Cleaning:
1. Wet masonry with water applied by low-pressure spray.
 2. Scrub masonry with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used, and that masonry surface remains wet.

3. Rinse with water applied by pressure spray to remove detergent solution and soil.
 4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- F. Mold, Mildew, and Algae Removal:
1. Wet masonry with water applied by low-pressure spray.
 2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
 3. Scrub masonry with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used, and that masonry surface remains wet.
 4. Rinse with (--2--) water applied by pressure spray to remove mold, mildew, and algae remover and soil.
 5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- G. Nonacidic Gel Chemical Cleaning:
1. Wet masonry with (--2--) water applied by low-pressure spray.
 2. Apply nonacidic gel cleaner in 1/8-inch thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively so area will be uniformly covered with fresh cleaner and dwell time will be uniform throughout area being cleaned.
 3. Let cleaner remain on surface for period indicated below:
 - b. As established by mockup.
 4. Remove bulk of nonacidic gel cleaner by squeegeeing into containers for disposal.
 5. Rinse with water applied by pressure spray to remove chemicals and soil.
- H. Nonacidic Liquid Chemical Cleaning:
1. Wet masonry with water applied by low-pressure spray.
 2. Apply cleaner to masonry in two applications by brush or low-pressure spray. Let cleaner remain on surface for period indicated below:
 - a. As recommended by chemical-cleaner manufacturer.
 - b. As established by mockup.
 - c. Two to three minutes.
 3. Rinse with water applied by pressure spray to remove chemicals and soil.
- I. Acidic Chemical Cleaning:
1. Wet masonry with cold water applied by low-pressure spray.
 2. Apply cleaner to masonry in two applications by brush or low-pressure spray. Let cleaner remain on surface for period indicated below:
 - a. As recommended by chemical-cleaner manufacturer.
 - b. As established by mockup.
 - c. Two to three minutes.
 3. Rinse with cold water applied by pressure spray to remove chemicals and soil.
 4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use a steam cleaning.

3.13 REPOINTING MASONRY

- A. Rake out and repoint joints to the following extent:
 - 1. All joints in areas indicated.
 - 2. Joints where mortar is missing or where they contain holes.
 - 3. Cracked joints where cracks can be penetrated at least 1/4 inch by a knife blade 0.027 inch thick.
 - 4. Cracked joints where cracks are 1/16 inch or more in width and of any depth.
 - 5. Joints where they sound hollow when tapped by metal object.
 - 6. Joints where they are worn back 1/4 inch or more from surface.
 - 7. Joints where they are deteriorated to point that mortar can be easily removed by hand, without tools.
 - 8. Joints where they have been filled with substances other than mortar.
 - 9. Joints indicated as sealant-filled joints.
- B. Do not rake out and repoint joints where not required.
 - 1. Remove mortar from joints to depth of 2-1/2 times joint width, but not less than 1/2 inch or not less than that required to expose sound, unweathered mortar.
 - 2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
 - 3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by ENGINEER.
 - a. Cut out mortar by hand with chisel and resilient mallet. Do not use power- operated grinders without ENGINEER's written approval based on approved quality- control program.
- D. Notify ENGINEER of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.
- E. Pointing with Mortar:
 - 1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
 - 2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
 - 3. After low areas have been filled to same depth as remaining joints, point all joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
 - 4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from

- edge of joint by
brushing
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours including weekends and holidays.
 7. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.
- F. Pointing with Sealant:
1. After raking out, keep joints dry and free of mortar and debris.
 2. Clean and prepare joint surfaces according to Section 07 92 00, Joint Sealants. Prime joint surfaces unless sealant manufacturer recommends against priming. Do not allow primer to spill or migrate onto adjoining surfaces.
 3. Fill sealant joints with specified joint sealant according to Section 07 92 00, Joint Sealants, and the following:
 - a. Install cylindrical sealant backing beneath the sealant, except where space is insufficient. There, install bond-breaker tape.
 - b. Install sealant using only proven installation techniques that will ensure that sealant will be deposited in a uniform, continuous ribbon, without gaps or air pockets, and with complete wetting of the joint bond surfaces equally on both sides. Fill joint flush with surrounding masonry and matching the contour of adjoining mortar joints.
 - c. Install sealant as recommended by sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead:
 - 1) Fill joints to a depth equal to joint width, but not more than 1/2 inch deep or less than 1/4 inch deep.
 - d. Immediately after first tooling, apply ground-mortar aggregate to sealant, gently pushing aggregate into the surface of sealant. Retool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant and aggregate from surfaces adjacent to joint.
 - e. Do not allow sealant to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces, particularly rough textures. Remove excess and spillage of sealant promptly as the work progresses. Clean adjoining surfaces by the means necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes, as demonstrated in an approved mockup.
 4. Cure sealant according to Section 07 92 00, Joint Sealants.
- G. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.14 MISCELLANEOUS REPAIRS

- A. Sheet Metal Flashing and Trim: Refer to Section 04 05 05, Unit Masonry Construction

- B. Steel Lintels: Refer to Section 05 50 13, Miscellaneous Metal Fabrications.

3.15 FINAL CLEANING

- A. See Section 04 05 05, Unit Masonry Construction.

3.16 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, spray applied at low pressure.
 - 1. Do not use metal scrapers or brushes.
 - 2. Do not use acidic or alkaline cleaners.
- B. Wash adjacent woodwork and other non-masonry surfaces. Use detergent and soft brushes or cloths.
- C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- D. Sweep and rake adjacent pavement and grounds to remove mortar and debris. Where necessary, pressure wash pavement surfaces to remove mortar, dust, dirt, and stains.

3.17 FIELD QUALITY CONTROL

- A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare test reports. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.
- C. Notify inspectors and ENGINEER in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors and ENGINEER have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.
- D. Comply with Section 01 45 33.00.CAOH, Code-Reqd Special Inspections and Procedures.

++END OF SECTION ++

SECTION 04 05 05

UNIT MASONRY CONSTRUCTION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all unit masonry construction. The Work also includes:
 - a. Providing openings in unit masonry construction to accommodate the Work under this and other Sections and building into unit masonry construction all items such as sleeves, anchorage devices, inserts, and other items to be embedded in unit masonry construction for which placement is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items to be installed with or before unit masonry construction Work.
2. Remove and rebuild unit masonry construction advanced without built-in flashings and other built-in items at no additional cost to OWNER, even after unit masonry construction has been completed.

C. Related Sections:

1. Section 04 01 21, Masonry Restoration and Cleaning.
2. Section 04 05 11, Masonry Mortaring and Grouting.
3. Section 04 05 19, Masonry Anchorage and Reinforcing.
4. Section 05 50 13, Miscellaneous Metal Fabrications.
5. Section 06 10 53, Miscellaneous Rough Carpentry.
6. Section 07 11 13, Bituminous Dampproofing.
7. Section 07 21 05, Building Insulation.
8. Section 07 62 00, Sheet Metal Flashing and Trim.
9. Section 07 92 00, Joint Sealants.
10. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ACI 530, Building Code Requirements for Masonry Structures.
2. ACI 530.1, Specification for Masonry Structures.
3. ASTM C67, Test Methods for Sampling and Testing Brick and Structural Clay Tile.

4. ASTM C140, Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
5. ASTM C387, Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
6. ASTM C780, Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
7. ASTM C1091, Test Method for Hydrostatic Infiltration Testing of Vitrified Clay Pipe Lines.
8. ASTM C1093, Practice for Accreditation of Testing Agencies for Unit Masonry.
9. ASTM C1314, Test Method for Compressive Strength of Masonry Prisms.

1.3 TERMINOLOGY

- A. The following words or terms are not defined but, when used in this Section, have the following meaning:
1. "Masonry control joint" is a joint in interior and exterior masonry walls that allows expansion and contraction to occur independently without damage to the masonry.
 2. "Masonry expansion joint" is a control joint in interior and exterior masonry walls, located at the separation between adjoining parts of a concrete or steel structure that is provided to allow movements transferred to the masonry to occur independently without damage to the masonry.

1.4 QUALITY ASSURANCE

- A. Qualifications:
1. Installer:
 - a. Engage a single installer regularly engaged in preformed unit masonry installation and with successful and documented experience in erecting unit masonry of the scope and type of Work required; and who employs only tradesmen with specific skill and successful experience in the type of Work required. Submit name and qualifications with the following information for a minimum of three successful projects:
 - 1) Names and telephone numbers of owners, architects, or engineers responsible for projects.
 - 2) Approximate contract cost of unit masonry.
 - 3) Quantity (area) of unit masonry installed.
 2. Testing Laboratory:
 - a. In accordance with ASTM C1093 and Section 01 45 29.13, Testing Laboratory Services Furnished by Owner
- B. Component Supply and Compatibility:
1. Obtain each type of concrete masonry units from one manufacturer, cured by one process and of uniform texture and color or in an established uniform blend thereof.
 2. Use a single source and brand of mortar materials throughout the Work.

- C. Regulatory Requirements:
 - 1. Where fire resistance classification is shown or indicated (e.g., four hour rating, three hour rating, and similar designations) for unit masonry construction, comply with applicable requirements for materials and installation established by UL tests referenced in this Section and requirements of authorities having jurisdiction.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Drawings showing location, extent, and accurate configuration and profile of all items required by the Contract Documents, in this and other Sections, for unit masonry construction. Provide elevations drawn at scale of 1/4-inch equal to one foot, and details drawn at scale of 1.5-inch equal to one foot.
 - 2. Samples:
 - a. Mock-ups.
- B. Informational Submittals: Submit the following:
 - 1. Field Quality Control Submittals:
 - a. Pre-installation test results in accordance with ASTM C140 and ASTM C1314, and the field quality control Article of this Section.
 - b. Post-installation quality control submittals in accordance with the field quality control Article of this Section.
 - 2. Sustainable Design Submittals (other than sustainable design closeout documentation):
 - a. Submittals associated with LEED certifications.
 - b. Submittals associated with construction waste management applicable to this Section and not submitted under other Sections.
 - 3. Qualifications Statements:
 - a. Installer.
 - b. Testing laboratory.
- C. Closeout Submittals: Submit the following:
 - 1. Record Documentation:
 - a. Comply with Section 01 78 39, Project Record Documents.
 - b. Indication location of all masonry control joints and expansion joints.

1.6 DELIVERY, STORAGE AND HANDLING

- A. General:
 - 1. Comply with:
 - a. Section 01 65 00, Product Delivery Requirements
 - b. Section 01 66 00, Product Storage and Handling Requirements

2. Storage: Maintain temperatures in shelter so that masonry materials are above 20 degrees F when installed.

1.7 SITE CONDITIONS

A. Environmental Requirements:

1. General:

- a. Temporary Facilities and Temporary Utilities: Provide supplemental heat sources and energy as required for unit masonry construction in cold weather.
- b. Do not perform unit masonry construction when air temperature is below 28 degrees F for rising temperature, or below 36 degrees F for falling temperatures, without providing temporary enclosures and heat, or without heating materials or other measures necessary to prevent freezing as specified.
- c. Do not use frozen materials and do not build on frozen unit masonry construction.
- d. Remove and replace all unit masonry construction damaged by cold temperatures and freezing.

2. Protection:

- a. Cold Weather Protection: Protect unit masonry construction against freezing for at least 48 hours after placement, as follows:
 - 1) When anticipated minimum temperature will be between 40 degrees F and 25 degrees F, cover newly constructed masonry with weather-resistive membrane for 48 hours after installation.
 - 2) When anticipated minimum temperature will be between 25 degrees F and 20 degrees F, completely cover newly constructed masonry with weather-resistive insulating blankets, or equal protection, for 48 hours after installation.
 - 3) When anticipated minimum temperature will be below 20 degrees F, maintain newly constructed masonry at temperature above 32 degrees F for at least 48 hours after installation by using heated enclosures, electric heating blankets, infrared lamps, or other acceptable methods of supplementary heating.
- b. Hot Weather Protection: When mean daily temperature exceeds 100 degrees F, or exceeds 90 degrees F with wind velocity greater than eight miles per hour, fog-spray newly constructed masonry until damp at least three times per day until masonry is 72 hours old.
- c. When Work is not in progress, protect partially-completed unit masonry construction against rapid heat loss and from water entering the masonry by covering top of walls with strong, waterproof, non-staining membrane. Extend membrane at least two feet down both sides of wall and secure in place using wall cover clamps spaced at intervals of four feet and at each end, and at joints in the membrane.
- d. Do not apply floor or roof loading for at least 72 hours after completing masonry columns or walls.

- e. Do not apply concentrated loads for at least 168 hours after completing masonry columns or walls.
3. Cold Weather Unit Masonry Construction:
- a. When mean daily temperature is below 40 degrees F, mortar used in unit masonry construction shall be portland cement-lime-sand mortar using high-early strength portland cement. Use mortar within 1.5 hours of initial mixing. Use grout within 1.5 hours of initial mixing.
 - b. Clay or shale unit masonry with suctions in excess of 20 grams of water per 30 square inches per minute shall be sprinkled with heated water just prior to installation. Provide water temperature above 70 degrees F when temperature of masonry units is above 32 degrees F. Water temperature shall be above 120 degrees F when temperature of masonry units is below 32 degrees F.
 - c. For Air Temperatures of 40 degrees F to 32 degrees F: Water and aggregates used in mortar and grout shall not be heated above 140 degrees F. Heat mortar sand or mixing water to produce mortar temperatures between 40 degrees F and 120 degrees F at time of mixing. Heat water and aggregates for grout when water or aggregate temperature is below 32 degrees F.
 - d. For Air Temperatures of 32 degrees F to 25 degrees F: Comply with Paragraph 1.7.A.3.c of this Section and the following: Maintain mortar temperature above freezing until used in masonry. Heat aggregates and mixing water for grout to produce grout temperature between 70 degrees F and 120 degrees F at time of mixing. Maintain grout temperature above 70 degrees F at time of grout placement.
 - e. For Air Temperatures of 25 degrees F to 20 degrees F: Comply with Paragraphs 1.7.A.3.c and 1.7.A.3.d of this Section and the following: Heat masonry surfaces under construction to 40 degrees F. Provide temporary wind breaks or enclosures when wind velocity exceeds 15 miles per hour. Prior to grouting, heat the masonry to minimum of 40 degrees F.
 - f. For Air Temperatures of 20 degrees F and Below: Comply with Paragraphs 1.7.A.3.c, 1.7.A.3.d, and 1.7.A.3.e of this Section and the following: Provide temporary enclosures and auxiliary heat to maintain air temperature within temporary enclosure above 32 degrees F. Temperature of masonry units when laid shall not be less than 20 degrees F.
4. Hot Weather Unit Masonry Construction: Using methods acceptable to ENGINEER, protect unit masonry construction from direct exposure to wind and sun when ambient air temperature is 99 degrees F in shade with relative humidity less than 50 percent.
- a. When ambient temperature exceeds 100 degrees F, or exceeds 90 degrees F with wind velocity greater than eight miles per hour, maintain temperature of mortar and grout below 120 degrees F. Flush mixers, mortar transport containers, and mortarboards with cool water before they come into contact with mortar ingredients or mortar. Maintain mortar consistency by re-tempering with cool water. Use mortar within

two hours of initial mixing. Use grout within 1.5 hours of initial mixing. Maintain sand piles in damp, loose condition.

- b. When ambient temperature exceeds 115 degrees F, or exceeds 105 degrees F with wind velocity greater than eight miles per hour, comply with Paragraph 1.7.A.4.a of this Section and the following: Use cool mixing water for mortar and grout. Use of ice will be allowed in mixing water prior to use; ice is not allowed in the mixing water when added to other mortar or grout materials. Shade materials and mixing equipment from exposure to direct sunlight.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Material requirements for masonry materials are in the following:
 1. Section 04 05 11, Masonry Mortaring and Grouting.
 2. Section 04 05 19, Masonry Anchorage and Reinforcing.
 3. Section 04 21 13, Brick Masonry.
 4. Section 04 22 00, Concrete Unit Masonry.
- B. Mortar, General:
 1. Where question of compliance with or interpretation of requirements of this Section arises, mortar properties Specification will take precedence over mortar proportion Specifications.
 2. Make no change in proportions established for mortar approved under property Specifications, and do not use materials with different physical characteristics in mortar unless compliance with requirements of property Specifications is re-established by Shop Drawing or submittal data.
 3. Do not combine two air-entraining materials in mortar.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which unit masonry construction will be installed, and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Wetting of Masonry Units:
 1. Face Brick: Wet brick having ASTM C67 absorption rates in excess of 20 grams of water per 30 square inches per minute, so that rate of absorption when laid does not exceed the following.

- a. Determine absorption by placing 20 drops of water using medicine dropper inside one-inch diameter circle on typical brick units. If water is absorbed within 90 seconds, wet the brick before laying.
 2. Use wetting methods that ensure that each masonry unit is nearly saturated, but surface-dry when laid.
 3. Concrete Masonry Units: Except for absorbent units specified to be wetted, lay masonry units dry. Do not wet concrete masonry units.
 4. Glazed Structural Tile: Wet units that display an absorption rate of 12 percent or more when immersed for one hour in boiling water.
- B. Cleaning of Reinforcing: Before placing, remove loose rust, mill scale, earth, ice, and other contamination from reinforcing materials. Do not use reinforcing bars with kinks or bends not shown or approved Shop Drawings, or bars with reduced cross-section due to rusting or other causes.

3.3 INSTALLATION, GENERAL

- A. Thickness: Build walls, floors, and other unit masonry construction to thickness shown or indicated. Build single wythe walls to actual thickness of masonry units using units of nominal thickness shown or indicated.
- B. Build chases and recesses as shown or required by others, as specified. Provide not less than eight inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.
- C. Leave openings for equipment, piping, ducts, and other items to be installed subsequent to starting unit masonry construction. After installation of said items, complete unit masonry construction to match the Work immediately adjacent to openings.
- D. Cut masonry units using motor-driven wet cutting saws to provide clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining Work neatly. Use full-size units without cutting where possible. Provide special unit masonry shapes for transitions and intersections. Do not attempt to field-cut special shapes from regular unit masonry shapes, and do not use other options for special unit masonry shapes.
- E. Build interior masonry walls visible from both sides in the finished Work using two wythes of masonry. Masonry shall be continuous over entire plane of wall, including walls that continue behind fixtures, equipment, furniture, lockers, and similar items
- F. Matching Existing Masonry: Match with existing masonry the coursing, pattern bond, color, and texture of new unit masonry construction

3.4 LAYING MASONRY WALLS

A. General:

1. Mortar Types: Unless otherwise shown or indicated, use mortar specified in Section 04 05 11, Masonry Mortar and Grout, as follows:
 - a. Use Type S mortar for other exterior walls and interior load-bearing walls.
 - b. Use Type N mortar for interior, non-load-bearing walls.
 - c. Use mortar type specified in Section 04 05 11, Masonry Mortar and Grout, for tuck pointing mortar.
 - d. Do not use mortar that has begun to set or if more than thirty minutes have elapsed since initial mixing. Re-temper mortar during the thirty-minute period only as required to restore workability.
2. Lay out walls in advance for accurate spacing of surface pattern bond with uniform joint widths and to properly locate openings, masonry control joints, returns, and offsets. Avoid using less than half-size units at corners, jambs, and where possible at other locations.
3. Lay up walls plumb and true to comply with specified tolerances, with courses level, accurately spaced, and coordinated with other work.
4. Pattern Bond:
 - a. Lay interior concrete unit masonry in running bond. Avoid using less than full-size units.
 - b. Lay interior concrete unit masonry visible in the finished Work in running bond.
 - c. Lay exterior and interior face brick unit masonry in pattern bonds shown or, if not shown, lay in running bond with vertical joints in each course centered on units in courses above and below.
 - d. Lay concrete unit masonry scheduled or shown to be concealed by finish materials, except paint, with units in wythe bonded by lapping not less than two inches.
 - e. Bond and interlock each course of each wythe at corners.
 - f. Do not use units with less than four-inched horizontal face dimensions at corners or jambs.
5. Color and Texture:
 - a. Lay brick masonry using mortar of natural color.
 - d. Lay existing brick masonry using tuck pointing mortar of matching color.

B. Construction Tolerances:

1. Variation from Plumb: For lines and surfaces of columns, walls and arises, do not exceed 1/4-inch in ten feet, or 3/8-inch in a story height (20 feet), maximum, nor 1/2-inch in 40 feet or more. Except for external corners, expansion joints and other conspicuous lines, do not exceed 1/4-inch in any story or 20 feet maximum, nor 1/2-inch in 40 feet or more.
2. Variation from Level: For lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4-inch in any bay or 20 feet maximum, nor 3/4-inch in 40 feet or more.

3. Variation of Linear Building Line: For position shown and related portion of columns, walls and partitions, do not exceed 1/2-inch in any bay or 20 feet maximum, nor 3/4-inch in 40 feet or more.
 4. Variation in Cross Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4-inch nor plus 1/2-inch.
- C. Mortar Bedding and Jointing:
1. Lay solid masonry units and glazed structural tile with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
 3. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course of piers, columns, and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout.
 4. Maintain joint widths shown, except for minor variations required to maintain pattern bond alignment. If not shown, lay unit masonry to provide the following joint widths:
 - a. Brick and Concrete Unit Masonry: 3/8-inch.
 - c. Concrete Unit Masonry Patches: Match existing adjacent joint width.
 - e. Provide joints that match (existing Operations Building Administration. Match width, texture and color of existing joints.
 5. Cut joints flush for masonry walls to be concealed or to be covered by other materials, except paint, unless otherwise shown.
 6. Tool exposed joints slightly concave, when mortar is "thumbprint hard", unless otherwise required to match existing joint treatment. Rake out mortar 1/2-inch deep in preparation for application of calking or sealants and for epoxy pointing mortar for glazed structural tile where required.
 7. Concave-tool exterior joints below grade.
 8. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units that have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.
- D. Collar Joints:
1. Fill vertical space between wythes solidly with mortar by parging the in-place wythe and shoving units into the parging, for the following unit masonry construction:
 - a
- E. Stopping and Resuming Work: Rake back one unit masonry length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly, if required, and remove loose masonry units and mortar prior to laying new masonry.
- F. Built-in Work:
1. As the Work progresses, build-in the items shown, specified or required in the Contract Documents. Fill cores in one-block width solidly with mortar around built-in items.

2. Do not fill space between hollow metal frames and masonry solidly with mortar.
 3. Where built-in items are to be embedded in cores of hollow masonry units, place layer of cavity fill mesh in the joint below and rod mortar or grout into core.
 4. Where required by Laws or Regulations, or to comply with thickness-to-height ratio, or to provide required fire resistance, fill all cells of unit masonry construction solid with grout.
3. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown or indicated.
 4. Intersecting and Abutting Walls: Unless vertical expansion or masonry control joints are shown at juncture, provide same type of bonding specified
 - a. Provide masonry bond in alternate courses.
 - b. Provide continuity with horizontal joint reinforcing using prefabricated "T" and "L" units.
- G. Non-Load Bearing Interior Partitions and Non-Load Bearing Interior Cavity Wall Wythe:
1. Build full height of story to underside of structure above, unless otherwise shown or indicated.
 2. Tie nonloadbearing partitions and nonloadbearing interior wythe of cavity walls at top and sides with masonry anchors at terminations. Build in end blocks as shown and specified to facilitate placing compressible filler. Insert compressible filler, specified in Section 04 05 19, Masonry Anchorage and Reinforcing, in all horizontal and vertical joints where nonloadbearing masonry and non-load-bearing interior wythe of cavity walls terminate. Insert filler 3/4-inch from both faces of masonry. Use filler four times as thick as widest part of joint. Thickness of filler shall be a minimum of 1.5 times the compressed thickness. Compress filler to less than thickness of joint and insert. At splices, overlap strips by three inches and compress ends to form tight joint. Finish with backer rod and sealant.
 3. At terminations of non-load-bearing masonry walls and non-load-bearing interior wythe of cavity walls requiring a fire rating, use fire-safing insulation specified in Section 07 21 05, Building Insulation. Build in end blocks to facilitate placing fire-safing insulation. Insert insulation in a continuous, vapor-tight, solid blanket to 3/4-inch from both faces of masonry. Finish with backer rod and sealant.
- H. Horizontal Joint Reinforcing:
1. Provide continuous horizontal joint reinforcing as shown and specified. Refer to Section 04 05 19, Masonry Anchorage and Reinforcing, for reinforcing units required. Fully embed longitudinal side rods in mortar for entire length of rods with minimum cover of 5/8-inch on exterior side of walls and 1/2-inch at other locations. Lap reinforcing minimum of six inches at ends of

units. Do not bridge masonry control joints and building expansion joints with reinforcing.

2. Provide continuity at corners and wall intersections by using prefabricated “L” and “T” sections. Cut and bend units in accordance with manufacturer’s written instructions for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
 3. Space continuous horizontal reinforcing as follows:
 - a. For multi-wythe walls, solid or cavity, where continuous horizontal reinforcing also acts as structural bond or tie between wythes, space reinforcing as required by Laws and Regulations, but not more than 16 inches on centers vertically.
 - b. For single-wythe walls, space reinforcing at 16 inches on centers vertically, unless otherwise shown.
- I. Structural Reinforced Unit Masonry Construction:
1. Comply with ACI 530, ACI 530.1 and Laws and Regulations for structural reinforced unit masonry construction.
 2. Shape and dimension reinforcement as shown and required by applicable ACI standards and Laws and Regulations.
 3. Position reinforcing accurately at spacing shown on approved Shop Drawings. Support and secure vertical bars against displacement using rebar positioners.
 4. Where vertical bars are shown in close proximity, provide clear distance between bars of not less than the greater of the nominal bar diameter or one-inch.
 5. For columns, piers, and pilasters, provide clear distance between vertical bars as shown, but not less than the greater of 1.5 times nominal bar diameter or 1.5 inches. Provide lateral ties.
 6. Provide lapped splices with reinforcing steel placed in contact and wire tied. Provide minimum lap required by Laws and Regulations, unless requirements that are more stringent are shown or indicated. Do not splice reinforcing at points other than shown or as approved on Shop Drawings.
- J. Anchoring Masonry Work:
1. Provide anchoring devices as specified under Section 04 05 19, Masonry Anchorage and Reinforcing. If not shown or indicated, provide standard type for facing and back-up involved in compliance with Laws and Regulations.
 2. Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:
 - a. Provide an open space not less than a 1/2-inch or more than one-inch in width between masonry and structural members, unless otherwise shown. Keep open space free of mortar and other rigid materials.
 - b. Anchor masonry to cast-in-place concrete and structural steel members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible tie sections.
 - c. Space anchors as shown, but not more than two feet on center vertically and three feet on centers horizontally.

- d. Provide end blocks where masonry abuts structural support to facilitate installation of compressible filler, fire-safing insulation, backer rod, and sealant.
- 3. Anchor single-wythe masonry veneer to backing with metal ties as follows:
 - a. Anchor veneer to structural members with metal anchors embedded in masonry joints and attached to structure. Provide anchors with flexible tie section, unless otherwise shown.
 - b. Anchor veneer to concrete back-up with dovetail anchors and to structural steel back-up with slotted anchors.
 - c. Space anchors as shown, but not more than two feet on centers vertically and three feet on centers horizontally.

K. Masonry Control and Expansion Joints:

- 1. Provide vertical expansion and control joints in masonry where shown. Build in related items as unit masonry construction progresses. Rake out mortar in preparation for application of calking and sealants, in accordance with Section 07 92 00, Joint Sealants.
- 2. Provide masonry control and expansion joints items where masonry control and expansion joints are shown.
 - a. Build-in compressible fillers as specified. Install in accordance with manufacturer's written instructions.
 - b. Provide end blocks where masonry partitions abut structure to facilitate installation of compressible filler, fire-safing insulation, backer rod, and sealant.
- 4. Concrete Unit Masonry Control Joint Spacing: Locate masonry control joints as recommended by NCMA TEK Manual for Concrete Masonry Design and Construction.
- 5. Masonry Expansion Joint Spacing: Locate masonry expansion joints at structural expansion joints.

L. Lintels and Bond Beams:

- 1. Provide steel lintels where shown and as specified in Section 05 50 13, Miscellaneous Metal Fabrications.
- 2. Provide masonry lintels and bond beams where shown and where openings of 16-inches or greater are shown without structural steel lintels. Provide formed-in-place masonry lintels and bond beams. Temporarily support formed-in-place lintels and bond beams.
 - a. Unless otherwise shown or indicated, provide one horizontal No. 4 deformed reinforcing bar for each four inches of wall thickness.
 - b. For hollow masonry unit walls, use specially formed U-shaped lintel and bond beam units with reinforcing bars placed as shown, filled with grout as specified in Section 04 05 11, Masonry Mortaring and Grouting.
- 3. Provide minimum bearing at each jamb, of four inches for openings less than six feet wide, and eight inches for wider openings.

4. On concrete and clay unit masonry walls where pattern bond remains visually exposed, increase minimum bearing of masonry lintels to maintain joint pattern of wall and install to be indistinguishable from surrounding masonry.
- M. Flashing of Masonry Work:
1. Provide concealed flashings in masonry Work as shown or indicated. Refer to Section 07 62 00, Sheet Metal Flashing and Trim, for flashing requirements. Prepare masonry surfaces smooth and free from projections that might puncture flashing. Place through-wall flashing on bed of mortar and cover with mortar. Seal flashing penetrations with mastic before covering with mortar. Terminate flashing 1/2-inch from face of wall, unless otherwise shown or indicated.

3.5 REPAIR, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or defective, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point up all joints at corners, openings, and adjacent Work to provide a neat, uniform appearance, properly prepared for application of sealant compounds.
- C. Tuck Pointing Existing Masonry: Refer to Section 04 01 21, Masonry Restoration and Cleaning.
- D. Cleaning Glazed Masonry Work:
1. After laying glazed masonry units, wipe off excess mortar with clean, soft, damp cloth.
 2. Clean glazed surfaces with clean water and soap powder and rinse with clear water, as recommended by unit masonry manufacturer.
 3. Do not use acid cleaning agent, abrasive tools, or powders, or metal cleaning tools or wire brushes, unless specifically recommended in writing by manufacturer.
- E. Cleaning Exposed, Unglazed Masonry Surfaces:
1. Wipe off excess mortar as the Work progresses. Dry-brush at end of each day's work.
 2. Final Cleaning: After mortar is thoroughly set and cured, clean sample wall area of approximately 20 square feet as described below. Obtain ENGINEER's acceptance of sample cleaning before proceeding to clean remainder of masonry Work.
 - a. Dry clean to remove large particles of mortar using wood paddles and scrappers. Use chisel or wire brush if required.

- b. Presoak wall by saturating with water and flush off loose mortar and dirt.
- c. Scrub down wall with stiff fiber brush and solution of half-cup of sodium hexameta phosphate and half-cup of household detergent dissolved in one gallon of water.
- d. Rinse walls, using clean, pressurized water, to neutralize cleaning solution and remove loose material.
- e. Acid cleaning of masonry is unacceptable.

F. Protection:

- 1. Protect the unit masonry construction from deterioration, discoloration, and damage during subsequent construction operations. At areas where items are installed that project from the finish plane of masonry walls, such as concrete curbs, precast concrete sills, and the like, immediately upon completion of the projecting portion of the Work, provide a minimum 3/4-inch thick plywood cover, cut to fit, to prevent damage from operations continuing above the work. Refer to Section 06 10 53, Miscellaneous Rough Carpentry.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

- 1. Pre-construction Testing:
 - a. Engage independent testing laboratory to obtain samples and conduct the following tests prior to the start of installation of unit masonry construction:
 - 1) Mortar Test: For each mix required: ASTM C780.
 - 2) Grout Test: For each mix required: ASTM C1019 and ACI 530.1.
 - 3) Prism Test: For each type of construction required: ASTM C1314 and ACI 530.1.
 - 4) Compressive strength of completed concrete unit masonry walls shall be at least 1,500 psi as determined by methods in ACI 530.1.
 - b. Obtain ENGINEER's acceptance of tests results prior to commencing installation of materials.
 - c. After initial test, ENGINEER will require performance of up to five additional tests ENGINEER's discretion.
- 2. During and After Installation:
 - a. Comply with Section 01 45 33.00.CAOH, Code-Reqd Special Inspections and Procedures.
 - b. Test and inspect unit masonry during construction in accordance with quality assurance program defined in ACI 530, ACI 530.1 and Laws and Regulations in effect at the Site, including building code. Level of special inspections shall comply with requirements of Business classification and occupancy.
- 3. Repair masonry walls that do not comply with requirements of the special inspections in a manner acceptable to ENGINEER.

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SECTION 04 05 11

MASONRY MORTARING AND GROUTING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install masonry mortaring and grouting for unit masonry (--1--) construction.
2. This Section includes masonry mortaring and grouting for masonry products specified in:
 - a. Section 04 01 21, Masonry Restoration and Cleaning.
 - b. Section 04 21 13, Brick Masonry.
 - c. Section 04 22 00, Concrete Unit Masonry.
3. Types of materials required under this Section include:
 - a. Portland cement-lime mortars.
 - b. Fire-resistant mortars.
 - c. Ready-mixed mortar
 - d. Fine grout.
 - e. Coarse grout.
 - f. Grout fill around reinforcement in masonry lintels and bond beams.
 - g. Epoxy pointing mortar.
 - h. Tuck pointing mortar
 - i. Mortar waterproofing admixtures, inorganic pigments, and other miscellaneous mortar components and additives.

B. Related Sections:

2. Section 04 01 21, Masonry Restoration and Cleaning.
3. Section 04 05 05, Unit Masonry Construction.
4. Section 04 21 13, Brick Masonry.
6. Section 04 22 00, Concrete Unit Masonry.

1.2 REFERENCES

A. Referenced Standards: Standards referenced in this Section are:

1. ANSI A108/A118/A136.1, Installation of Ceramic Tile.
2. ANSI/UL 263, Fire Resistance Ratings.
 - a. BXUV U901, Bearing Wall Rating – 4 HR.; Nonbearing Wall Rating – 4 HR.
 - b. BXUV U902, Bearing Wall Rating – 4 HR., Alternative Detail.
 - c. BXUV U904, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR.
 - d. BXUV U905, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR.

- e. BXUV U906, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR.
- f. BXUV U907, Nonbearing Wall Rating – 3 or 4 HR.
- g. BXUV U909, Nonbearing Wall Rating – 3 or 4 HR.
- h. BXUV U912, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR.
- i. BXUV U913, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR.
- j. BXUV U914, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR.
- 3. ASTM C5, Specification for Quicklime for Structural Purposes.
- 4. ASTM C144, Specification for Aggregate for Masonry Mortar.
- 5. ASTM C150/C150M, Specification for Portland Cement.
- 6. ASTM C207, Specification for Hydrated Lime for Masonry Purposes.
- 7. ASTM C270, Specification for Mortar for Unit Masonry.
- 8. ASTM C387/C387M, Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
- 9. ASTM C404, Specification for Aggregates for Masonry Grout.
- 10. ASTM C1019, Test Method for Sampling and Testing Grout.

1.3 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Do not change source or brands of mortar materials during the Project.
- B. Regulatory Requirements:
 - 1. Where fire-resistance classification is shown or indicated for unit masonry construction (four-hour, three-hour, and similar designations), proportion mortar and masonry grouts to comply with requirements established by fire rating designations of ANSI/UL 263 indicated in this Section, Laws and Regulations, and requirements of authorities having jurisdiction.
- C. Pre-submittal Meeting:
 - 1. Before submitting Samples of colored mortar for approval, CONTRACTOR and Supplier shall meet at the Site with ENGINEER to review existing mortar to be matched and to preview proposed materials and colors.
 - 2. Refer to Section 04 05 05, Unit Masonry Construction.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Schedule of locations where each mortar type will be used in the Work.
 - b. Grout mix design and material certification.
 - 2. Product Data:
 - a. Manufacturer's specifications and instructions for each manufactured material or product.

- b. Compression test results of grout mix, for identical mix previously prepared and tested, in accordance with ASTM C1019, at maximum aggregate allowed. If no previously-prepared mix is identical, perform tests on the job mix design in accordance with ASTM C1019 and submit to ENGINEER.
 - c. Product data and specifications for integral waterproofing admixture.
- 3. Samples:
 - a. Each type of colored mortar, showing range of color expected in the Work.
 - b. Label samples to indicate type and quantity of colorant used.
 - d. ENGINEER's review will be for color only. Compliance with other requirements is CONTRACTOR's responsibility.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Portland Cement: Provide the following for portland cement-lime mortars:
 - 1. ASTM C150/C150M:
 - a. Use Type I when installation temperature is 50 degrees F or higher.
 - b. Use Type III, high-early strength, when installation temperature is lower than 50 degrees F.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Type I and Type III Portland Cement, by Essroc Italcementi Group.
 - b. Type I and Type III Portland Cement, by Lehigh Portland Cement Company.
 - c. White Portland Cement Type I and Type III, by Federal White Cement Ltd.
 - d. White Portland Cement Type I and Type III, by Lehigh Portland Cement Company.
 - e. Or equal.
 - 3. Provide non-staining portland cement of natural color or of color required to be compatible with required mortar pigment color selected by ENGINEER.
- B. Hydrated Lime: ASTM C207, Type S, or lime putty ASTM C5.
- C. Sand Aggregates:
 - 1. Mortar Aggregates: ASTM C144, except for joints less than 1/4-inch use aggregate graded with 100 percent passing the No. 16 sieve.
 - 2. White Mortar Aggregates: Provide natural white sand or ground white stone for portland cement-lime mortars.
 - 3. Colored Mortar Aggregates: Provide ground marble, granite or other sound stone, as required to match the Sample approved by ENGINEER for portland cement-lime mortars.
 - 4. Fine Aggregate for Grout: ASTM C404, Size No. 1.
 - 5. Coarse Aggregate for Grout: ASTM C404, Size No. 8 or Size No. 89.

- D. Colored Mortar Pigments: Provide the following for portland cement-lime mortars:
 - 1. Commercial iron oxide, manganese dioxide, ultramarine blue, chromium oxide, or carbon black, compounded for use in mortar mixes.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. True-Tone Mortar Colors, by Davis Colors, a Subsidiary of Rockwood Pigments, Inc.
 - b. SGS Concentrated Mortar Colors, by Solomon Colors.
 - c. Or equal.
 - 3. Do not exceed pigment to cement ratios, by weight, of one-to-35 for carbon black, and one-to-seven for other pigments.
 - 4. Submit complete selection of manufacturer's standard and custom colors for final selection by ENGINEER.
- E. Ready-mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified in Article 2.1 of this Section, combined with set-controlling admixtures to produce a ready-mixed mortar complying with ASTM C270 and ASTM C387/C387M.
- F. Water: Free of injurious amounts of oils, acids, alkalis, and organic matter, and clean, fresh, and potable.
- G. Water-repellent Admixture for Exterior Cavity Block Masonry Mortar:
 - 1. Provide cross-linked acrylic polymer integral waterproofing system.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. DRY-BLOCK Mortar Admixture, by Grace Construction Products Division, W. R. Grace & Company.
 - b. Eucon Blocktite Mortar Admixture, by Euclid Chemical Company.
 - c. Or equal.
 - 3. Proportion: In accordance with manufacturer's instructions.

2.2 MORTAR MIXES

- A. General:
 - 1. Material Performance:
 - a. Masonry Strength: Refer to Section 04 05 05, Unit Masonry Construction.
 - b. If questions of compliance with the Contract Documents arise, Specifications for mortar properties shall take precedence over Specification for mortar proportions.
 - 2. Do not change proportions established for mortar approved, and do not use materials with different physical characteristics in mortar used in the Work, unless compliance with the Contract Documents for mortar properties is re-established via submittals approved by ENGINEER.
 - 4. Do not combine in mortar different air-entraining materials.
 - 5. Anti-freeze Admixture or Agents: Not allowed.
 - 6. Calcium Chloride: Not allowed.

- B. Fire-Resistant Mortar:
1. Reference Standard: ANSI/UL BXUV U901 through BXUV U914.
 2. Proportion: Use one part portland cement, three parts clean sand, and 15 percent hydrated lime (by cement volume).
- C. Mortar for All Other Unit Masonry: Comply with ASTM C270, Table 2, except limit materials to those specified in this Section. Limit cement-to-lime ratio by volume as follows:
1. Type S:
 - a. Provide the following proportions by volume:
 - 1) Portland Cement: One part.
 - 2) Hydrated Lime or Lime Putty: Over 1/4 to 1/2, maximum.
 - 3) Aggregate Ratio (measured in damp loose condition): Not less than 2-1/4 and not more than three times sum of volumes of cementitious materials.
 - b. Properties:
 - 1) Average Compressive Strength, ASTM C270: 1,800 psi.
 - 2) Minimum Water Retention, ASTM C270: 75 percent.
 - 3) Maximum Air Content, ASTM C270: 12 percent.
 2. Type N:
 - a. Provide the following proportions by volume:
 - 1) Portland Cement: One part.
 - 2) Hydrated Lime or Lime Putty: Over 1/2 to 1-1/4, maximum.
 - 3) Aggregate Ratio (measured in damp loose condition): Not less than 2-1/4 and not more than three times sum of volumes of cementitious materials.
 - b. Properties:
 - 1) Average Compressive Strength, ASTM C270: 750 psi.
 - 2) Minimum Water Retention, ASTM C270: 75 percent.
 - 3) Maximum Air Content, ASTM C270: 12 percent.
- D. Grout:
1. Fine Grout:
 - a. Provide the following proportions by volume:
 - 1) Portland Cement: One part.
 - 2) Hydrated Lime or Lime Putty: Zero to 1/10 part.
 - 3) Aggregate Ratio (measured in a damp loose condition): Sand; not less than 2-1/4 and not more than three times sum of volumes of cementitious materials.
 - b. Mix grout to have slump of ten inches plus or minus one inch at time of placement.
 2. Coarse Grout:
 - a. Provide the following proportions by volume:
 - 1) Portland Cement: One part.
 - 2) Hydrated Lime or Lime Putty: Zero to 1/10 part.
 - 3) Fine Aggregate Ratio (measured in a damp loose condition): Sand; not less than 2-1/4 and not more than three times sum of volumes of cementitious materials.

- 4) Coarse Aggregate Ratio: Not less than one and not more than two times the sum of volumes of cementitious materials.
- b. Mix grout to have slump of ten inches plus or minus one inch at time of placement.
- E. Grout Fill Around Reinforcement in Masonry Lintels: Portland cement, sand, gravel and water, to be proportioned as required to provide 28-day minimum compressive strength of 2,000 psi.
- F. Colored Pigmented Cement Mortar: For portland cement-lime mortars proportion pigments with other ingredients as follows:
 - 1. Mix to match Sample approved by ENGINEER.
 - 2. For black mortar, mix with 1/8 part black iron oxide per part of portland cement and reduce lime content to not more than 1/10 part.
- G. Colored Aggregate Mortar: For portland cement-lime mortars proportion colored aggregate with other ingredients to match existing exposed mortar.
- H. Water-repellent Admixture: Add to mix in accordance with manufacturer's written instructions.
- I. Pointing Mortar:
 - 1. Glazed Structural Tile:
 - a. Provide two-component, non-sag epoxy resin and hardener with mineral filler complying with ANSI A108/A118/A136.1.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Latapoxy 2000 with Part D (non-sag) additive, by Laticrete International, Inc.
 - 2) Hydroment Color-Poxy, by Bostik, a unit of TotalFinaElf.
 - 3) Or equal.
 - c. Colors: Complete selection of standard and custom colors for final selection by ENGINEER. Match or contrast colors of glazed structural tile as selected by ENGINEER in submittals provided.
 - d. Provide epoxy mortar capable of water-cleanup during installation but which, after curing, is waterproof.
 - 2. Tuck Pointing Mortar: Refer to Section 04 01 21, Masonry Restoration and Cleaning, for proportions of mortar.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Measurement of Materials:

1. Cement and Hydrated Lime: Batched by the bag.
2. Sand: Batched by volume in suitably calibrated containers. Make allowance for bulking and consolidation, and for weight per cubic foot of contained moisture.
3. Proportion of Volumetric Mixtures: One 94-pound sack of portland cement and one 50-pound sack of hydrated lime constitute nominal one cubic foot.
4. Shovel measurement: Unacceptable.

B. Mortar Mixing:

1. Type of Mixer: Machine mix in appropriate mixer in which quantity of water is accurately and uniformly controlled.
2. While mixer is operating, add approximately three-quarters of required water, half the sand, all the cement, and then add remainder of sand.
3. Allow batch to mix briefly and then add balance of water in small quantities until satisfactory workability is obtained.
4. Mix for not less than five minutes after all materials have been added.
5. Hydrated Lime for Mortar Requiring Lime Content: Use dry-mix method. Turn materials over together for each batch until even color of mixed, dry materials indicates that cementitious material has been thoroughly distributed throughout the mass, and then add water to obtain required plasticity.
6. Prepare lime putty, if approved for use, in accordance with ASTM C5.
7. Waterproofing Admixture: Add to mortar mix for all exterior masonry in accordance with manufacturer's instructions.
8. Mixer drum shall be completely emptied before recharging the next batch.
9. Limit batch size to avoid re-tempering. Re-tempering of mortar is not allowed.

3.3 INSTALLATION AND MORTAR AND GROUT TYPE LOCATION

A. For mortar and grout type, location, and installation requirements, refer to:

1. Section 04 01 21, Masonry Restoration and Cleaning.
2. Section 04 05 05, Unit Masonry Construction.

3.4 FIELD QUALITY CONTROL

A. Site Tests:

1. Refer to Section 04 05 05, Unit Masonry Construction, for load-bearing masonry wall strength tests.

+ + END OF SECTION + +

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SECTION 04 05 19

MASONRY ANCHORAGE AND REINFORCING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install masonry anchorages and reinforcing.
2. Section specifies masonry anchorages and reinforcing for Work specified in:
 - a. Section 04 05 05, Unit Masonry Construction.
3. Types of products required include:
 - a. Continuous horizontal wire reinforcing and ties.
 - b. Individual wire ties.
 - c. Anchoring and positioning devices.
 - d. Embedded flashing materials.
 - e. Miscellaneous masonry accessories, reinforcing bars, compressible filler, and premolded control joint strips.

B. Coordination:

1. Provide masonry anchorages and reinforcing of sizes, dimensions and configurations coordinated with unit masonry construction system component sizes, dimensions and configurations.
2. Where continuous horizontal cavity wall reinforcement is required for restraining cavity wall insulation, coordinate dimensions with specified thickness of cavity wall insulation for proper clearances. Refer to Section 07 21 05, Building Insulation.

C. Related Sections:

1. Section 04 01 21, Masonry Restoration and Cleaning.
2. Section 04 05 05, Unit Masonry Construction.
3. Section 05 20 13, Miscellaneous Metal Fabrications.
4. Section 07 21 05, Building Insulation.
5. Section 07 62 00, Sheet Metal Flashing and Trim.
6. Section 07 92 00, Joint Sealants.
7. Section 09 91 00, Painting.

1.2 REFERENCES

A. Reference Standards: Standards referenced in this Section are:

1. ACI 315, Details and Detailing of Concrete Reinforcement.
2. ASTM A36/A36M, Specification for Carbon Structural Steel.
3. ASTM A82/A82M, Specification for Steel Wire, Plain, for Concrete Reinforcement.

4. ASTM A153/A153M, Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
5. ASTM A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
6. ASTM A240/A240M, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
7. ASTM A580/A580M, Specification for Stainless Steel Wire.
8. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
9. ASTM A663/A663M, Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
10. ASTM A1008/A1008M, Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
11. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
12. ASTM B 32, Specification for Solder Metal.
13. ASTM D2240, Test Method for Rubber Property – Durometer Hardness.
14. ASTM D2287, Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
15. SMACNA, Architectural Sheet Metal Manual.
16. UL U904, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR (ANSI/UL 263).
17. UL U905, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR (ANSI/UL 263).
18. UL U906, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR (ANSI/UL 263).
19. UL U907, Nonbearing Wall Rating – 3 or 4 HR (ANSI/UL 263).
20. UL U909, Nonbearing Wall Rating – 3 or 4 HR (ANSI/UL 263).
21. UL U912, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR (ANSI/UL 263).
22. UL U913, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR (ANSI/UL 263).
23. UL U914, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR (ANSI/UL 263).

1.3 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 1. Provide all metal sheet, wire, plate and bar stock masonry anchorages and reinforcing from same manufacturer.
 2. Miscellaneous masonry accessory items other than metal sheet, wire, plate and bar stock shall each be obtained from a single, manufacturer, which may be different from the manufacturer of other products specified in this Section.

B. Regulatory Requirements:

1. Where fire-resistance classification (four-hour, three-hour, and similar designations) is shown or indicated for unit masonry construction, provide masonry anchorages and reinforcing complying with requirements established by UL tests referenced in this Section (UL U901 through UL U914, as applicable), Laws and Regulations, and requirements of authorities having jurisdiction.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Submit drawings and material schedules showing all dimensions and sizes of masonry anchorages and reinforcing coordinated with unit masonry Work and other Work in which masonry anchorages and reinforcing will be embedded, be supported from, or restrained.
 - b. Submit schedule indicating type, location, and spacing of each masonry accessory in unit masonry construction and that type, location, and spacing are in compliance with code requirements.
2. Product Data:
 - a. Manufacturer's product literature and specifications for each masonry accessory required. Include data substantiating that materials comply with the Contract Documents.

B. Informational Submittals: Submit the following:

1. Manufacturer's Instructions:
 - a. Manufacturer's instructions for handling, storing, and installing for each masonry accessory required.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with:

1. Applicable requirements of standards referenced in this Section.
2. Section 01 65 00, Product Delivery Requirements
3. Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Continuous Horizontal Wire Reinforcing and Ties: Provide the following for all masonry walls unless otherwise shown or indicated:

1. General: Provide the following:
 - a. Reinforcement, wire and ties of cold-drawn steel wire complying with ASTM A82, and hot-dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A153.

- b. Welded wire units, prefabricated in straight lengths, at least ten feet long, with matching corner “L” and intersection “T” units, all with deformed continuous nine-gage side rods and plain nine-gage truss-type diagonal cross-rods, butt-welded to side rods, not more than 16 inches on centers, with unit width of 1.5 to two inches less than thickness of wall or partition.
 - c. Rectangular boxes, pintles and ties fabricated of 3/16-inch diameter wire, unless otherwise specified.
 - 2. Single-wythe and Multi-wythe Masonry Walls (except cavity wall):
 - a. Wall reinforcement system with one horizontal rod beneath each unit masonry face shell wall.
 - b. Products and Manufacturers: Provide products of one of the following:
 - 1) Ladder Mesh Reinforcement with #120 by Hohmann & Barnard, Inc.
 - 2) Series 200 Ladder 2 Wire and, by Wire Bond.
 - 3) Or equal.
 - 3. Multi-wythe Masonry Cavity Walls:
 - a. Tab-type wall reinforcing and support system with single pair of side rods in interior wythe, four-inch wide boxes with restraint bar welded across box and adjustable rectangular pintle ties spaced not more than 16 inches on centers. Space side rods for embedment in each face shell wall of back-up wythe and extend box to allow engagement of rectangular pintle box tie for proper embedment in facing wythe.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) #270 Adjustable Ladder Eye-Wire, by Hohmann & Barnard, Inc.
 - 2) Series 600 – Ladder Adjustable Tab, by Wire Bond.
 - 3) Or equal.
- B. Individual Wire Ties for Masonry: Provide the following where shown:
 - 1. General: Provide the following:
 - a. Reinforcing, wire, and ties of cold-drawn steel wire complying with ASTM A82, and hot-dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A153.
 - b. Crimped with vee-drip for use in cavity wall construction and of length required for proper embedment in outer-most face shell walls of wythes of masonry shown or indicated.
 - c. Rectangular box ties and adjustable box ties fabricated of 3/16-inch diameter wire.
 - 2. Single-piece Ties (where facing and back-up joints align):
 - a. For use with hollow masonry units laid with cells vertical and with solid masonry units or hollow units laid with cells horizontal, provide four-inch wide rectangular shaped box-ties.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Rectangular Box Ties, by Hohmann & Barnard, Inc.
 - 2) No. 253 Rectangular Wire Ties, by Heckmann Building Products.
 - 3) Or equal.
- C. Anchoring Devices for Masonry: Provide the following, unless otherwise shown or indicated:

1. General: Provide the following:
 - a. Cold-drawn steel wire complying with ASTM A82, and hot-dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A153.
 - b. Rectangular, corrugated, one-inch wide ties, fabricated of 12-gage sheet metal, unless otherwise specified.
 - c. Size tie lengths to extend to within one-inch of outside face of outer wythe face shell of opposite face of masonry or to a maximum depth of 12 inches and between 1.5 to two inches less than width of masonry abutting webs and to maximum depth of 12 inches abutting flanges of structural supports. Provide wire crimped with a vee-drip for use in cavity wall construction.
 - d. Flexible Anchors: Where masonry abuts structural walls or framework, provide flexible anchors that allow horizontal and vertical movement of masonry, but provides lateral restraint.
 2. Anchorage to Bottom of Concrete Beams and Slabs and Bottom of Steel Beam Flanges: Provide the following for lateral restraint of unit masonry walls at bottom of beam flanges and concrete slabs:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) #PTA - 420 - Partition Top Anchors with PTA Tube, by Hohmann & Barnard, Inc.
 - 2) #419 Pin Type with #421 Plastic Tube, by Heckmann Building Products.
 - 3) Or equal.
 - b. Factory-fabricated partition anchor assembly consisting of 1/4-inch thick plate welded to 3/8-inch diameter, eight-inch long rod at center of plate face. Provide plate with two holes to accept fasteners.
 - c. Clear acrylic tube with compressible polyethylene filler, one for each rod.
- D. Miscellaneous Masonry Accessories: Provide the following where shown:
1. Reinforcing Bars:
 - a. Deformed carbon steel, ASTM A615, Grade 60 for bars No. 3 to No. 18, except as otherwise shown.
 - b. Plain carbon steel, ASTM A663, Grade 80 where No. 2 bars are shown or required.
 2. Compressible Filler: Provide watertight joint filler where unit masonry construction abuts structural framework members, or as shown. Provide the following:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Polytite Standard, by Polytite Manufacturing Corp.
 - 2) Polyseal, by Sandell Manufacturing Company, Inc.
 - 3) Or equal.
 - b. Polyurethane foam strip saturated with polybutylene waterproofing material that, when installed at a compression ratio of two-to-one, is impermeable to water.
 - c. Resilient to -40 degrees F with 100 percent movement recovery.
 - d. Elongation of 140 percent with a tensile strength of not less than 53 pounds per square inch.

3. Masonry Control Joint Components: Provide the following:
 - a. Premolded Control Joint Strips: Provide complete selection of solid extruded rubber and PVC strips with a Shore A durometer hardness of 80 to 90 complying with ASTM D2240 and ASTM D2287, designed to fit standard sash block and maintain lateral stability in masonry wall. Size and configuration shall be as shown.
 - 1) Products and Manufacturers: Provide one of the following:
 - a) #RS - Control Joints, by Hohmann & Barnard, Inc.
 - b) Control Joints, by Heckmann Building Products.
 - c) Or equal.
 - b. Sealants: Refer to Section 07 92 00, Joint Sealants.
- E. Embedded Flashing Materials
1. Self-adhering flashing with stainless steel drip edge trim.
 2. Adhesives, Primers, and Seam Tapes for Flashings:
 - a. Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to embedded substrates.

2.2 FABRICATION

- A. Weld-in-place all channel slots and other specified weld-on anchors at the shop. Field welding is unacceptable.
- B. Coordinate location of weld-on anchors and show on structural steel Shop Drawings required under Section 05 50 13, Miscellaneous Metal Fabrications.
- C. Weld anchor slots and other required accessories in place before shop priming of structural steel.
- D. Prime coat weld-on anchors and other accessories and passivate anchor coating in accordance with Section 09 91 00, Painting.
- E. Shop-fabricate reinforcing bars that are shown or required to be bent or hooked. Comply with ACI 315 for fabricating reinforcing steel for unit masonry Work.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to the following:
 1. Section 03 00 05, Concrete.
 2. Section 04 05 05, Unit Masonry Construction.
 3. Section 04 21 01, Masonry Restoration and Cleaning.

+ + END OF SECTION + +

SECTION 04 21 13

BRICK MASONRY

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified and required to furnish and install all brick masonry.
 - 2. Extent of each type of brick masonry is shown.
 - 3. Types of products required include:
 - a. Custom shapes, profiles, textures, colors, and sizes.
 - b. Building (common) brick.
 - c. Brick masonry units required to match existing.
- B. Related Sections:
 - 1. Section 04 01 21, Masonry Restoration and Cleaning.
 - 2. Section 04 05 05, Unit Masonry Construction.

1.2 REFERENCES

- A. Reference Standards: Standards referenced in this Section are:
 - 1. ASTM C62, Specifications for Building Brick (Solid Masonry Units Made from Clay or Shale).
 - 2. ASTM C216, Specifications for Facing Brick (Solid Masonry Units Made from Clay or Shale).
 - 3. ASTM C652, Specifications for Hollow Brick (Hollow Masonry Units Made from Clay or Shale).

1.3 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Obtain each type of brick masonry from one manufacturer, of uniform texture and color or uniform blend in the variation thereof, for each continuous area and for visually related areas.
 - 2. Do not change source or brands of brick masonry materials during the Work.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Product Data:

- a. Submit copies of brick manufacturer's specifications and test data for each type of brick masonry required.
 - 2. Samples:
 - a. Straps of each type of brick masonry specified. Select units to show range of color and texture expected in finished Work.
 - b. Each type of custom molded brick masonry shapes shown or required.
 - c. ENGINEER's review will be for color and texture only. Compliance with other requirements is responsibility of CONTRACTOR.
- B. Informational Submittals: Submit the following
- 1. Certifications:
 - b. Certification of Compliance: Submit certification that each type of brick masonry required complies with the Contract Documents and applicable referenced standards.
 - 2. Supplier Instructions:
 - a. Submit instructions for handling, storing, installing, and protecting each type of brick masonry.
 - 3. Source Quality Control Submittals:
 - a. Submit for approval laboratory testing acceptable to ENGINEER establishing minimum recycle content of face brick.

PART 2 – PRODUCTS

2.1 BRICK SIZE

- A. Size: Unless otherwise shown or specified, provide standard modular-size brick for 3/8-inch mortar joints. Actual size for exposed vertical brick when laid as a stretcher shall be 7-5/8 inches long by 2-1/4 inches high by 3-5/8 inches wide.
- 1. Provide custom-molded shapes, profiles, and sizes where shown and for applications that cannot be sawed from standard brick sizes.
 - 2. Where specified brick masonry is comprised of a mix or range of colors or textures, provide custom-molded brick masonry shapes in same mix or range of colors and textures as brick masonry specified.

2.2 BRICK

- A. Solid Face Brick: ASTM C216, Grade SW, complying with USGBC LEED-NC Credits 5.1 and 5.2, of the following types:
- 1. Type FBS.
 - 4. Color and Texture:
 - a. Provide complete selection of manufacturer's standard colors and textures within the following color group:
 - 1) Red color group.

- 2) Buff color group.
 - 3) Gray color group.
 - 4) Brown color group.
 - b. Custom Colors and Textures: Match approved Sample.
 - 5. Where shown or specified to “match existing”, provide brick of matching custom color, texture, shape, and size. Provide handmade shapes required to match existing detail and ornamentation.
- B. Hollow Face Brick: ASTM C652, Grade SW, complying with USGBC LEED-NC Credits 5.1 and 5.2, of the following types.
- 1.Type HBS.
 - 2.Type HBX.
 - 3.Type HBA.
 - 4. Color and Texture:
 - a. Provide complete selection of brick manufacturer’s standard colors and textures within the following color group:
 - 1) Red color group.
 - 2) Buff color group.
 - 3) Gray color group.
 - 4) Brown color group.
 - b. Custom Colors and Textures: Match existing building sample.
 - 5. Where specified or shown to “match existing”, provide brick of matching custom color, texture, shape, and size. Provide handmade shapes as required to match existing detail and ornamentation.
- C. Face Brick to Match Existing: Match custom color, texture, and size of existing face brick and comply with ASTM C216 for type required, and comply with USGBC LEED-NC Credits 5.1 and 5.2. Provide Grade SW for brick exposed to exterior. If matching brick of this grade is not available, submit to ENGINEER custom-manufactured Samples that match existing face brick.
- D. Building (Common) Brick: Per ASTM C62.
- 1. Grade SW for all exposed brick.
 - a. Where brick complying with ASTM C62 is not available, provide brick complying with ASTM C216 for the same grade specified for common brick, excluding the chippage requirements.
 - 2. Color and Texture:
 - a. Provide complete selection of brick manufacturer’s colors and textures.
 - b. Custom Colors and Textures: Match approved Sample.
 - 3. Where specified or shown to “match existing”, provide building brick of custom matching color, texture, shape, and size. Provide handmade shapes required to match existing detail and ornamentation.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to the following:
 - 1. Section 04 05 05, Unit Masonry Construction.
 - 2. Section 04 01 21, Masonry Restoration and Cleaning.

+ + END OF SECTION + +

SECTION 04 22 00

CONCRETE UNIT MASONRY

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete unit masonry.
2. Extent of each type of concrete unit masonry is shown and indicated.
3. Types of materials and features required include:
 - a. Hollow loadbearing units.
 - b. Hollow non-load-bearing units.

B. Related Sections:

1. Section 04 05 05, Unit Masonry Construction.
2. Section 07 21 05, Building Insulation.
3. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM C33, Specification for Concrete Aggregates.
2. ASTM C90, Specification for Load bearing Concrete Masonry Units.
3. ASTM C129, Specification for Non-load-bearing Concrete Masonry Units.
4. ASTM C140, Test Methods for Sampling and Testing Concrete Masonry Units.
5. ASTM C331, Specification for Lightweight Aggregates for Concrete Masonry Units.
6. ASTM C426, Test Method for Drying Shrinkage of Concrete Masonry Units.
7. ASTM C744, Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
8. ASTM C1093, Practice for Accreditation of Testing Agencies for Unit Masonry.
9. ASTM C1262, Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units.
10. UL U 904, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR.
11. UL U 905, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Testing Laboratory: In accordance with ASTM C1093.

- B. Component Supply and Compatibility:
 - 1. Obtain each type of concrete masonry units from one manufacturer, cured by one process and of uniform texture and color or an established uniform blend texture and color.
- C. Regulatory Requirements:
 - 1. Where fire resistance classification is shown (four-hour, three-hour, and similar designations) for concrete unit masonry construction, provide materials complying with requirements established by UL tests referenced in this Section (UL U901 through UL U914), Laws and Regulations including applicable building codes, and requirements of authorities having jurisdiction.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Product Data:
 - a. Manufacturer's specifications, manufacturing procedures, and test data for each material specified. Include instructions for handling, storage, installation, and protection of each type of concrete masonry unit.
 - b. Laboratory test reports in accordance with ASTM C140.
- B. Informational Submittals: Submit the following:
 - 1. Certifications: Submit certification that (-1-) concrete unit masonry has been manufactured using only licensing manufacturer's approved materials, manufacturing methods, product standards, and is in accordance with ASTM C744.
 - 2. Source Quality Control Submittals:
 - a. Submit test results as specified in this Section.
 - 3. Qualifications Statements:
 - a. Testing laboratory, if not explicitly included in submittals furnished under other Sections.

1.5 DELIVERY, STORAGE AND HANDLING

- A. At time of unloading at Site, concrete masonry units shall comply with ASTM C90, Table 2.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements: Maintain temperature in area of storage and installation so that masonry products are above 20 degrees F when installed.

PART 2 – PRODUCTS

2.1 GENERAL, CONCRETE UNIT MASONRY

- A. General:
 - 1. Unless specifically modified by other requirements of the Contract Documents, provide concrete unit masonry in compliance with classifications, weights, grades, colors, textures, scores, thermal resistance values, and other features specified in this Section.
 - 2. Cure units by autoclave treatment at minimum temperature of 350 degrees F, and minimum pressure of 125 pounds per square inch.
- B. Hollow Load-bearing Concrete Masonry Units: ASTM C90, with minimum of 15 percent coal fly ash and 50 percent recycle aggregate as part of concrete mix.
 - 1. Minimum compressive strength: 1,900-psi average of three units.
- C. Hollow Non-load-bearing Concrete Masonry Units: ASTM C129, with minimum of 15 percent coal fly ash and 50 percent recycle aggregate as part of concrete mix.
- D. Size: Manufacturer's standard units with nominal face dimensions of 16 inches long by eight inches high (15-5/8 inches by 7-5/8 inches actual).
- E. Moisture Control:
 - 1. Limit total moisture absorption until time of installation to maximum percentage specified for the weight classification in ASTM C90, Table 2.
 - 2. Total linear dry shrinkage at time of installation shall be less than 0.065 percent.
- F. Special Shapes: Provide the following:
 - 1. Lintels, bond beams, reinforcing units, and flush-end reinforcing units, interior and exterior corner shapes, solid jambs, sash block, coves, pre-molded control joint blocks, headers, and other special conditions.
 - 2. Bullnose units for outside vertical corners including doors, windows, louvers and other openings, unless specifically shown on the Drawings indicating that such feature is not required.
 - 3. End blocks at locations where masonry walls abut concrete, or steel columns, to facilitate installation of compressible filler, backer rod, and sealant or fire-rated fire stop sealant systems, if required.
- G. Waterproofing Admixture: Manufacture all types of concrete unit masonry used for constructing exterior walls (including interior Wythe of cavity walls) with integral waterproofing admixture as follows:
 - 1. Products and Manufacturers: Provide one of the following:
 - a. DRY-BLOCK System, by Grace Construction Products Division, W. R. Grace & Company.
 - b. Eucon Blocktite Integral Water-Repellent Masonry Admixture, by Euclid Chemical Company.
 - c. Or equal.

2. Material: Cross-linking acrylic polymer.
 3. Proportion: In accordance with manufacturer's instructions.
- H. Weight: Provide (medium-- weight- units using aggregate complying with-ASTM33--- producing dry net weight of not more than 125 pounds per cubic foot.
- I. Exposed Faces: Provide manufacturer's standard colors and textures as specified for type of concrete masonry unit.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to Section 04 05 05, Unit Masonry Construction.

+ + END OF SECTION + +

SECTION 05 05 33

ANCHOR SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all professional services, labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install anchor systems.
2. This Section includes all anchor systems required for the Work, but not specified under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before anchor systems Work.
2. Notify other contractors in advance of installing anchor systems to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before anchor systems Work.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ACI 318, Building Code Requirements for Structural Concrete.
2. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.
3. ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
4. ANSI B212.15, Cutting Tools - Carbide-tipped Masonry Drills And Blanks For Carbide-tipped Masonry Drills.
5. ANSI/MSS SP-58, Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.
6. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
7. ASTM A276, Specification for Stainless Steel Bars and Shapes.
8. ASTM A493, Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
9. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
10. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
11. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
12. ASTM C307, Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.

13. ASTM C881/C881M, Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
14. ASTM D695, Test Method for Compressive Properties of Rigid Plastics.
15. ASTM D790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
16. ASTM E329, Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
17. ASTM E488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.
18. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
19. ASTM F594, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
20. ASTM F1554, Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
21. FS A-A-1922A, Shield, Expansion (Caulking Anchors, Single Lead).
22. FS A-A-1923A, Concrete Expansion Anchors.
23. FS A-A-1925A, Shield, Expansion (Nail Anchors).
24. FS A-A-55614, Shield, Expansion (non-drilling expansion anchors).
25. ICC-ES AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
26. ICC-ES AC58, Acceptance Criteria for Adhesive Anchors in Masonry Elements.
27. ICC-ES AC60, Acceptance Criteria for Anchors in Unreinforced Masonry Elements.
28. ICC-ES AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
29. ICC-ES AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
30. ISO 3506-1, Mechanical Properties of Corrosion-Resistant Stainless Steel Fasteners -- Part 1: Bolts, Screws and Studs.
31. NSF/ANSI 61, Drinking Water System Components – Health Effects.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Testing Laboratory: Shall comply with ASTM E329 and shall be experienced in tension testing of post-installed anchoring systems.
2. Post-installed Anchor Installer: Shall be experienced and trained by post-installed anchor system manufacturer in proper installation of manufacturer's products.
3. Product installation training by distributors or manufacturer's representatives is unacceptable unless the person furnishing the training is qualified as a trainer by the anchor manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Listing of all anchor systems products intended for use in the Work including product type, intended location in the Project, and embedded lengths.
 - 2. Product Data:
 - a. Manufacturer's specifications, load tables, dimension diagrams, acceptable base material conditions, acceptable drilling methods, and acceptable bored hole conditions.
 - b. Copies of valid ICC ES reports that presents load-carrying capacities and installation requirements for anchor systems.
- B. Delegated Design Submittals:
 - 1. Design Data: Submit the following:
 - a. Design Calculations for delegated anchor systems. Structural calculations shall include all specified performance criteria. The magnitude of delegated system/anchorage reactions to supporting structure shall be clearly noted. Design calculations shall be signed, sealed and dated by CONTRACTOR's professional engineer.
- C. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. For each type of anchor bolt or threaded rod, submit copies of laboratory test reports and other data required to demonstrate compliance with the Contract Documents.
 - b. Post-installed anchor system manufacturer's certification that installer received training in the proper installation of manufacturer's products required for the Work.
 - c. For each adhesive anchor installer, submit ACI/CRSI Adhesive Anchor Installer Certification.
 - 2. Manufacturer's Instructions:
 - a. Installation instructions for each anchor system product proposed for use, including bore hole cleaning procedures and adhesive injection, cure and gel time tables, and temperature ranges (storage, installation and in-service).
 - 3. Field Quality Control Submittals:
 - a. Submit results of field quality control testing and inspections performed by testing laboratory.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage and Protection:
 - 1. Keep materials dry during delivery and storage.
 - 2. Store adhesive materials within manufacturer's recommended storage temperature range.
 - 3. Protect anchor systems from damage at the Site. Protect products from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. General:

1. At locations where conditions dictate that Work specified in other Sections is to be of corrosion resistant materials, provide associated anchor systems of stainless steel materials, unless other corrosion-resistant anchor system material is specified. Provide anchor systems of stainless steel materials where stainless steel materials are required in the Contract Documents.
2. Stainless Steel Nuts:
 - a. For anchor bolts and adhesive anchors, provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts for stainless steel anchors used for anchoring equipment, gates, and weirs, and other locations, if any, where the attachment will require future removal for operation or maintenance. Provide lock washer or double nuts on each anchorage device provided for equipment, as required by equipment manufacturer.
 - b. For other locations, provide for each anchorage device a nut as specified or as required by anchor manufacturer. When ASTM A194/A194M, Grade 8S (Nitronic 60) nuts are not required for anchor bolts and adhesive anchors as specified in this Section, provide anti-seizing compound where stainless steel rods are used with stainless steel nuts of the same type.
3. Materials that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

B. Design Criteria

1. Size, Length, and Load-carrying Capacity: Comply with the Contract Documents. When size, length or load-carrying capacity of anchor system is not otherwise shown or indicated, provide the following:
 - a. Anchor Bolts: Provide size, length, and capacity required to carry design load based on values and requirements of Paragraph 3.2.A of this Section. For conditions outside limits of critical edge distance and spacing in Paragraph 3.2.A of this Section, minimum anchor bolt embedment as shown or indicated in Paragraph 3.2.A of this Section apply and capacity shall be based on requirements of Laws and Regulations, including applicable building codes.
 - b. Adhesive Anchors, Expansion Anchors, or Concrete Inserts: Provide size, length, type, and capacity required to carry design load. Anchor capacity shall be based on the procedures required by the building code in effect at the Site. Where Evaluation Service Reports issued by the ICC Evaluation Service are required in this Section, anchor capacities shall be based on design procedure required in the applicable ICC Evaluation Service Report.
 - 1) General: Determine capacity considering reductions due to installation and inspection procedures, embedment length, strength

of base fastening materials, spacing, and edge distance, as indicated in the manufacturer's design guidelines. For capacity determination, concrete shall be assumed to be in the cracked condition, unless calculations demonstrate that the anchor system will be installed in an area that is not expected to crack under any and all conditions of design loading.

- 2) Concrete Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of the greater of the following: required to develop tensile strength of anchor, or a minimum embedment of 10 anchor diameters; and minimum anchor spacing and edge distance of 12 anchor diameters.
 - 3) Concrete Masonry Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.
 - 4) Concrete Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of six anchor diameters, and minimum anchor spacing and edge distance of seven anchor diameters.
 - 5) Concrete Masonry Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.
 - 6) Concrete Undercut Anchors: Unless otherwise shown or indicated in the Contract Documents, or approved by ENGINEER, provide minimum anchor spacing and edge distance as tabulated in anchor manufacturer's instructions.
2. Delegated Design: When anchor systems are used for supporting materials, equipment, or systems delegated to CONTRACTOR, Subcontractor, or Supplier, provide anchor system suitable for loads indicated in delegated design documents and consistent with the design intent expressed in the Contract Documents. Anchor system shall be designed by a professional engineer, retained by CONTRACTOR, Subcontractor, or Supplier, registered in the same state as the Site, with proper consideration of concrete strength, spacing and edge distance
- a. Design Loads. Comply with the Contract Documents. When design load of supported material, equipment, or system is not otherwise shown or indicated, provide the following:
 - 1) Equipment Anchors: Use design load recommended by equipment manufacturer. When equipment can be filled with fluid, use loads that incorporate equipment load and load imposed by fluid.
 - 2) Pipe Hangers and Supports: Use full weight of pipe, and fluid contained in pipe that are tributary to the support plus the full weight of valves and accessories located between the hanger or support being anchored and the next hanger or support.
 - 3) Hangers and Supports for Electrical Systems, and HVAC, Plumbing, and Fire Suppression Systems and Piping: Use the full

weight of supported system that is tributary to the support plus the full weight of accessories located between the hanger or support being anchored and the next hanger or support. When piping or equipment is to be filled with fluid, anchor systems shall be sized to support such loads in addition to the weight of the equipment, piping, or system, as applicable.

C. Application:

1. Anchor Bolts:
 - a. Where anchor bolt is shown or indicated, use cast-in-place anchor bolt unless another anchor type is approved by ENGINEER.
 - b. Provide anchor bolts as shown or indicated, or as required to secure structural element to appropriate anchor surface.
2. Concrete Adhesive Anchors:
 - a. Use where adhesive anchors are shown or indicated for installation in concrete.
 - b. Suitable for use where subject to vibration.
 - c. Suitable for use in exterior locations or locations subject to freezing.
 - d. Suitable for use in submerged, intermittently submerged, or buried locations.
 - e. Do not use in overhead applications, unless otherwise shown or approved by ENGINEER.
 - f. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.
3. Concrete Masonry Adhesive Anchors:
 - a. Use where adhesive anchors are shown or indicated for installation in grout-filled or hollow masonry units.
 - b. Suitable for use where subject to vibration.
 - c. Suitable for use in exterior locations or locations subject to freezing.
 - d. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.
4. Concrete Wedge Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation in concrete.
 - b. Do not use where subject to vibration.
 - c. Do not use in exterior locations or locations subject to freezing.
 - d. Do not use in submerged, intermittently submerged, or buried locations.
 - e. Suitable for use in overhead applications.
5. Grout-filled Concrete Masonry Wedge Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation on the interior face of grout-filled unit masonry.
 - b. Do not use where subject to vibration.
 - c. Do not use in exterior locations or locations subject to freezing.
6. Hollow Concrete Masonry Sleeve Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation in hollow concrete unit masonry or solid brick.

- b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use where subject to vibration.
 - d. Do not use in exterior locations or locations subject to freezing.
- 7. Drop-in Expansion Anchors:
 - a. Use drop-in expansion anchors installed in concrete where light-duty anchors are required to support piping or conduit two-inch diameter or smaller.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use where subject to vibration.
 - d. Do not use at submerged, intermittently submerged, or buried locations.
 - e. Do not use in exterior locations or locations subject to freezing.
 - f. Suitable for use in overhead applications.
- 8. Concrete Undercut Anchors:
 - a. Use where undercut anchors are shown or indicated for installation in concrete.
 - b. Suitable for use where subject to vibration.
 - c. Do not use in submerged, intermittently submerged, or buried locations.
 - d. Do not use in exterior locations or locations subject to freezing.
 - e. Suitable for use in overhead applications.
- 9. Concrete Inserts:
 - a. Use only where shown or indicated in the Contract Documents.
 - b. Allowed for use to support pipe hangers and pipe supports for pipe size and loading recommended by the concrete insert manufacturer.
- 10. Drive-In Expansion Anchors:
 - a. Use drive-in expansion anchors installed in concrete, precast concrete, grouted masonry units, or brick, where light-duty anchors are required to support piping or conduit one-inch diameter and smaller.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use in overhead applications.
- 11. For Use in Precast Concrete Planks:
 - a. To support piping or conduit two-inch diameter and smaller, use low-profile drop-in anchors, hollow concrete masonry adhesive anchors, or through-bolts.
 - b. For piping greater than two-inch diameter, or to support safety-related systems, use through-bolts. Each through-bolt shall consist of threaded rod, nuts, washers, and bearing plate.

2.2 MATERIALS

A. Anchor Bolts:

1. Interior Dry Non-corrosive Locations: Provide straight threaded carbon steel rods complying with ASTM F1554, Grade 36, with heavy hex nuts complying with ASTM A563 Grade A, unless otherwise shown or indicated on the Drawings. Hooked anchor bolts are unacceptable.
 2. Exterior, Buried, Submerged Locations, or When Exposed to Wastewater: Provide stainless steel straight threaded rods complying with ASTM F593, AISI Type 316, Condition A, with ASTM F594, AISI Type 316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required. Other AISI types may be used when approved by ENGINEER. Hooked bolts are unacceptable.
 3. Equipment: Provide anchor bolts complying with material requirements of this Section and equipment manufacturer's requirements relative to size, embedment length, and anchor bolt projection. Anchor bolts shall be straight threaded rods with washers and nuts as specified in this Section. Hooked bolts are unacceptable.
 4. Anchoring of Structural Elements: Provide anchor bolts of size, material, and strength shown or indicated in the Contract Documents.
- B. Concrete Adhesive Anchors:
1. General:
 - a. Adhesive anchors shall consist of threaded rods anchored into hardened concrete using an adhesive system.
 2. Products and Manufacturers: Provide one of the following:
 - a. HIT-RE 500-V3 Injection Epoxy Adhesive Anchoring System, by Hilti Fastening Systems, Inc.
 - b. HIT-HY 200-A and HIT-HY 200-R Adhesive Anchoring System, by Hilti Fastening Systems, Inc
 - c. SET-XP Adhesive anchoring system, by Simpson Strong-Tie Company, Inc.
 - d. Or equal.
 3. Adhesive:
 - a. Adhesive system shall use two-component adhesive mix.
 - b. Adhesives shall have a current evaluation report by ICC Evaluation Service for use in both cracked and uncracked concrete with seismic recognition for SDC A through F as tested and assessed in accordance with ICC-ES AC308, which incorporates the requirements of ACI 355.4-11
 - c. Adhesives shall have minimum bond strength and minimum design bond strength in accordance with Table 05 05 33-A:

TABLE 05 05 33-A:
ADHESIVE BOND STRENGTH ^{1,2}

Bond Strength (psi)					
Rod Diameter	Uncracked Concrete	Cracked Concrete	Dowel Size	Uncracked Concrete	Cracked Concrete
1/2-inch	1670	880	#4	1500	1080
5/8-inch	1670	750	#5	1460	1090
3/4-inch	1670	665	#6	1415	1015
7/8inch	1525	610	#7	1370	835

1-inch	1360	595	#8	1330	760
-	-	-	#9	1560	850
1.25-inch	1070	595	#10	1240	475

Table Notes:

1. Bond strengths listed for hammer-drilled, dry hole.
2. Bond strengths listed for maximum short term concrete temperature of 130 degrees F and maximum long term concrete temperature of 110 degrees F.

4. Anchor:

- a. Provide continuously-threaded, AISI Type 316 stainless steel adhesive anchor rod. Threaded rods shall comply with the concrete adhesive anchor manufacturer's specifications as included in the ICC Service Evaluation Report for the anchor submitted. Nuts shall have specified proof load stresses equal to or greater than the minimum tensile strength of the stainless steel threaded rod used. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

C. Concrete Masonry Adhesive Anchors:

1. General:

- a. Grout-filled concrete masonry adhesive anchors shall consist of threaded rods anchored into grout-filled concrete block masonry using an adhesive system.
- b. Hollow concrete masonry adhesive anchors shall consist of threaded rods with a cylindrical mesh steel or plastic screen tube anchored into hollow concrete block masonry using an adhesive system.

2. Products and Manufacturers: Provide one of the following:

- a. HIT-HY 270 Hybrid Adhesive Anchor System, by Hilti Fastening Systems, Inc.
- b. Acrylic-Tie Adhesive, by Simpson Strong-Tie Company, Inc.
- c. Or equal.

3. Adhesive:

- a. Adhesive system shall use two-component adhesive mix.
- b. Adhesives shall have current ICC Evaluation Service Report for use in grout-filled concrete masonry, tested and assessed in accordance with ICC-ES AC 58 and ICC-ES AC 60.

4. Anchor:

- a. Provide stainless steel adhesive anchor rod complying with ASTM F593, AISI Type 316, Condition CW, with ASTM F594, AISI Type 316 stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

5. Mesh Screen Tube (for hollow masonry applications):

- a. Provide with mesh size, length, and diameter as specified by adhesive anchor manufacturer.

D. Concrete Wedge Expansion Anchors:

1. General:

- a. Concrete wedge expansion anchors shall consist of stud, wedge, nut, and washer.

2. Products and Manufacturers: Provide one of the following:
 - a. Kwik Bolt TZ Wedge Anchor, by Hilti Fastening Systems, Inc.
 - b. Strong Bolt 2 Wedge Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
 3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4.
 4. Provide concrete wedge expansion anchors suitable for use in cracked and uncracked concrete in accordance with ACI 318 Chapter 17 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete wedge anchors in accordance with ACI 355.2 prequalification tests.
 4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 5. Other Locations: Provide expansion anchors complete with nuts and washers, AISI Type 304 stainless steel anchor body, in accordance with ASTM A276 or ASTM A493.
 6. Concrete wedge expansion anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete with seismic recognition in seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.
- E. Grout-filled Masonry Wedge Expansion Anchors:
1. General:
 - a. Grout-filled masonry wedge expansion anchors shall each consist of stud, wedge, nut, and washer.
 2. Product and Manufacturers: Provide one of the following:
 - a. Kwik-Bolt 3 Expansion Anchors, by Hilti Fastening Systems, Inc.
 - b. Wedge-All Wedge Anchors, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
 3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4.
 4. Anchors shall be non-bottom bearing type with single-piece steel expansion clip providing 360-degree contact with base material and shall not require oversized holes for installation.
 4. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 5. Grout-filled masonry wedge expansion anchors shall have a current ICC Evaluation Service report for use in fully-grouted concrete masonry construction when tested and assessed in accordance with ICC-ES AC01.
- F. Hollow Concrete Masonry Sleeve Expansion Anchors:
1. General:
 - a. Sleeve expansion anchors shall each consist of an externally threaded stud with full length expanding sleeve.
 2. Products and Manufacturers: Provide one of the following:
 - a. HLC Sleeve Anchors, by Hilti Fastening Systems, Inc.
 - b. Dynabolt Sleeve Anchors, by ITW Red Head.
 - c. Or equal.
 3. Anchors shall comply with physical requirements of FS A-A-1922A. Anchors shall be non-bottom bearing type with single-piece steel expansion

sleeve providing 360-degree contact with base material, and shall not require oversized holes for installation.

4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
5. Other Locations: Provide expansion anchors complete with nuts and washers, Type 304 stainless steel, in accordance with ASTM A276 or ASTM A493.

G. Drop-in Expansion Anchors:

1. General:
 - a. Drop-in expansion anchors shall each consist of an internally threaded, deformation-controlled expansion anchor with pre-assembled expander plug.
2. Products and Manufacturers: Provide one of the following:
 - a. HDI Drop-In Anchors, by Hilti Fastening Systems, Inc.
 - b. Drop-In Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
3. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633, complying with physical requirements of FS A-A-55614, Type I. Anchors shall be flush or shell type. Provide low-profile anchors for use in precast concrete planks.

H. Concrete Undercut Anchors:

1. General:
 - a. Each concrete undercut anchor shall consist of threaded stud, thick-walled expansion sleeve, expander coupler, and nut and washer. Anchors shall be pre-set type or through-set type, as shown on the Drawings.
2. Products and Manufacturers: Provide one of the following:
 - a. HDA Undercut Anchor, by Hilti Fastening Systems, Inc.
 - b. DUC Ductile Undercut Anchor, by USP Structural Connectors.
 - c. Or equal
3. Provide concrete undercut expansion anchors in accordance with ACI 318 Chapter 17 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete undercut anchors in accordance with ACI 355.2 prequalification tests.
4. Installed anchor shall exhibit form fit between bearing elements and the undercut in the concrete.
5. Interior Dry Non-Corrosive Locations: Provide carbon steel anchors, complete with nuts and washers, zinc plated, in accordance with ASTM B633.
6. Other Locations: Provide stainless steel anchors, complete with nuts and washers, manufactured of AISI Type 316 stainless steel or materials complying with ISO 3506-1 and having corrosion resistance equivalent to AISI Type 316 stainless steel.
7. Concrete undercut anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete for seismic

recognition for seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.

I. Concrete Inserts:

1. Manufacturers: Provide products of one of the following:
 - a. Unistrut Corporation.
 - b. Cooper B-Line, Inc.
 - c. Anvil International, Inc.
 - d. Or equal.
2. Spot Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall comply with ANSI/MSS SP-58, malleable iron, Type 18. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Provide nuts compatible with insert and to suit threaded hanger rod sizes.
3. Continuous Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall be continuous type and shall be manufactured from minimum 12-gage cold-formed channel sections, complying with ASTM A1011/A1011M, stainless steel, Grade 33, complete with styrofoam inserts, end caps, and means for attaching to forms. Provide channel nuts compatible with insert suitable for threaded hanger rod sizes.
4. Provide inserts with plain finish.

J. Drive-In Expansion Anchors:

1. General:
 - a. Drive-In expansion anchors shall each consist of stainless steel drive pin and expanding alloy body.
2. Products and Manufacturers: Provide one of the following:
 - a. Metal HIT Anchor, by Hilti Fastening Systems, Inc.
 - b. Zinc Nailon Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
3. Provide Type 304 stainless steel drive pin with zinc alloy body. Anchor shall comply with physical requirements of FS A-A-1925A, Type 1.

K. Unless approved by ENGINEER, do not use power-actuated fasteners or other types of bolts and fasteners not specified in this Section.

L. Anti-Seizing Compound:

1. Products and Manufacturers: Provide one of the following:
 - a. Pure Nickel Never-Seez, by Bostik.
 - b. Nickel-Graf, by Anti-Seize Technology.
 - c. Or equal.
2. Provide pure nickel anti-seizing compound.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials will be installed and advise ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Anchor Bolts:
1. Provide anchor bolts as shown or indicated in the Contract Documents, or as required to secure structural element to the appropriate anchor surface.
 2. Locate and accurately set anchor bolts using templates or other devices as required, prior to placing concrete. Wet setting of anchor bolts is unacceptable.
 3. Protect threads and shank from damage during installation and subsequent construction operations.
 4. Unless otherwise shown or approved by ENGINEER anchor bolts shall comply with Table 05 05 33-B:

**TABLE 05 05 33-B:
SINGLE ANCHOR ALLOWABLE LOADS ON ANCHOR BOLTS ¹**

Bolt Diameter (inch)	F1554 Grade 36				F1554			
	F593 Type 316, Condition A				Grade 55			
	Minimum Embedment (inch)	Minimum Edge Distance and Spacing ² (inch)	Shear ^{3,4} (lb)	Tension ³ (lb)	Minimum Embedment (inch)	Minimum Edge Distance and Spacing ² (inch)	Shear ³ (lb)	Tension ³ (lb)
1/2	6	9	1,262	2,420	8.5	12.75	1,660	3,190
5/8	7.5	11.25	2,010	3,860	10.5	15.75	2,640	5,080
3/4	9	13.5	2,974	5,720	13	19.5	3,910	7,520
7/8	10.5	15.75	4,106	7,890	15	22.5	5,400	10,390
1	12	18	5,386	10,360	17	25.5	7,090	13,450
1 1/8	13.5	20.25	6,787	13,052	19	28.5	8,930	16,580
1 1/4	15	22.5	8,617	16,572	21	31.5	11,340	20,040

Table Notes:

1. Table is based on ACI 318 Chapter 17 and ACI 350, Appendix D, $f'_c = 4000$ psi. Table 05 05 33-B is not applicable to anchor bolts embedded in grouted masonry.
2. Critical edge distance and spacing are indicated in the table. Capacity of anchor bolts for other combination of edge distances and spacing shall be evaluated in accordance with ACI 318 Chapter 17 and ACI 350, Appendix D.
3. Values for shear and tension listed are not considered to act concurrently. Interaction of tension and shear will be evaluated by ENGINEER in accordance with ACI 318 Chapter 17 and ACI 350, Appendix D.

- B. Adhesive Anchors, Undercut Anchors, and Expansion Anchors – General:

1. Prior to drilling, locate existing reinforcing steel in vicinity of proposed holes. If reinforcing conflicts with proposed hole location, obtain ENGINEER's approval of alternate hole locations to avoid drilling through or damaging existing reinforcing bars.

C. Adhesive Anchors:

1. Installation conditions shall comply with all requirements of the approved product Evaluation Service Report (ESR), including "Conditions of Use." Comply with manufacturer's written installation instructions and the following.
2. Drill holes to adhesive system manufacturer's recommended drill bit diameter to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits that comply with the tolerances of ANSI B212.15. Core-drilled holes are unacceptable.
3. Before setting adhesive anchor, hole shall be made free of dust and debris by method recommended by adhesive anchor system manufacturer. Hole shall be brushed with adhesive system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
4. Before injecting adhesive, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
5. Prior to injecting adhesive into the drilled hole, dispense, to a location appropriate for such waste, an initial amount of adhesive from the mixing nozzle, until adhesive is uniform color.
6. Inject adhesive into hole through injection system-mixing nozzle and necessary extension tubes, placed to bottom of hole. Discharge end shall be withdrawn as adhesive is placed but kept immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during anchor placement.
7. Twist anchors during insertion into partially-filled hole to guarantee full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.
8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining Work that could place load on installed adhesive anchors. Do not begin adjoining Work until adhesive anchors are successfully tested or when allowed by ENGINEER.
9. Limitations:
 - a. Core drilled holes shall not be allowed.
 - b. At time of anchor installation, concrete shall have compressive strength (f'_c) of not less than 3,000 psi.
 - b. At time of anchor installation, concrete shall have age of not less than 21 days.
 - c. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with anchor systems

manufacturer's requirements during installation and curing of adhesive anchor system.

- d. Oversized Holes: Advise ENGINEER immediately if size of drilled hole is larger than recommended by anchor system manufacturer. Cost of corrective measures, including but not limited to redesign of anchors due to decreased anchor capacities, shall be paid by CONTRACTOR.
- e. Embedment depths shall be based on installation in normal-weight concrete with compressive strength of 3,000 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.
- f. Obstructions in drill path: When existing reinforcing steel is encountered during drilling, stop and do not damage existing reinforcing. Obtain ENGINEER approval for any required modifications.

D. Expansion Anchors:

- 1. Comply with expansion anchor manufacturer's written installation instructions and the following:
- 2. Drill holes using anchor system manufacturer's recommended drill bit diameter and to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances of ANSI B212.15. Core drilled holes are unacceptable.
- 3. Before installing anchor, hole shall be made free of dust and debris by method recommended by anchor system manufacturer. Hole shall be brushed with anchor system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
- 4. Before installing anchor, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
- 5. Protect threads from damage during anchor installation. Drive anchors not less than four threads below surface of the attachment. Set anchors to anchor manufacturer's recommended torque using a torque wrench.
- 6. Limitations:
 - a. At time of anchor installation, concrete shall have age of not less than 7 days.
 - b. At time of anchor loading, concrete shall have attained full specified compressive strength (f'c).

E. Concrete Undercut Anchors:

- 1. Comply with undercut anchor manufacturer's written installation instructions and the following.
- 2. Protect threads from damage during anchor installation.
- 3. Drill hole to anchor manufacturer's specified depth and diameter using a drill bit matched to the specific anchor.
- 4. Before setting the undercut anchor, hole shall be free of dust and debris using method recommended by undercut anchor system manufacturer. Hole shall be blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.

5. Insert the anchor by hand until anchor reaches bottom of hole.
6. Set anchor in accordance with manufacturer's instructions using anchor manufacturer's specified setting tool.
7. Verify that the setting mark is visible on the threaded rod above the sleeve.
8. Anchor shall be set to manufacturer's recommended torque, using a torque wrench.
9. Limitations:
 - a. At time of anchor installation, concrete shall have age of not less than 7 days.
 - b. At time of anchor loading, concrete shall have attained full specified compressive strength (f'_c).

F. Concrete Inserts:

1. Comply with concrete insert manufacturer's installation instructions.
2. Inserts shall be flush with slab bottom surface.
3. Protect embedded items from damage during concrete placing. Ensure that embedded items are securely fastened to prevent movement during concrete placing, and ensure that embedded items do fill with concrete during concrete placing.
4. Inserts intended for piping greater than four-inch diameter shall be provided with hooked rods attached to concrete reinforcing.

G. Anti-Seizing Compound:

1. Provide anti-seizing compound in accordance with anti-seizing compound manufacturer's installation instructions, at locations indicated in Paragraph 2.1.B of this Section.
2. Do not use anti-seizing compound at locations where anchor bolt or adhesive anchor will contact potable water or water that will be treated to become potable.

3.3 CLEANING

- A. After embedding concrete is placed, remove protection and clean bolts and inserts.

3.4 FIELD QUALITY CONTROL

A. Site Tests:

1. Furnish services of independent testing laboratory to perform field quality tensile testing of production adhesive anchors at the Site, unless otherwise specified.
 - a. Testing shall comply with ASTM E488.
 - b. Test at least ten percent of all types of adhesive anchors. If one or more adhesive anchors fail the test, CONTRACTOR shall pay cost of testing all anchors of the same type installed in the Work. CONTRACTOR shall be responsible for retesting costs.
 - c. ENGINEER will direct which adhesive anchors are to be tested and indicate test load to be used

- d. Apply test loads with hydraulic ram.
- e. Displacement of post-installed anchors shall not exceed $D/10$, where D is nominal diameter of anchor being tested.
 - 1) Load each test anchor to failure.
 - 2) Testing shall comply with ASTM E488.
 - 3) Apply test loads with hydraulic ram.
- d. Anchors that fail to reach the specified test load shall be considered as not passing the test and shall be re-tested at no additional cost to OWNER.
- e. Testing agency shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.
- 3. Correct defective Work by removing and replacing or correcting, as directed by ENGINEER.
- 4. CONTRACTOR shall pay for all corrections and subsequent testing required to confirm competence in the installation of post-installed mechanical anchors.
- 5. Testing agency shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.

B. Manufacturer's Services:

- 1. Provide at the Site services of qualified adhesive manufacturer's representative during initial installation of adhesive anchor systems to train CONTRACTOR's personnel in proper installation procedures. Manufacturer's representative shall observe to confirm that installer demonstrates proper installation procedures for adhesive anchors and adhesive material.

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SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish miscellaneous metal fabrications including surface preparation and shop priming.
2. The Work also includes:
 - a. Providing openings in miscellaneous metal fabrications to accommodate the Work under this and other Sections, and attaching to miscellaneous metal fabrications all items such as sleeves, bands, studs, fasteners, and all items required for which provision is not specifically included under other Sections.
 - b. Providing openings in and attachments to miscellaneous metal fabrications to accommodate the work under other contracts, and assisting other contractors in building on or attaching to miscellaneous metal fabrications items such as bands, fasteners, and studs, and providing all items required for which provision is not specifically included under other contracts.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the Work to be installed with, or attached to miscellaneous metal fabrications Work.
2. Notify other contractors in advance of installing miscellaneous metal fabrications Work to provide other contractors with sufficient time for installing items included in their contracts that are to be installed in conjunction with or before miscellaneous metal fabrications Work.

C. Related Sections:

1. Section 03 00 05, Concrete.
2. Section 05 05 33, Anchor Systems.
3. Section 05 52 15, Aluminum Handrails and Railings.
4. Section 09 91 00, Painting,

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM A36/A36M, Specification for Carbon Structural Steel.
2. ASTM A53/A53M, Specification for Pipe Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

3. ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
6. ASTM A320/A320M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
7. ASTM A500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
8. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
9. ASTM A992/A992M, Specification for Structural Steel Shapes.
10. ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
11. ASTM B211, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.
12. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
13. ASTM B308/B308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
14. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
15. ASTM B632/B632M, Specification for Aluminum-Alloy Rolled Tread Plate.
16. AWS D1.1/D1.1M, Structural Welding Code – Steel.
17. AWS D1.2/D1.2M, Structural Welding Code – Aluminum.
18. AWS D1.6, Structural Welding Code – Stainless Steel.
19. NAAMM, Metal Finishes Manual.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Welding:

- a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, D1.2/D1.2M, or D1.6, as applicable.
- b. When requested by ENGINEER, provide certification that each welder employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.

B. Regulatory Requirements: Conform to the following:

1. 29 CFR 1910, Occupational Health and Safety Standards.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Fabrication and erection details for assemblies of miscellaneous metal Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings and templates for locating and installing miscellaneous metal items and anchorage devices.
 - 2. Product Data:
 - a. Copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal Work.
 - 3. Samples:
 - a. Sets of representative Samples of materials including nosings, rungs, and other finished products as requested by ENGINEER. ENGINEER's review will be for color, texture, style, and finish only. Compliance with other requirements is exclusive responsibility of CONTRACTOR.
- B. Informational Submittals: Submit the following:
 - 1. Test and Evaluation Reports:
 - a. Mill test report that indicate chemical and physical properties of each type of material, when requested by ENGINEER.
 - 2. Qualifications Statements:
 - a. Copies of welder's certifications, when requested by ENGINEER.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in other construction in ample time to prevent delaying the Work.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Steel:
 - 1. S-Shapes and Channels: ASTM A572/A572M, Grade 50.
 - 2. Angles, Plates, Bars: ASTM A36/A36M.
 - 3. Steel Pipe: ASTM A53/A53M, Grade B.
- B. Aluminum:
 - 1. Aluminum Tubes and Pipes: ASTM B429, Alloy 6061-T6.
 - 2. Aluminum Bars and Rod: ASTM B211, Alloy 6061-T6.
 - 3. Aluminum Plates: ASTM B209, Alloy 6061-T6.

C. Stainless Steel Fasteners and Fittings: ASTM A 320/A 320M, Type 304L or Type 316 Stainless Steel.

D. Zinc-coated Hardware: ASTM A153/A153M.

2.2 MISCELLANEOUS METAL ITEMS

A. Shop Assembly:

1. Pre-assemble items in the shop to the greatest extent possible to minimize field-splicing and field-assembly of units at the Site. Disassemble units only to extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Steel Lintels:

1. Provide loose structural steel lintels for openings and recesses in masonry walls and brick walls as specified or as shown.
2. Weld adjoining members together to form a single unit, where shown or indicated.
3. Provide not less than eight inches bearing at each side of openings, unless otherwise shown.
4. Steel lintels to be installed in exterior walls shall be hot-dip galvanized and finish painted. Other steel lintels shall be painted.
5. Surface preparation and painting shall conform to Section 09 91 00, Painting.
6. Where lintels are not shown on the Drawings, provide lintels as specified in the following table. Provide other lintels where shown and of size indicated on the Drawings.

Clear Span (Max)	Exterior Angle	Interior Angles (typical 8-inch wall)
4.0 feet	3.5 inches by 3.5 inches by 5/16 inches	Two 3.5 inches by 3.5 inches by 5/16 inches
6.0 feet	Four inches by 3.5-inches by 5/16 inches	Two 4 inches by 3.5 inches by 5/16 inches
8.0 feet	Five inches by 3.5 inches by 5/16 inches	Two 5 inches by 3.5 inches by 5/16 inches

E. Shelf Angles:

1. Provide structural steel shelf angles of sizes shown, for attachment to concrete or masonry construction. Provide slotted holes to receive 3/4-inch bolts, spaced not more than six inches from ends and not more than 2.0 feet on centers, unless otherwise shown.
 - a. Provide galvanized shelf angles on outdoor construction.
2. Provide wedge-type concrete inserts, complete with fasteners, for attachment of shelf angles to cast-in-place concrete.

- F. Miscellaneous Framing and Supports:
1. Provide miscellaneous metal framing and supports that are not part of structural steel framework and are required to complete the Work.
 2. Fabricate miscellaneous units to sizes, shapes, and profiles shown on the Drawings or, if not shown, of required dimensions to receive adjacent grating, plates, tanks, doors, and other work to be retained by the framing.
 3. Except as otherwise shown, fabricate from structural shapes, plates, and bars, of all-welded construction using mitered corners, welded brackets, and splice plates and minimum number of joints for field connection.
 4. Cut, drill, and tap units to receive hardware and similar items to be anchored to the Work.
 5. Furnish units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units are to be installed after concrete is placed.
 - a. Except as otherwise shown, space anchors, 2.0 feet on centers, and provide units the equivalent of 1.25-inch by 1/4-inch by eight-inch strips.
 - b. Galvanize exterior miscellaneous frames and supports.
 - c. Where shown or indicated, galvanize miscellaneous frames and supports that are not to be installed outdoors.
 6. Miscellaneous steel framing and supports shall be hot-dip galvanized and finish-painted, unless otherwise shown or indicated.
 7. For railings, refer to Section 05 52 15, Aluminum Handrails and Railing.
 8. Surface preparation and painting of galvanized surface shall conform to Section 09 91 00, Painting
- G. Fasteners and Hardware: Provide Type 316 stainless steel fasteners for aluminum fabrications and zinc-coated hardware for galvanized fabrications, unless otherwise shown or specified.
- H. Anchors and Expansion Anchors: Refer to Section 05 05 33, Anchor Systems.

2.3 FINISHING

- A. Surface Preparation and Shop Priming: Perform surface preparation and apply primer coat to miscellaneous metal fabrications in the shop. Conform to surface preparation and shop priming requirements in Section 09 91 00, Painting.
- B. Aluminum Finish: Provide natural mill finish for aluminum Work unless otherwise shown or specified.

2.4 SOURCE QUALITY CONTROL

- A. Tests and Inspections:
1. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures complying with the Contract Documents.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine conditions under which the Work is to be performed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install miscellaneous metal fabrications accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels. Brace temporarily or anchor temporarily in formwork where fabrications are to be built into concrete, masonry, or other construction.
- B. Anchor securely as shown and as required for the intended use, using concealed anchors where possible.
- C. Fit exposed connections accurately together to form tight, hairline joints. Field-weld steel connections that are not to be exposed joints and cannot be shop-welded because of shipping size limitations. Comply with AWS D1.1/D1.1M, D1.2/D1.2M and D1.6, as applicable to the material being welded. Grind steel 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. Protection of Aluminum from Dissimilar Materials:
 - 1. Coat surfaces of aluminum that will contact dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09 91 00, Painting.

+ + END OF SECTION + +

SECTION 05 52 15

ALUMINUM HANDRAILS AND RAILINGS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install aluminum handrail and railing systems. The Work also includes:
 - a. Providing openings in, and attachments to, aluminum handrail and railing systems to accommodate the Work under this and other Specification Sections. Provide all items for aluminum handrails and railings, including anchorages, fasteners, studs, and other items required for which provision for is not specifically included under other Sections.
 - b. Provide openings in and attachments to aluminum handrails and railings to accommodate work under other contracts. Assist other contractors in building on or attaching to aluminum handrails and railings all items such as fasteners and other items required for which provision is not specifically included under other contracts.
2. Aluminum handrails and railings Work shall include components and features shown and specified, and all components and features available from specified manufacturers required for providing complete aluminum handrail and railing system in accordance with the Contract Documents.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before aluminum handrails and railings Work.
2. Notify other contractors in advance of installing aluminum handrail and railings to provide them with sufficient time to install items included in their contracts that are to be installed with or before aluminum handrails and railings Work.
3. Aluminum handrail and railing locations shall comply with Laws and Regulations.

C. Related Sections:

1. Section 03 00 05, Concrete.
2. Section 05 05 33, Anchor Systems.
3. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AA, Aluminum Design Manual.
2. ASTM B26/B26M, Specification for Aluminum-Alloy Sand Castings.
3. ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
4. ASTM B136, Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum.
5. ASTM B137, Standard Test Method for Measurement of Coating Mass per Unit Area on Anodically Coated Aluminum.
6. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
7. ASTM B241/B241M, Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
8. ASTM B244, Standard Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments.
9. ASTM B247, Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and rolled Ring Forgings.
10. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
11. ASTM E 935, Standard Test Methods for Permanent Metal Railing Systems and Rails for Buildings.
12. NAAMM/Architectural Metal Products Division (AMP), Pipe Railing Manual.
13. NAAMM/AMP AMP 501 Finishes for Aluminum.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Upon request manufacturer shall submit document at least five years successful experience in fabricating aluminum handrail and railing systems of scope and type similar to that required.
 - b. Manufacturer shall be capable of providing custom detail drawings for the products required.
2. Installer:
 - a. Retain a single installer trained and with record of successful experience in installing aluminum handrail and railing systems.
 - b. Installer shall have record of successfully installing aluminum handrail and railing systems in accordance with recommendations and requirements of manufacturer, or shall provide evidence of being acceptable to the manufacturer.
 - c. Installer shall employ only tradesmen with specific skill and successful experience in the type of Work required.
 - d. When requested by ENGINEER, submit name and qualifications of installer with the following information for at least three successful, completed projects:

- 1) Names and telephone numbers of owner and architect or engineer responsible for each project.
 - 2) Approximate contract cost of the aluminum handrail and railing systems for which installer was responsible.
 - 3) Amount (linear feet) of aluminum handrail and railing installed.
- B. Component Supply and Compatibility:
1. Obtain all materials furnished under this Section regardless of component manufacturer, from a single aluminum handrail and railing system manufacturer.
 2. Aluminum handrail and railing system manufacturer shall review and approve or prepare all Shop Drawings and other submittals (except for delegated design submittals, when professional engineer is retained by other than handrail and railing manufacturer) for all components furnished under this Section.
 3. Components shall be specifically constructed for specified service conditions and shall be integrated into overall assembly by aluminum handrails and railings manufacturer.
- C. Regulatory Requirements: Comply with Laws and Regulations including:
1. OSHA Part 1910.28, Duty to have fall protection and falling object protection.
 2. OSHA Part 1910.29, Fall protection systems and falling object protection-criteria and practices.
- D. Certifications:
1. Submit certification, signed by authorized officer of manufacturer and notarized, stating that handrail and railing systems comply with the design prepared by the professional engineer.
 2. Submit certification, signed by authorized officer of CONTRACTOR and notarized, stating that all components and fittings are furnished by the same manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Drawings for fabrication and installation of aluminum handrail and railing systems with sizes of members, pipe wall thickness, information on components, and anchorage devices. Show all anchorages. Provide details drawn at scale of 1.5-inch equal to one foot.
 - b. Indicate required location of posts.
 - c. Indicate locations and details of all expansion joints, if any.
 - d. Indicate locations and details of gaps across seismic joints, if any.
 - e. Profile drawings of aluminum handrail and railing system components.
 - f. Custom detail drawings. Details of forming, jointing, sections, connections, internal supports, trim and accessories. Provide details drawn at scale of 1.5-inch equal to one foot.
 2. Product Data:

- a. Manufacturer's specifications, standard detail drawings, and installation instructions for aluminum handrail and railing systems.
 - b. Manufacturer's catalogs showing complete selection of standard and custom components and miscellaneous accessories for selection by ENGINEER.
 - 3. Delegated Design Submittals:
 - a. Design Data:
 - 1) Design computations or complete structural analysis of handrail and railing systems, signed and sealed by professional engineer. Professional engineer's seal shall be clearly legible, including state of registration, registration number, and name on seal.
 - 2) Certification by professional engineer that professional engineer has performed design of aluminum handrail and railing systems in accordance with performance and design criteria stated in the Contract Documents, and that design conforms to all local, state, and federal Laws and Regulations, and to prevailing standards of practice.
 - 4. Test Procedure: Submit detailed description of proposed shop testing procedures. Do not perform shop testing until ENGINEER approves shop test procedure:
- B. Informational Submittals: Submit the following:
- 1. Certificates:
 - a. Certification on source of supply, as specified in Article 1.3 of this Section.
 - b. Manufacturer certification specified in Article 1.3 of this Section.
 - 2. Qualifications Statements: Submit qualifications for the following:
 - a. Manufacturer, when requested by ENGINEER.
 - b. Professional engineer.
 - c. Installer, when requested by ENGINEER. Qualifications statement shall include record of experience with references specified.
- C. Closeout Submittals: Submit the following:
- 1. Maintenance Manuals: Furnish detailed maintenance manuals that include the following:
 - a. Product name and number.
 - b. Detailed procedures for routine maintenance and cleaning, including cleaning materials, application methods and precautions in use of products that may be detrimental to finish when improperly applied.
 - c. Handrail and railings systems manufacturer's current catalog including individual parts.
 - d. Maintenance manuals shall be in accordance with Section 01 78 23, Operations and Maintenance Data.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage and Protection:
- 1. Keep products off ground using pallets, platforms, or other supports. Protect products from corrosion and deterioration.

B. Handling of Products:

1. Do not subject handrail and railing products to bending or stress.
2. Do not damage edges or handle products in a manner that will cause scratches, warping, or dents.
3. Protect handrails and railings by paper or coating as acceptable to handrail and railing manufacturer, against scratching, splashes of mortar, paint, and other marring during transportation, handling, and erection. Protect until completion of adjacent work.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description: Aluminum handrail and railing system shall consist of equally spaced horizontal rails with totally concealed mechanical fasteners, internally threaded tubular rivets and components fastened to posts spaced no more than five feet on centers and system of handrails supported from adjacent construction by mounting brackets spaced at no more than five feet on centers.

B. Design Criteria and Performance Criteria:

1. Design, fabricate, and install aluminum handrail and railing systems to withstand the most critical effects resulting from the following loads (loads listed below do not act concurrently):
 - a. Uniform Load: 50 pounds per foot, applied at top in any direction.
 - b. Concentrated Load: 200 pounds single load, applied at any point along the top in any direction.
 - c. Components: Intermediate rails (all rails except the handrail), balusters, and panel fillers, if any, shall withstand horizontally-applied normal load of 50 pounds on an area equal to one square foot, including openings and space between rails. Reactions due to this loading are not required to be superimposed to loading specified for main supporting members of handrails and railings.
 - d. Comply with AA Aluminum Design Manual for determining allowable stresses and safety factors for aluminum structural components.
 - e. Limit deflection in each single span of railing and handrail to 1.5-inch maximum, and to 1/4-inch maximum on railing posts. Applied loads shall not produce permanent deflection in the completed Work when loads are removed.
2. Thermal Control: Provide adequate expansion within fabricated systems that allows for thermal expansion and contraction caused by material temperature change of 140 degrees F to -20 degrees F without warp or bow of system components. Distance between expansion joints shall be based on providing 1/4-inch wide joint at 70 degrees F, which accommodates movement of 150 percent of calculated amount of movement for specified temperature range.
3. Where handrail and railing systems cross expansion joints in the building or structure, provide expansion joints in handrail and railings systems.

4. For posts located at or near end of runs as shown, uniformly space intermediate posts as required to conform to loading and deflection criteria specified, at intervals no greater than maximum post spacing specified. Where posts are shown for handrails along both sides of walkways and other similar locations, locate posts opposite each other; do not stagger post locations.

2.2 MANUFACTURERS

- A. Products and Manufacturers: Provide one of the following:
 1. Custom Fabricated Connectorail System, by Julius Blum & Company, Inc.
 2. Custom Fabricated Series 500 Non-Welded Aluminum Pipe Aluminum handrails and railing systems, by Superior Aluminum Products, Inc.
 3. Or equal.

2.3 MATERIALS

- A. Extruded Aluminum Architectural and Ornamental Shapes: ASTM B221, Alloy 6063-T52.
- B. Aluminum Forgings: ASTM B247.
- C. Extruded or Drawn Aluminum Pipe and Tube:
 1. ASTM B429 or ASTM B241/B241M, Alloy 6063-T5, 6063-T52, or 6063-T832 as required by loadings, deflections, and post spacing specified.
 2. Provide Schedule 40 pipe, minimum, unless conditions of detail and fabrication require extra-heavy pipe to comply with Specifications. Rails and posts shall have minimum outside diameter of 1.90 inches.
- D. Reinforcing Bars: Solid, circular profile, two feet long, 6061-T6 aluminum reinforcing bars with same outside diameter as inside diameter of post.
- E. Anchors and Fastenings:
 1. For anchors and fasteners, use Type 316 stainless steel; minimum 3/8-inch diameter.
 2. Provide minimum of four bolt fasteners per post where surface-mounted posts are shown. Components shall be in accordance with manufacturer's recommendations and as approved or accepted (as applicable) by ENGINEER on submittals.
 3. Anchors: In accordance with Section 05 05 33, Anchor Systems.
- F. Castings:
 1. Provide high-strength aluminum alloy brackets, flanges, and fittings suitable for anodizing as specified.
 2. Aluminum alloy sand castings: ASTM B26/B26M.
- G. Connector Sleeves: Schedule 40, five-inch long by 1.610-inch diameter.

- H. Sockets: Provide six-inch deep by 2.5-inch outside diameter aluminum sockets with 3.5-inch wide socket cover on bottom of each socket and on top and bottom of removable post sockets.
- H. Custom Cover Flanges: 1/4-inch high by four-inch diameter, aluminum.
- I. Adhesive: Two-part waterproof epoxy-type as recommended by handrail and railing systems manufacturer.
- J. Non-shrink Grout: Comply with Section 03 00 05, Concrete.
- K. Toeboards:
 - 1. Provide extruded Alloy 6063-T5 or T52 aluminum alloy toeboards, unless railing is mounted on curbs or other construction of sufficient height and type to comply with OSHA 1910.23. Bars or plates are not acceptable.
 - 2. Unless otherwise specified, toeboards shall comply with OSHA 1910.23, Section (e).
- L. System Components and Miscellaneous Accessories: Provide complete selection of manufacturer's standard and custom aluminum handrail and railing systems components and miscellaneous accessories required. Show type and location of all such items on Shop Drawings and other submittals as applicable.

2.4 FABRICATION

- A. General: Unless otherwise shown or specified, provide typical non-welded construction details and fabrication techniques recommended in NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501.
- B. Fabricate handrail and railing systems true to line and level, with accurate angles surfaces and straight edges. Fabricate corners without using fittings. Provide bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces, or use prefabricated bends. Provide not less than four-inch outside radius.
- C. Remove burrs from exposed edges.
- D. Close aluminum pipe ends by using prefabricated fittings.
- E. Weep Holes:
 - 1. Fabricate joints that will be exposed to weather to exclude water.
 - 2. Provide 15/64-inch diameter weep holes at lowest possible point on each post in handrail and railing systems.
 - 3. Provide pressure relief holes at closed ends of handrail and railing systems.

- F. Toeboards:
1. Provide manufacturer's standard toeboard, that accommodates movement caused by thermal change specified without warping or bowing toeboards.
 2. Provide manufacturer's standard toeboard, which accommodates storage for removable socket covers.
 3. Coordinate and cope toeboard as required to accommodate cover flanges at posts.
 4. Toeboards shall follow curvature of railing. Where railing is shown to have curved contours at corners, or other locations, toeboard shall likewise be curved to follow line of railing system.
- G. Reinforcing Bars: Provide reinforcing bar friction-fitted at each post in railing system. Extend reinforcing bars of tubes six inches into cast-in-place sleeves or other types of supporting brackets.
- H. Mechanically Fitted Component Pipe Handrail and Railing System:
1. Use non-welded pipe handrail and railing system with posts, top and intermediate rail(s), and flush joints.
 2. Provide top and one intermediate horizontal rail(s), equally spaced.
 3. Do not use blind rivets, pop rivets, or other exposed fastening devices in the Work under this Section. Fasteners used for side-mounting fascia flanges where shown or specified may be exposed in the Work. Provide internal threaded aluminum rivets, stainless steel through-bolts with lock nuts, stainless steel sheet metal screws with lock washers, and epoxy adhesive for fastening components of the Work.

2.5 FINISHES

- A. General:
1. Prepare surfaces for finishing in accordance with recommendation of aluminum producer and the aluminum finisher or processor.
 2. Adjust and control direction of mechanical finishes specified to achieve best overall visual effect in the Work.
 3. Color and Texture Tolerance: Provide uniform color and continuous mechanical texture for aluminum components. ENGINEER reserves the right to reject aluminum materials because of color or texture variations that are visually objectionable, but only where variation exceed range of variations established by manufacturer prior to fabrication, by means of range of Samples approved by ENGINEER.
 4. Anodize aluminum components.
- B. Finish:
1. Mechanically finish aluminum by wheel or belt polishing with aluminum oxide grit of 180 to 220 size, using peripheral wheel speed of 6,000 feet per minute; AA Designation - M32 Medium Satin Directional Texture.
 2. Hand-Rubbed Finish: Where required to complete the Work and provide uniform, continuous texture, provide hand-rubbed finish to match medium satin

directional texture specified to even out and blend satin finishes produced by other means.

C. Cleaning:

1. Provide non-etching chemical cleaning by immersing aluminum in inhibited chemical solution, as recommended by coating applicator, to remove lard oil, fats, mineral grease, and other contamination detrimental to providing specified finishes.
2. Clean and rinse with water between steps as recommended by aluminum manufacturer.

D. Exposed Aluminum Anodic Coating: Provide anodic coatings as specified that do not depend on dyes, organic or inorganic pigments, or impregnation processes to obtain color. Apply coatings using only the alloy, temperature, current density, and acid electrolytes to obtain specified colors in compliance with designation system and requirements of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501. Comply with the following:

1. Provide Architectural Class I high density anodic treatment by immersing the components in tank containing solution of 15 percent sulfuric acid at 70 degrees F with 12 amperes per square foot of direct current for minimum of sixty minutes; AA Designation --A41 Clear-.
2. Physical Properties:
 - a. Anodic Coating Thickness, ASTM B244: Minimum of 0.7-mils thick.
 - b. Anodic Coating Weight, ASTM B137: Minimum of 32 mg/sq. in.
 - c. Resistance to Staining, ASTM B136: No stain after five minutes dye solution exposure.
 - d. Salt Spray, ASTM B117: 30,000 hours exposure with no corrosion or shade change.
3. Seal finished anodized coatings using deionized boiling water to seal pores and prevent further absorption.
4. Products and Manufacturers: Provide one of the following:
 - a. (Alumilite 215 Clear by Aluminum Company of America, Inc.
 - b. Or equal.

2.6 SOURCE QUALITY CONTROL

A. Allowable Tolerances:

1. Limit variation of cast-in-place inserts, sleeves and field-drilled anchor and fastener holes to the following:
 - a. Spacing: Plus-or-minus 3/8-inch.
 - b. Alignment: Plus-or-minus 1/4-inch.
 - c. Plumbness: Plus-or-minus 1/8-inch.
2. Minimum Handrails and Railings Systems Plumb Criteria:
 - a. Limit variation of completed handrail and railing system alignment to 1/4-inch in 12 feet with posts set plumb to within 1/16-inch in 3.0 feet.
 - b. Align rails so variations from level for horizontal members and from parallel with rake of stairs and ramps for sloping members do not exceed 1/4-inch in 12.0 feet.

3. Provide “pencil-line” thin butt joints.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.
- B. Verify to ENGINEER the gage of aluminum pipe railing posts and rails brought to the Site by actual measurement of on-Site material in presence of ENGINEER.

3.2 INSTALLATION

- A. General:
 1. Do not erect components that are scarred, dented, chipped, discolored, otherwise damaged, or defaced. Remove from Site railing and handrail system components that have holes, cuts, gouges, deep scratches, or dents of any kind. Repairs to correct such Work will not be accepted. Remove and replace with new material.
 2. Comply with installation and anchorage recommendations of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501 in addition to requirements specified and approved or accepted (as applicable) submittals.
- B. Fastening to In-Place Construction:
 1. Remove protective plastic immediately before installing.
 2. Adjust handrails and railings prior to securing in place, to ensure proper matching at butting joints and correct alignment throughout their length. Plumb posts in each direction. Secure posts and rail ends to building or structure as follows:
 - a. Anchor posts in concrete by providing sockets set and anchored into concrete floor slab. Provide closure secured to bottom of sleeve. Before installing posts, remove debris and water from sleeves. Verify that reinforcing bars or tubes have been inserted into posts before installation. Do not install posts without reinforcing bar. For all non-removable handrail and railing systems sections, after posts have been inserted into sockets, fill annular space between posts and sockets solid with grout as specified in Section 03 00 05, Concrete. Crown the grout and slope grout to drain away from posts.
 - c. Side-mount posts by fastening them securely in brackets attached to steel or concrete fascia as shown and in accordance with approved or accepted (as applicable) submittals.
 - e. Provide posts set in concrete with an aluminum floor cover flange.
 3. Use devices and fasteners recommended by handrail and railing systems manufacturer and as shown on approved or accepted (as applicable) submittals.

C. Cutting, Fitting, and Placement:

1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels.
2. Fit exposed connections accurately together to form tight hairline joints. Do not cut or abrade surfaces of units that have been finished after fabrication, and are intended for field connections.
3. Make permanent field splice connections using manufacturer's recommended epoxy adhesive and five-inch minimum length connector sleeves. Tight press-fit field splice connectors and install in accordance with manufacturer's written instructions. Follow epoxy manufacturer's recommendations for requirements of installation and conditions of use.
4. Make splices as near as possible to posts, but not exceeding 12 inches from nearest post.
5. Field welding is not allowed. Make splices using pipe splice lock employing a single allen screw to lock joint.
8. Secure handrails to walls with wall brackets and end fittings as shown. Drill wall plate portion of the bracket to receive one bolt, unless otherwise shown for concealed anchorage. Locate brackets as shown or, if not shown, at not more than five feet on centers. Provide flush type wall return fittings with same projection shown for wall brackets. Secure wall brackets and wall return fittings to building or structure. Refer to Section 05 05 33, Anchor Systems.
9. Securely fasten toeboards in place with not more than 1/4-inch clearance above floor level.
10. Drill one 15/64-inch diameter weep hole not more than 1/4-inch above top of location of solid reinforcing bar or tube in each post.

D. Fastening to Existing Construction:

1. Provide heavy-duty floor flange and anchorage devices and fasteners where necessary for securing handrail and railing systems components to existing construction; including stainless steel threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as required. Refer to Section 05 05 33, Anchor Systems.
2. Use devices and fasteners recommended by handrail and railing systems manufacturer and as shown on approved or accepted (as applicable) submittals.

E. Expansion Joints:

1. Provide slip joint with internal sleeve extending not less than two inches beyond joint on each side.
2. Construct expansion joints as for field splices, except fasten internal sleeve securely to one side of rail only.
3. Locate joints within six inches of posts.

F. Seismic Joints:

1. Discontinue handrails and railings on each side of seismic joints where handrails and railings cross over seismic joints in structure.
2. Comply with details shown on the Drawings.

G. Protection from Dissimilar Materials:

1. Coat aluminum surfaces in contact with dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09 91 00, Painting.
2. Do not extend coating beyond contact surfaces. Remove coating where exposed-to-view in the finished Work.

3.3 CLEANING AND REPAIRING

A. Cleaning:

1. Clean exposed surfaces of handrail and railing systems after completion of installation. Comply with recommendations of both handrail and railing system manufacturer and finish manufacturer. Do not use abrasives or unacceptable solvent cleaners. Test cleaning techniques on an unused section of railing before employing cleaning technique.
2. Remove stains, dirt, grease, and other substances by washing handrails and railings systems thoroughly using clean water and soap, then rinse with clean water.
3. Do not use acid solution, steel wool, or other harsh abrasives.
4. If stain remains after washing, remove defective sections and replace with new material complying with this Section.

B. Handrails and railings shall be free of dents, burrs, scratches, holes, and other blemishes. Replace damaged or otherwise defective Work with new material that complies with this Section at no additional cost to OWNER.

C. Prior to Substantial Completion, replace adjacent work marred by the Work of this Section.

++ END OF SECTION ++

SECTION 06 10 53

MISCELLANEOUS ROUGH CARPENTRY

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, material, tools, equipment, and incidentals as shown, specified, and required to furnish and install all miscellaneous rough carpentry Work.
2. The Work also includes:
 - a. Providing openings in miscellaneous rough carpentry to accommodate the Work under this and other Sections and building into miscellaneous rough carpentry items such as sleeves, anchorages, inserts and other items to be embedded in or penetrating miscellaneous rough carpentry for
2. Types of materials required include:
 - a. Miscellaneous blocking, furring strips, and other miscellaneous wood framing.
 - b. Lumber for temporary protection.
 - c. Lumber for temporary support.
 - d. Pressure treatment of lumber specified in this Section.
 - e. Miscellaneous accessories.
 - f. Air and water infiltration barrier system.
 - g. Vapor barrier system.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before miscellaneous rough carpentry Work.
2. Notify other contractors in advance of installing miscellaneous rough carpentry to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before miscellaneous rough carpentry Work.

C. Related Sections:

1. Section 05 05 33, Anchor Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ALSC PS 20, American Softwood Lumber Standard.
2. ASME B18.2.1 Square and Hex Bolts and Screws, Inch Series.
3. ASME B18.6.1 Wood Screws, Inch Series.

4. ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
5. ASTM D2898, Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
6. ASTM D5516, Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures.
7. ASTM D5664, Test Method for Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire-Retardant Treated Lumber.
8. ASTM D6305, Practice for Calculating Bending Strength Design Adjustment Factors for Fire-Retardant-Treated Plywood Roof Sheathing.
9. ASTM D6841, Practice for Calculating Design Value Treatment Adjustment Factors for Fire-Retardant-Treated Lumber.
10. ASTM F1667, Specification for Driven Fasteners: Nails, Spikes, and Staples.
11. AWP A M4, Care of Preservative Treated Wood Products.
12. AWP A P5, Waterborne Preservatives.
13. AWP A P17, Fire Retardant Formulations.
14. AWP A T1, Use Category System: Processing and Treatment Standard.
15. AWP A U1, Use Category System: User Specification for Treated Wood.
16. APA E445S, Performance Standards and Policies for Structural-Use Panels (APA PRP-108).
17. NIST PS-1, Construction and Industrial Plywood.
18. National Lumber Grade Authority (NLGA), Standard Grading Rules for Canadian Lumber.
19. Northeastern Lumber Manufacturers Association (NELMA), Standard Grading Rules for Northeastern Lumber.
20. Southern Pine Inspection Bureau (SPIB), Standard Grading Rules for Southern Pine Lumber.
21. West Coast Lumber Inspection Bureau (WCLIB), Standard Grading Rules.
22. Western Wood Products Association (WWPA), Western Lumber Grading Rules.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of authorities having jurisdiction and the building code referred to in Section 01 42 00, References for size, spacing and attachment of wood members, unless more stringent requirements are shown or specified in the Contract Documents.
- B. Certifications:
 1. Pressure Treatment: For each type of pressure treatment specified, submit certification by wood treating plant stating chemicals and process used, and certifying conformance with applicable standards referenced in the Contract Documents.
 - a. For water borne preservatives, include statement that moisture content of treated materials was reduced to maximum of 19 percent prior to shipment to the Site.

2. Certificates of Grade: Where appearance of wood is important and grade marks will deface the Work, in lieu of grade markings on wood, submit certificates attesting that materials comply with grade requirements specified.

1.4 SUBMITTALS

- A. Action Submittals; Submit the following:
 1. Shop Drawings:
 - a. List of species and grade of lumber proposed for each use.
 - b. Fastener schedule with location, size, material and type of each fastener to be used in the Work.
- B. Informational Submittals: Submit the following:
 1. Certificates:
 - a. Lumber treater's certification of compliance, in accordance with Paragraph 1.3.B.1 of this Section.
 - b. Certificates of grade in accordance with Paragraph 1.3.B.2 of this Section.
 2. Manufacturer's Instructions:
 - a. Chemical treatment manufacturer's instructions for proper use of each type of treated material.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 1. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete or masonry in ample time to prevent delaying the Work.
 2. Handle treated materials in accordance with AWP A M4.
 3. Comply with Section 01 65 00, Product Delivery Requirements.
- B. Storage and Protection:
 1. Keep materials dry during delivery and storage.
 2. Keep materials off ground using pallets, platforms, or other appropriate supports. Protect materials from corrosion and deterioration. Stack lumber and provide air circulation within stacks.
 3. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Lumber, General:
 1. Factory-mark each piece of lumber with type, grade, mill and grading agency. Surfaces that will be exposed to view shall not have grade marks or other types of identifying marks.

2. Nominal sizes are shown or indicated, unless otherwise shown or indicated in the Contract Documents. Provide actual sizes as required by ALSC PS 20 for moisture content specified for each use.
 - a. Provide dressed lumber, surfaced four sides (S4S), unless otherwise shown or specified.
 - b. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing.
 3. Provide the following grade and species:
 - a. Construction Grade, for material up to and including four-inch wide.
 - b. No. 2 or better for material greater than four-inch wide up to and including 12-inch wide.
 - c. No. 3 or better for material greater than 12-inch wide.
 - d. Eastern White Pine, NELMA.
 - e. Spruce-Pine-Fir, NLGA.
 - f. Hem-Fir (North), NLGA.
 - g. Southern Pine, SPIB.
 4. Lumber for Protection and Temporary Support: Size and grades to conform to Laws and Regulations, including OSHA.
- B. Plywood for Diaphragms: Provide the following:
1. NIST PS-1 rated sheathing, exterior exposure, Grade C-C, with minimum thickness shown on the Drawings, and span rating not less than 24/0.
 - a. Mark each sheet to identify plywood by species group or span rating, exposure durability classification, grade, and compliance with NIST PS-1) Surfaces that will be exposed to view shall not bear grade marks or other identifying marks.
- C. Vapor Barrier:
1. Provide reinforced rubber, modified high density polyethylene vapor barrier with perm rating of 0.045 maximum. Provide maximum widths to minimize field seaming.
 2. Provide adhesive, tapes and flashings as recommended by vapor barrier manufacturer, of type that maintains perm rating of entire vapor barrier installation.
 3. Products and Manufacturers: Provide one of the following:
 - a. VapAir Seal MD by Carlisle Syntec Systems, Division of Carlisle Construction Materials.
 - b. Or equal.
- D. Water and Air Infiltration Barrier:
1. Provide vapor permeable membrane recommended by manufacturer for installation on outside face of plywood wall siding.
 2. Provide minimum moisture vapor transmission of 35 grains per square meter per 24-hour period.
 3. Products and Manufacturers: Provide one of the following:
 - a. Tyvek Housewrap by DuPont Company Textile Fibers Department.
 - b. Typar Housewrap by Reemay, Incorporated.
 - c. Or equal.

E. Fasteners and Anchorages:

1. Fasteners exposed to the weather as well as fasteners embedded in, or in contact with, preservative treated wood shall be hot-dip galvanized.
32. Common wire nails shall conform to ASTM F1667.
3. Wood screws shall conform to ASME B18.6.1.
4. Lag screws and lag bolts shall conform to ASME B18.2.1.
5. Anchorage devices shall conform to Section 05 05 33, Anchor Systems.
6. Use joist hangers, framing anchors and clips where shown or specified.
 - a. Joist hangers shall be steel, zinc coated, sized to fit the supporting member, of sufficient strength to develop full strength of the supported member in accordance with applicable building code, and furnished complete with special nails required by joist hanger manufacturer.
 - b. Framing anchors shall be hot-dip galvanized steel conforming to ASTM A653/A653M, Z275 G90. Steel shall not be lighter than 18-gage. Use special nails furnished by manufacturer for nailing.
 - c. Clips shall consist of hot-dip galvanized conforming to ASTM A653/A653M, Z275 G90 steel angles, minimum 3/16-inch thick.

2.2 WOOD TREATMENT

- A. Preservative Treatment: Where lumber is specified in this Section as treated, comply with AWPAP5, "Alkaline Copper Quat Mixture". Mark each treated item to comply with AWPAP5 quality mark requirements.
1. Pressure-treat above ground items with water-borne preservatives in accordance with AWPAP5 and AWPAP5 T1. After treatment, kiln-dry to maximum moisture content of 19 percent. Treat materials indicated on the Drawings and the following:
 - a. Wood nailers, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - b. Wood, plates, blocking, furring, stripping, and similar concealed members and wood in contact with masonry, concrete, or steel.
 - c. Soffit and rain drainage framing.
 2. Complete the fabrication of treated items prior to treatment, wherever possible. If wood is cut after treatment, coat cut surfaces with heavy brush coat of same chemical used for treatment. Inspect each piece of wood after drying and discard damaged or defective pieces.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine substrates and supporting structure and conditions under which miscellaneous rough carpentry Work will be installed and notify ENGINEER in writing of conditions detrimental to proper completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Coordination: Fit miscellaneous rough carpentry Work to other Work and work under other contracts, as applicable, and scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of other construction.
- B. General:
 - 1. Discard units of material with defects that might impair quality of the Work, and units too small to fabricate the Work with minimum joints or optimum joint arrangement.
 - 2. Set miscellaneous rough carpentry Work accurately to required levels and lines, with members plumb and true, accurately cut and fitted.
 - 3. Securely attach miscellaneous rough carpentry Work to substrates by anchoring and fastening as shown and indicated in the Contract Documents. Countersink nail heads on exposed miscellaneous rough carpentry Work and fill holes. Make tight connections between members.
 - 4. Install fasteners without splitting of wood, pre-drill as required and for masonry anchors fastened to wood stud wall framing.
- C. Wood Grounds, Nailers, and Blocking:
 - 1. Provide where shown or indicated, and where required for attachment of other construction. Form to shapes as shown or indicated and cut as required for true line and level of Work to be attached. Coordinate location with other work involved.
 - 2. Attach substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown or indicated.
 - 3. Provide permanent grounds of dressed, preservative-treated, key-bevelled lumber not less than 1.5-inch wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.
- D. Plywood, General:
 - 1. Install in accordance with the Contract Documents and requirements of authorities having jurisdiction.
 - 2. Allow for installed clearances between individual plywood panels as specified by plywood manufacturer. Provide 1/4-inch space at panel edge joints and 1/8-inch space at panel end joints, unless otherwise recommended by manufacturer.
 - 3. Install plywood with long dimension across supports.
 - 4. Install roof sheathing using 8d helical or annular nails spaced six inches at panel edges and 12 inches at intermediate framing.
 - 5. Provide panel edge clips at unsupported edges of roof sheathing.
- E. Plywood, Diaphragm:
 - 1. Diaphragms shall be blocked or unblocked, as shown or indicated on the Drawings. Comply with nailing schedule on the Drawings.
 - 2. Provide continuous lumber blocking at unsupported edges of blocked diaphragms. Do not use panel edge clips in blocked diaphragms.

F. Air and Water Infiltration Barrier:

1. Install air and water infiltration barrier over entire wall area of wood framed building, as shown or indicated in the Contract Documents.
2. Comply with manufacturer's written installation instruction and provide large head sheathing nails sufficiently long to penetrate and grip framing studs, sills, and plates.
3. Fabric shall be snugly taunt before nailing with all fabric lapped 12-inches minimum, at splices.
4. Tape all seams along sills.

G. Vapor Barrier:

1. Install vapor barrier over entire interior room-side surfaces of exterior gypsum board perimeter walls, and over entire interior room-side surface plane of bottom of ceiling joists.
2. Install in accordance with manufacturer's written recommendations and using all taped joints and all taped fastener location to maintain perm rating of entire installed system in accordance with the Contract Documents.

+ + END OF SECTION + +

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SECTION 07 11 13

BITUMINOUS DAMPPROOFING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install bituminous dampproofing.
2. Extent of bituminous dampproofing is shown.
3. Types of products required include the following:
 - a. Cold-applied asphalt non-fibrated, solvent-based, Asbestos-free dampproofing, for exterior structure and wall surfaces above- and below-grade.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before bituminous dampproofing Work.
2. Notify other contractors in advance of installing bituminous dampproofing to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before bituminous dampproofing Work.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM D1187, Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
2. ASTM D1227, Specification for Emulsified Asphalt Used as Protective Coating for Roofing.
3. ASTM D4479, Specification for Asphalt Roof Coatings—Asbestos-Free.
4. ASTM D4586, Specification for Asphalt Roof Cement, Asbestos-Free.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Installer: Engage a single installer with successful experience installing bituminous dampproofing, and that is acceptable to or licensed by manufacturer of bituminous dampproofing materials, and that employs only workers with specific skill and successful experience in the type of Work required.

- B Component Supply and Compatibility:
 - 1. Provide all bituminous dampproofing of each type required produced by one manufacturer.
- C. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise required.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Schedule of all Project-specific surfaces where bituminous dampproofing will be applied.
 - 2. Product Data:
 - a. Manufacturer's specifications and technical data for each required dampproofing material. Indicate VOC content of materials proposed.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Submit bituminous dampproofing manufacturer's certification or other data substantiating that materials proposed for use comply with the Contract Documents, and are recommended by bituminous dampproofing manufacturer for the required applications.
 - b. Certification indicating that bituminous dampproofing materials delivered in bulk, if any, to the Site comply with the Contract Documents. Include statistical and descriptive data for each product furnished. Submit certificate with each load before using the material
 - c. Certification indicating compliance with Laws and Regulations for air quality regarding maximum VOC content for bituminous dampproofing materials.
 - d. Certification that materials furnished is Asbestos-free as required by ASTM D4479 and ASTM D4586.
 - 2. Supplier's Instructions:
 - a. Manufacturer's instructions for handling and storing.
 - b. Manufacturer's instructions for application methods and application procedures.
 - 3. Qualifications Statements:
 - a. Installer: Submit copy of manufacturer's acceptance of installer and installer's record of experience in work similar to that required under this Section.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials:
 - 1. Deliver bituminous dampproofing bulk shipments in original, unopened, undamaged containers with manufacturer's certification indicating compliance with the Contract Documents.

2. Do not store damaged or opened containers at the Site. Remove from Site and do not offer such damaged material again.
 3. Include with each bulk shipment information on the material's shelf-life, date, quantity delivered, and other information as may be required to establish acceptability of materials delivered to the Site.
- B. Storage of Materials:
1. Store emulsions at temperatures above 40 degrees F.
- C. Handling of Materials:
1. Do not open containers or mix components until preparatory Work is completed.
 2. Do not use solvent-based bituminous dampproofing without adequate ventilation. Prevent build-up of explosive and hazardous fumes.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements:
1. Do not install bituminous dampproofing when ambient air temperature is 40 degrees F or less.
 2. Do not apply bituminous dampproofing materials to frozen substrates or to substrate in condition not complying with bituminous dampproofing material manufacturer's recommendations.
 3. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General:
1. For interior and concealed-in-wall uses, provide bituminous dampproofing material that is odor-free after drying for 24 hours.
- B. Cold-Applied, Cut-Back Asphalt Dampproofing:
1. Asphalt Compound: Manufacturer's standard asphalt and cut-back solvent-based compound with mineral stabilizers, recommended for below-grade exterior and for above-grade interior applications, compounded to penetrate the substrate and build to a moisture-resistant, firm, elastic coating.
 2. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Non-Fibrated Dampproofing Material:
 - a. Provide non-fibrated type, spray-applied liquid dampproofing compound, complying with ASTM D4479, Type I.
 - b. Products and Manufacturers: Provide one of the following:

- 1) Sealmastic–Solvent, Spray-Mastic by R. W. Meadows, Incorporated.Spray-Mastic, by W.R. Meadows, Inc.
- 2) Or equal.

2.2 AUXILIARY MATERIALS

- A. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
- B. Cut-Back-Asphalt Primer: ASTM D 41.
- C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- D. Patching Compound: Asbestos-free fibered mastic of type recommended in writing by dampproofing manufacturer.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine the substrates and conditions under which bituminous dampproofing Work will be applied and advise ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. General:
 1. Do not proceed with bituminous dampproofing Work until blocking, nailers, piping, conduits, and other projections through the substrate are installed, with substrate properly patched and sealed or flashed to receive the bituminous dampproofing.
- B. Surface Preparation:
 1. Remove from the substrate dirt, oil, loose materials, and other substances that interfere with penetration, bond, and performance of bituminous dampproofing materials.
 2. Dampen with water surfaces that are dry and are to receive application of bituminous dampproofing. Keep such surfaces damp ahead of application.
 3. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

3.3 INSTALLATION- GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.

1. Apply dampproofing to provide continuous plane of protection.
 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.
1. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch-wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.
- C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
 2. Lap dampproofing at least 1/4 inch onto shelf angles supporting veneer.
- D. Where dampproofing interior face of above-grade, exterior concrete, and masonry single-wythe masonry walls, continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by dampproofing wall before constructing intersecting walls.

3.4 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

- A. Concrete Foundations and Parged Masonry Foundation Walls: one trowel coat at not less than 4 gal./100 sq. ft.
- B. Unexposed Face of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than 1.25 gal./100 sq. ft.
- C. Concrete Backup for Brick Veneer Assemblies, Stone Veneer Assemblies, and Dimension Stone Cladding: Apply one brush or spray coat at not less than 1 gal./100 sq. ft.
- D. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft.

3.5 INSTALLATION OF PROTECTION COURSE

- A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.
 1. Support protection course over cured coating with spot application of adhesive type recommended in writing by protection-board

manufacturer.

2. Install protection course on same day of installation of dampproofing (while coating is tacky) to ensure adhesion.

3.6 CLEANING

- A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

3.7 PROTECTION OF EXECUTED WORK

- A. Protect other work from spillage of bituminous dampproofing materials, and prevent such materials from penetrating and clogging drains, conductors, and other utilities.
- B. Remedy damage to other construction that is soiled or otherwise damaged during installation of bituminous dampproofing.

+ + END OF SECTION + +

SECTION 07 19 16

SILANE WATER REPELLENTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install silane water repellents.
2. Extent of surface-applied silane water repellents includes all exterior brick masonry.
3. Types of silane water repellents required include:
 - a. Liquid, colorless, non-gloss-producing, VOC-compliant, applied water repellent.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before silane water repellents Work.
2. Notify other contractors in advance of installing silane water repellents to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before silane water repellents Work.
3. Coordinate water repellent provided with sealant. Water repellent and sealant shall be compatible with each other.

C. Related Sections:

1. Section 04 21 13, Brick Masonry.

1.2 QUALITY ASSURANCE

A. Qualifications:

1. Installer:
 - a. Water repellent applicator shall be acceptable to or licensed by water repellent manufacturer and shall be regularly engaged in installing water repellent products and work similar to the Work required under this Section.

B. Component Supply and Compatibility:

1. Provide all water repellents of each type required produced by one manufacturer.

C. Regulatory Requirements:

1. VOC emissions from water repellent materials shall not exceed allow limits by regulation.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:
 - a. Manufacturer's literature and specifications on products proposed for use. Indicate VOC emissions of materials.
 - b. Detailed chemical analysis and test results of previously-performed tests of materials required under this Section applied to surfaces identical to, or similar to, those to which silane water repellents will be applied for the Project.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Manufacturer's certification indicating silane water repellent complies with or exceeds requirements of the Contract Documents.
2. Supplier's Instructions:
 - a. Manufacturer's instructions for handling, storing, and shelf-life.
 - b. Manufacturer's instructions for methods and application procedures.
3. Qualifications Statements:
 - a. Installer: Submit copy of manufacturer's acceptance of installer and installer's record of experience in work similar to that required under this Section.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's instructions for handling, storing, and shelf-life.

1.5 SITE CONDITIONS

A. Environmental Conditions for Installation:

1. Comply with manufacturer's installation instructions regarding required temperature of surface to which material is applied.
2. Do not apply water repellent when ambient air temperature is lower than 50 degrees F.
3. Do apply materials when ice or frost covers the substrate.
4. Do apply materials when ambient temperature of surface exceeds 100 degrees F.
5. Do apply materials in rainy conditions or when heavy rain is expected within four hours after application.
6. Maintain ambient temperature above 20 degrees F during 24 hours after installation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Products and Manufacturers: Provide one of the following:

1. Prime-A-Pell Plus Series 663, by Tnemec Company, Inc.
2. SL100 Water Repellent, by PROSOCO, Inc.
3. Baracade Silane 100C, by Euclid Chemical Company.
4. Or equal.

2.2 MATERIALS

- A. Chemical Bonding Water Repellents Without Silicone Resin:
 1. Provide silane solution, with or without diffused quartz carbide; colorless, and VOC-compliant.
 2. When dry, water repellent shall be colorless and without gloss.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine under which the Work will be performed. Notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Verify that surfaces to receive water-repellent are clean, and free of efflorescence, stains, oil, grease, and other foreign matter detrimental to application.
- C. Verify that required sealants have been installed in areas to receive water repellent.

3.2 PREPARATION

- A. Protection of Adjacent Surfaces:
 1. Protect adjacent surfaces that will not receive silane water repellents. When applied or splashed onto surfaces not required to receive water repellents, remove immediately, using method recommended by water repellent manufacturer. Maintain cleaning materials available at the Site for immediate use.
- B. Surface Preparation:
 1. Remove loose particles and foreign matter. Remove grease and oil using solvent, effective alkaline cleaner, or detergent as instructed by water repellent manufacturer. Scrub surfaces with water.
 2. Surfaces shall be dry prior to applying water repellent.

3.3 APPLICATION

- A. Provide water repellents in accordance with water repellent manufacturer's instructions and recommendations.

- B. Apply in two continuous, uniform coats as recommended by water repellent manufacturer. Allow to dry between coats as recommended by water repellent manufacturer.
- C. Protect materials in vicinity of application. During windy conditions, do not apply water repellent by spraying. When plants and other flora receive water repellent coating, immediately remove water repellent from plants and flora by washing.

3.4 FIELD QUALITY CONTROL

- A. Site Tests:
 - 1. Spray Test: After water repellent has dried, spray with water the surfaces to which water repellent was applied. After surfaces have adequately dried, inspect for signs of water adsorption in presents of ENGINEER, and reapply water repellent to areas that indicate water absorption.

+ + END OF SECTION + +

SECTION 07 21 05

BUILDING INSULATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install building insulation.
2. Extent of each type of building insulation is shown and indicated in the Contract Documents.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before building insulation Work.
2. Notify other contractors in advance of the installation of building insulation to provide them with sufficient time for installing items included in their contracts that must be installed with or before building insulation Work.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM C177, Test Methods for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
2. ASTM C203, Test Method for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
3. ASTM C236, Test Methods for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box.
4. ASTM C303, Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation.
5. ASTM C518, Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
6. ASTM C531, Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars and Monolithic Surfacing.
7. ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
8. ASTM C578, Specification for Rigid, Cellular Polystyrene Thermal Insulation.
9. ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.
10. ASTM C665, Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

11. ASTM D696, Test Method for Coefficient of Linear Thermal Expansion of Plastics between -30 Degrees C and 30 Degrees C with a Vitreous silica dilatometer.
12. ASTM D1621, Test Method for Compressive Properties of Rigid Cellular Plastics.
13. ASTM D2126, Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
14. ASTM E84, Test Method for Surface Burning Characteristics of Building Materials.
15. ASTM E96, Test Methods for Water Vapor Transmission of Materials.
16. ASTM E119, Test Methods for Fire Tests of Building Construction and Materials.
17. UL 1479, Fire Tests of Through-Penetration Firestops.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers:
 - a. Obtain building insulations, requiring blowing agent from manufacturer(s) that manufacture product required using blowing agent acceptable for use after the year 2036 and complying in all respects with Copenhagen Amendments to the Montreal Protocol.
 - b. Manufacturer shall provide complete technical services including preparation and review of Shop Drawings and submittals, installation methods, and proposed detailing for the Work.
2. Installer: Engage single installer for each type of building insulation. Each installer shall be skilled, trained, and have record of successful experience in applying and installing each product, and possess successful record of performing work in accordance with recommendations and requirements of manufacturer or that can submit written evidence of being acceptable to manufacturer for providing the required Work. Installers shall employ only tradesmen with specific skill and successful experience in each type of Work required. Submit to ENGINEER name and qualifications of each installer with the following information for at least three successful, completed projects per installer:
 - a. Names and telephone numbers of owner and architect or engineer responsible for each project.
 - b. Approximate contract cost of the building insulation system installed.
 - c. Quantity (area) of building insulation installed.

B. Regulatory Requirements: Comply with code interpretations by authorities having jurisdiction at the Site.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

- a. Complete selection of fire stop manufacturer's recommended systems for each condition and kind of penetration encountered in the Work. Coordinate with equipment manufacturers for required number and kind of penetrations through fire-rated construction. Provide schedule of penetrations and fire stop system to be included for each condition and kind of penetration encountered.
- 2. Product Data:
 - a. Material specifications and general recommendations from building insulation manufacturer for each type of building insulation product. Include manufacturer's data substantiating that materials comply with Contract Documents.
- B. Informational Submittals: Submit the following:
 - 1. Manufacturer's Instructions: Manufacturer's installation instructions. Indicate by copy of transmittal form that installer has received copy of manufacturer's installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling of Materials:
 - 1. Do not deliver insulation materials to the Site before the time of installation.
 - 2. Deliver materials in sufficient quantities to allow uninterrupted continuity of the Work.
 - 3. Handle materials carefully to avoid damage and breakage or compressing of boards to less than their specified thickness, or other damage.
 - 4. Handle materials in manner that prevents inclusion of foreign materials.
 - 5. Conform to Section 01 65 00, Product Delivery Requirements.
- B. Storage of Materials:
 - 1. Store materials in dry, enclosed area, off ground and away from possible contact with water, ice, and snow.
 - 2. Prevent damage to materials during storage, including minimizing the time materials are stored at the Site before being incorporated into the Work. Store only sufficient quantity of building insulation materials at the Site required for continuous advancement of the Work without causing delay.
 - 3. Conform to Section 01 66 00, Product Storage and Handling Requirements.

1.6 SITE CONDITIONS

- A. Environmental Conditions:
 - 1. Complete the installation and concealment of building insulation materials as rapidly as possible to avoid damage from adjacent construction operations and adverse weather conditions.
 - 2. Install building insulations when weather and temperature conditions comply with building insulations manufacturers' written recommendations.
 - 3. Install building insulations when damaging environmental condition are not forecasted for the time when exposed systems materials components would be exposed to potential damage from the elements.

4. Protect building insulation Work from precipitation, frost, and direct sunlight.
5. Do not apply pressure-sensitive tape when temperature is below 35 degrees F or above 110 degrees F.
6. Record decisions, conditions, and agreements to proceed with the Work when weather conditions may be unfavorable. State reasons for proceeding, along with names of persons involved, and changes or revisions (if any), if required, to allow the Work to proceed.

1.7. SCHEDULING

- A. Proceed with building insulation Work when preceding Work is ready to receive the Work of this Section.
- B. Proceed with building insulation and associated Work after curbs, blocking, substrate board, nailer strips, vents, drains and other projections through the substrates have been installed, and when substrate construction and framing of openings is complete.
- C. Proceed with and complete the Work when materials, equipment and tradesmen required for the installation of building insulation and backfilling operations are at the Site and ready to follow with the Work in manner that does not leave the Work vulnerable to damage or deterioration.
- D. Do not advance installation of building insulation beyond that necessary for proper sequencing of the Work. Do not advance the Work when there is no proper and secure protection from damaging weather and construction activities.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Performance Criteria:
 1. Thermal Conductivity: Thicknesses shown are for thermal conductivity, k-value at 75 degrees F, specified for each material.
 2. Provide adjusted thicknesses based on thicknesses shown or specified for building insulations, as required to comply with required thermal resistances for material having different thermal conductivity.

2.2 MATERIALS

- A. Glass Fiber Insulations: Provide the following types:
 1. General: Provide insulations formed from glass fibers and resinous binders fabricated into flexible blankets, semi-rigid and rigid sheets complying with ASTM C665, ASTM C553, and ASTM C612.
 2. Unfaced Batt Insulation: Provide unfaced thermal batt insulation complying with ASTM C665, Type I.
 - a. Physical Properties:

- 1) Thermal Conductivity (k), ASTM C518: 0.33 Btu/inch/hour/square foot/degree F maximum.
 - 2) Density, ASTM C303: 1.5 pounds per cubic foot (pcf).
 - 3) Flame Spread, ASTM E84: 25 maximum.
 - 4) Smoke Developed, ASTM E84: 50 maximum.
- b. Thickness: 3.5 minimum.
- c. Width: 16 inches.
- d. Products and Manufacturers: Provide one of the following:
 - 1) Unfaced Thermal Batt Insulation by Owens-Corning Fiberglass Corporation.
 - 2) Unfaced Thermal Batt Insulation by Johns Manville.
 - 3) Or equal.
3. Rigid Board Insulation: Provide thermal rigid board insulation complying with ASTM C612, Classes 1A and 1B.
 - a. Physical Properties:
 - 1) Thermal Conductivity (k), ASTM C518: 0.23 Btu/inch/hour/square foot/degree F.
 - 2) Density, Manufacturer's Certified Test: Six pounds per cubic foot (pcf.)
 - 3) Compressive Strength (psi at 10 percent deformation): 350 psi.
 - 4) Flame Spread, ASTM E84: 15.
 - 5) Smoke Developed, ASTM E84: Zero.
 - b. Thickness: Refer to Contract Documents.
 - c. Width: 2.0 feet.
 - d. Length: 4.0 feet.
 - e. Products and Manufacturers: Provide one of the following:
 - 1) Type 705, 700 Series Board Insulation by Owens-Corning Fiberglass Corporation.
 - 2) Insul-Shield Thermal Board Insulation by Johns Manville.
 - 3) Or equal.
- B. Foam Plastic Insulations: Provide the following types:
 1. General: Rigid, closed-cell, thermally stabilized, extruded, hydrochlorofluoro-carbon blown, foam board insulation consisting of 100 percent virgin extruded polystyrene modified resin complying with ASTM C578.
 2. Provide blowing agent with lowest available ozone depletion potential, such as HCFC-142b or better. HCFC-141b is not acceptable.
 3. Perimeter Foundation Insulations: Provide very high-load-resisting, rigid foam board insulation complying with ASTM C578, Type VI.
 - a. Physical Properties: Provide the following:
 - 1) Thermal Conductivity (k), ASTM C177 and ASTM C518: 0.20 Btu/inch/hour/square foot/degree F.
 - 2) Compressive Strength (psi at five percent deformation) ASTM D1621: 40 psi minimum.
 - 3) Flexural Strength, ASTM C203: 60 psi minimum.
 - 4) Coefficient of Thermal Expansion, ASTM D696: 3.5×10^{-5} inches/inch/degree F.

- 5) Water Absorption, ASTM C272: Less than 0.1 percent by volume maximum.
 - 6) Water Vapor Permeance, ASTM E96: 0.3 to 0.8 perms/inch maximum.
 - 7) Flame Spread, ASTM E84: Five.
 - 8) Smoke Developed, ASTM E84: 165 maximum.
 - b. Thickness: One layers each two inches thick.
 - c. Width: 2.0 feet.
 - d. Length: 8.0 feet.
 - e. Products and Manufacturers: Provide one of the following:
 - 1) STYROFOAM 40 HIGH LOAD by the Dow Chemical Company.
 - 2) Foamular 400 by Owens-Corning Fiberglass Corporation.
 - 3) Or equal.
4. Under-slab Insulations: Provide very high-load-resisting, rigid foam board insulation complying with ASTM C578, Type V.
- a. Physical Properties: Provide the following:
 - 1) Thermal Conductivity (k), ASTM C177 and ASTM C518: 0.20 Btu/inch/hour/square foot/degree F.
 - 2) Compressive Strength (psi at five percent deformation) ASTMD1621: 100 psi minimum.
 - 3) Flexural Strength, ASTM C203: 100 psi minimum.
 - 4) Coefficient of Thermal Expansion, ASTM D696: 3.5×10^{-5} inches/inch/degree F.
 - 5) Water Absorption, ASTM C272: Less than 0.1 percent by volume maximum.
 - 6) Water Vapor Permeance, ASTM E96: 0.3 to 0.8 perms/inch maximum.
 - 7) Flame Spread, ASTM E84: Five.
 - 8) Smoke Developed, ASTM E84: 165 maximum.
 - b. Thickness: One layers each two inches thick.
 - c. Width: 2.0 feet.
 - d. Length: 8.0 feet.
 - e. Products and Manufacturers: Provide one of the following:
 - 1) STYROFOAM 100 HIGH LOAD by the Dow Chemical Company.
 - 2) Foamular 1000 by Owens-Corning Fiberglass Corporation.
 - 3) Or equal.
- C. Mineral Fiber Insulation: Provide the following types:
- 1. General: Provide insulations formed from inorganic mineral fiber extrusions spun at 2,500 degrees F complying with ASTM C665 and ASTM C764.
 - 2. Loose Mineral Fiber Insulation: Provide non-asbestos rock, slag, or glass processed into fiber and formed into loose resilient wool mass or granular nodules complying with ASTM C764, Type 1 (for blowing) Type 2 (for pouring).
 - a. Physical Properties:
 - 1) Thermal Conductivity (k), ASTM C764: 0.46 Btu/inch/hour/square foot/degree F.
 - 2) Ignition Loss: Less than one percent (99 percent pure mineral fiber).

- 3) Density, ASTM C 64: 1.5 pounds per cubic foot (pcf).
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Industrial Mineral Wool Fiber by Rock Wool Industries, Inc.
 - 2) FBX Insulating Wool by Fibrex, Inc.
 - 3) Or equal.
 - 3. Sound Attenuation Fire Blanket Insulation: Provide insulation containing non-asbestos, non-combustible compounds of spun mineral fiber felt formed into flexible, resilient blankets complying with ASTM C665, Type I.
 - a. Physical Properties:
 - 1) Thermal Conductivity (k), ASTM C518: 0.27 Btu/inch/hour/square foot/degree F.
 - 2) Density, Manufacturer's Certified Test: 2.5 pounds per cubic foot (pcf).
 - b. Thickness: Refer to Contract Documents.
 - c. Width: 16 inches.
 - d. Products and Manufacturers: Provide one of the following:
 - 1) Thermafiber SAFB Batts by USG Interiors, Inc.
 - 2) Sound Control Fire Blankets by Fibrex, Inc.
 - 3) Or equal.
 - 4. Safing Insulation: Provide unfaced semi-rigid non-asbestos, non-combustible blankets composed of compounds of spun mineral fiber felt, complying with ASTM C665, Type I.
 - a. Physical Properties:
 - 1) Thermal Conductivity (k), ASTM C518: 0.25 Btu/inch/hour/square foot/degree F.
 - 2) Density, Manufacturer's Certified Test: Four pounds per cubic foot (pcf).
 - 3) Flame Spread, ASTM E84: 15 maximum.
 - 4) Smoke Developed, ASTM E84: Five maximum.
 - 5) Fire Resistance Rating, ASTM E119: Three hours.
 - b. Thickness: Four inches.
 - c. Width: 2.0 feet.
 - d. Products and Manufacturers: Provide one of the following:
 - 1) Thermafiber Safing Insulation by USG Interiors, Inc.
 - 2) FBX Safing Insulation by Fibrex, Inc.
 - 3) Or equal.
- D. Spray Polyurethane Foam Insulation: Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Corporation.
 - b. Dow Chemical Company (The).
 - c. Henry Company.
 - d. Or Approved Equal.

2. Minimum density of 1.5 lb/cu. ft., thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F.
- E. Fire-Stop Sealants and Other Fire-Stop System Components: Provide the following:
1. Complete selection of fire-stop manufacturer's recommended silicone rubber fire-stop systems. Provide complete systems complying with UL 1479 with two- or three-hour fire rating. Provide equal fire protection as provided by fire-rating of construction penetrated.
 2. Provide multiple component systems coordinated to meet actual conditions encountered in the Work and as recommended by fire-stop manufacturer. In addition to providing fire resistance, fire-stop systems shall also be gas and watertight.
 3. Products and Manufacturers: Provide one of the following:
 - a. 3M Fire Stop Systems by 3M, Inc.
 - b. Or equal.
- F. Miscellaneous Materials and Accessories: Provide the following:
1. Adhesive for Bonding Insulation: Type recommended by insulation manufacturer, and complying with fire resistance requirements.
 2. Mechanical Anchors: Type and size shown or, if not shown, as recommended by insulation manufacturer for type of application shown and condition of substrate.
 3. Wire Arch Insulation Supports: Manufacturer's standard 11-gage galvanized spring-steel clip wire arches, for self-anchoring into wood joists; length as needed for joist spacing.
 4. Wire Mesh Insulation Support: Two-inch by 24-gage galvanized steel wire hexagonal woven mesh.
 5. Safing Impaling Clips: Provide galvanized steel impaling clips complying with requirements of code authorities having jurisdiction at the Site and as recommended by insulation manufacturer for full system responsibility.
 6. Protection Board: Fiberboard sheathing or heavy duty asphaltic panels as recommended by insulation manufacturer.
 7. Adhesive Tapes: Complete selection of insulation manufacturer's recommended taping materials.
 8. Bitumen: Asphalt, ASTM D 449.

PART 3 – EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and installer shall examine substrate and conditions under which building insulation Work will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surfaces to receive building insulation shall be clean of all debris, dirt, and other contamination before installation begins.

3.3 INSTALLATION

- A. General:

- 1. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to Site conditions, before proceeding with the Work obtain from manufacturer and submit to ENGINEER specific installation recommendations from manufacturer.
 - 2. Extend insulations full thickness over entire surface to be insulated. Cut and fit tightly around obstructions. Fill voids with insulation.
 - 3. Apply number of layers of insulation specified, each of required thickness, or required thickness to provide thermal value shown or indicated in the Contract Documents, to make up the total thickness.

- B. Unit-type Building Insulation:

- 1. Apply insulation units of type shown or indicated to substrate by method indicated. If not otherwise indicated and except for units resting on horizontal surfaces, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
 - 2. Seal joints between closed-cell (non-breathing) insulation units by applying mastic or sealant of type recommended by the manufacturer to edge of each unit to form tight seal as units are shoved into place. Fill voids in completed installation with mastic or sealant.
 - 3. Exercise extreme care to avoid damaging and soiling of faces on insulation units that will remain exposed-to-view. Align joints accurately, with adjoining surfaces set flush.
 - 4. Set vapor barrier faced units with vapor barrier to warm side of construction, (usually toward inside), except as otherwise shown or indicated. Do not obstruct ventilation spaces, except for fire-stopping.
 - 5. Tape joints and ruptures in vapor barriers using adhesive tape of type recommended by insulation manufacturer, and seal each continuous area of insulation to surrounding construction so as to ensure vapor-tight installation of the units.
 - 6. Support underfloor blanket insulation with vapor barrier up (if any). In wood frame construction, support by continuous wire mesh stapled to bottom of joists, or on wire arches impaled into joist walls, at 12-inch spacing near bottom of joists; or provide type of blanket insulation which has permeable kraft paper face with nailing flanges.

- C. Safing Insulations and Fire-Stop Systems:

- 1. Install safing insulation and fire-stop systems to present continuous fire-rated fire barrier in areas shown and at perimeter of all fire-rated partitions and poke-through floor and wall penetrations, to maintain continuity of fire-rated construction whether or not shown.

2. Install fire stop sealants and other fire stop system components in thicknesses recommended by manufacturer at all locations where poke-through penetrations occur, at all locations where other penetrations such as ducts, pipe, cables, cable trays, and conduit occur and at perimeter of all fire-rated walls.
 3. Include all components of manufacturer's fire/smoke-stop systems for complete system responsibility installed in accordance with manufacturer's written recommendations and specifications.
- D. Cavity Wall Rigid Insulation Board:
1. Install exterior wall rigid insulation board after all concrete unit masonry Work is complete.
 2. Apply single layer of insulation cut to fit snugly and uniformly and in continuous contact with edges of continuous masonry horizontal joint reinforcement over entire plane of the wall.
 3. Apply exterior wall rigid insulation to exterior concrete unit masonry walls in areas shown or indicated as receiving masonry outer cavity wall wythes.
 4. Set units in adhesive applied in accordance with manufacturer's instructions. Use type of adhesive recommended by manufacturer of board-type cavity wall insulation.
- E. Batt-type Insulation:
1. Install batt insulation above ceilings and between studs and rafters as shown. Extend insulation full width, length, and height in areas shown.
 2. Fit tightly around obstructions to form uniform, insulated barrier.
- F. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.
- G. Correcting Defective Work:
1. System components that are dislodged, damaged, expanded, broken, penetrated, or crushed by subsequent installation operations or damaged by detrimental weather shall be immediately replaced with undamaged material in compliance with the Contract Documents and properly protected as specified.
 2. Only original installer shall repair or replace deteriorated or defective Work.

3.4 PROTECTION

- A. Protection from Elements:
1. Protect all components of the Work from detrimental weather conditions. Do not allow building insulation materials to become wet or soiled, or covered with ice or snow. Provide continuous protection of materials against damage, wetting and moisture absorption and storing materials as specified
 2. Work that cannot, for reasons acceptable to ENGINEER, be covered with complete construction system before onset of weather detrimental to the Work,

shall be completely covered and protected in manner that deflects precipitation from building insulations without damaging adjacent Work.

B. Protection During Construction:

1. Protect all components of the Work from construction operations including, but not limited to, backfilling, framing, and sheathing, aluminum siding, and concrete unit masonry Work, until work is completed and acceptable to ENGINEER.
2. Protect building insulations from damage and abuse by other contractors and installers until readiness for final payment.
3. Do not allow building insulations to come into contact with welding operations or other fire or ignition sources.
4. Do not allow construction traffic not associated with installation of building insulation in the area of building insulation Work. Protect the area from access by other installers and contractors until the building insulation Work has been incorporated into finished construction systems.

C. Building insulation that becomes wet, damaged, or deteriorated shall be promptly removed from the Site and replaced with materials conforming to this Section.

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SECTION 07 22 16

ROOF BOARD INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install all roof board insulation.
2. The Work also includes:
 - a. Providing openings in roof board insulation to accommodate the Work under this and other Sections and building into the roof board insulation all items such as sleeves, inserts and all other items to be embedded in roof board insulation for which placement is not specifically provided under other Sections.
 - b. Providing openings in roof board insulation to accommodate the Work under other contracts and assisting other contractors in building into the roof board insulation all items, such as sleeves, inserts and all other items to be embedded in roof board insulation under other contracts.
3. Extent of each type of roof board insulation is shown.
4. Types of products required include the following:
 - a. Extruded, CFC, HCFC-free blowing agent, polyisocyanurate rigid board-type insulation.
 - b. Lightweight, vermiculite, insulating concrete with integral expanded polystyrene, rigid foam insulation board.
 - c. Miscellaneous materials and accessories.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the roof board insulation Work.
2. Notify other contractors in advance of the installation of the roof board insulation Work to provide them with sufficient time for the installation of items included in their contracts that must be installed with or before the roof board insulation Work.
3. All framing for openings, edge angles, nailers, curbs and other items shall be in place before start of roof board insulation Work.
4. Coordinate finish of galvanized steel metal roof deck for acceptance by lightweight insulating concrete manufacturer.
5. Field-verify location of all roof penetrations, drain locations, and deck deflections.

C. Related Sections:

1. Section 06 10 53, Miscellaneous Rough Carpentry.
2. Section 07 53 23, Ethylene-Propylene-Diene-Monomer (EPDM) Roofing.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
1. ASHRAE/IESNA 90.1, Energy Standard For Buildings Except Low Rise Residential Buildings.
 2. ASTM C 150, Specification for Portland Cement.
 3. ASTM C 177, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 4. ASTM C 203, Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
 5. ASTM C 209, Test Methods for Cellulosic Fiber Insulating Board.
 6. ASTM C 272, Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions.
 7. ASTM C 303, Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation.
 8. ASTM C 495, Test Method for Compressive Strength of Lightweight Insulating Concrete.
 9. ASTM C 518, Test Method for Steady-State Thermal Transmission Properties by Means of Heat Flow Meter Apparatus.
 10. ASTM C 550, Test Method for Measuring Trueness and Squareness of Rigid Block and Board Thermal Insulation.
 11. ASTM C578, Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 12. ASTM C 1289, Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 13. ASTM D 696, Test Method for Coefficient of Linear Thermal Expansion of Plastics between -30 Degrees C and 30 Degrees C with a Vitreous Silica Dilatometer.
 14. ASTM D 1621, Test Method for Compressive Properties of Rigid Cellular Plastics.
 15. ASTM D 1623, Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
 16. ASTM D 4263, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 17. ASTM E 84, Test Method for Surface Burning Characteristics of Building Materials.
 18. ASTM E 96, Test Methods for Water Vapor Transmission of Materials.
 19. ASTM E 108, Test Methods for Fire Tests of Roof Coverings.
 18. FM Global, Loss Prevention Data for Roofing Contractors, 1-29, Above-Deck Roof Components.
 20. FM Global, Approval Guide.
 21. NRDCA, LICRDC, Accreditation Program
 22. UL Building Materials Directory.

1.3 QUALITY ASSURANCE

- A. Installer's Qualifications:
 - 1. Roof board insulation Work shall be performed by the installer of the associated roofing for undivided responsibility.
- B. Source Quality Control:
 - 1. Obtain extruded polyisocyanurate rigid board-type insulation from manufacturers who manufacture specified insulation using a blowing agent containing no chlorine-based compounds.
 - 2. Engage a single manufacturer for each type of roofing insulation who shall provide the services of a technical representative to assist CONTRACTOR and ENGINEER by providing technical opinions on the adequacy of materials and methods of installation based on Shop Drawings approved by ENGINEER.
 - 3. Provide such services during the time of delivery, storage, handling and installation of all roofing insulation.
 - 4. The thicknesses shown are based on the thermal conductivity, k-value at 75°F specified for each material. Thicknesses of roof board insulation materials submitted by CONTRACTOR as "or equal" to specified materials shall have their thicknesses adjusted to provide the same thermal resistance as materials specified.
- C. Requirements of Regulatory Agencies: Comply with fire-resistance ratings as required by governing authorities and building codes, and complies with the following roof board insulation requirements:
 - 1. Underwriters Laboratories requirements for roof deck constructions which are rated "UL Class A".
 - 2. Factory Mutual requirements for "Class 1-90" rated construction, for wind resistance.
- D. Pre-Installation Conference: Provide both a representative of the insulation manufacturer and the foreman of the installer who will actually work on this Project at the Pre-Roofing Conference.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Field verified locations of all roof penetrations, drain locations, and deck deflections.
 - b. Complete layout of all roof board insulation showing sizes, placement, number of courses and methods of fastening. Include statement that fastening method, location and density of fasteners have been approved by roof membrane manufacturer and comply with wind uplift requirements specified.
 - c. Weights of all equipment to be used on roof.

- d. All required roof board insulation details approved by the roof board insulation manufacturer and the manufacturer of the respective roofing systems.
 - 2. Product Data:
 - a. Manufacturer's specifications and installation instructions for each type of roof board insulation required. Include data substantiating that the materials comply with specified requirements.
 - 3. Samples:
 - a. Each fastener to be used in the Work.
 - b. 12-inch by 12-inch sample of specified extruded and expanded rigid board-type insulation and composite insulation system.
- B. Informational Submittals: Submit the following:
- 1. Source Quality Control Submittals:
 - a. Laboratory test results for thermal resistance values based on ASTM C 177 or ASTM C 518 for actual lightweight insulating concrete system shown and specified.
 - 2. Qualifications Statements:
 - a. Manufacturer.
 - b. Installer.
- C. Closeout Submittals: Submit the following:
- 1. Operations and Maintenance Data: For membrane roofing system to include in maintenance manuals.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials:
- 1. Do not deliver insulation materials to the Site before time of installation.
 - 2. Deliver materials in manufacturer's original, undamaged packages or acceptable bulk containers.
- B. Storage of Materials:
- 1. Do not allow insulation materials to become wet or soiled, or covered with ice or snow.
 - 2. Protect plastic insulation from exposure to sunlight.
 - 3. Protect plastic insulation against ignition.
 - 4. Store packaged materials to protect them from the weather and physical damage.
- C. Handling of Materials:
- 1. Comply with manufacturer's recommendations for handling, storage and protection.

1.6 JOB CONDITIONS

- A. Environmental Requirements:
- 1. Do not install roof board insulation when weather conditions are such that the deck is not completely dry, there is ice or snow on the deck, or where there is no

assurance that the roof board insulation can be completely protected from the weather by the end of the day's Work.

B. Protection:

1. Do not overload the building structure with the weight of stored materials or use of equipment.
2. Install temporary water cut-offs at the end of each day's Work to protect the roof board insulation. Remove the temporary water cut-offs upon resumption of the Work.

1.7 SEQUENCING

- A. Proceed with and complete the Work only when materials, equipment and tradesmen required for the installation of the roofing membrane over the roof board insulation are at the Site and are ready to follow with this Work immediately (same day) after the roof board insulation Work.
- B. Proceed with and complete the Work only when materials, equipment and tradesmen required for the installation of the roofing membrane over the insulation are at the Site; are installing the vapor barrier, and are ready to follow with this Work immediately (same day) behind the roof board insulation Work.
- C. Do not install any more rigid board-type roof board insulation each day than can be covered with complete roofing system by the end of that working day.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Criteria:

1. General Performance: Installed insulation, membrane roofing, and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing, insulation, and base flashings shall remain watertight.
2. Material Compatibility: Provide insulation materials that are compatible with other roofing system materials under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

- B. FM Approvals Listing: Provide insulation and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals' markings.

2.2 MATERIALS

- A. Extruded Polyisocyanurate Rigid Board Roof board insulation:
 - 1. Rigid, rectangular boards of extruded closed-cell polyisocyanurate complying with ASTM C 1289, Type II, Grade 3, with low water vapor permeability and laminated to heavy black (non-asphaltic) fiber-reinforced felt facers with one side of board containing perforated facers and the other side containing non-perforated facers.
 - 2. Provide a blowing agent with zero ozone depletion potential, such as pentane.
 - 3. Physical Properties: Provide the following:
 - a. Minimum Compressive Strength, (at 10 percent deformation), ASTM D 1621: 25 psi minimum.
 - b. Flame Spread, ASTM E 108: Class A.
 - c. Smoke Development, ASTM E 84: 120 maximum.
 - d. Vapor Transmission, ASTM E 96: <1 perms/inch.
 - e. Thermal Resistance, ASTM C 518: 7/inch.
 - f. Maximum Water Absorption, ASTM C 209: 0.10 percent by volume.
 - 4. Size: 48-inches by 96 inches by 2-inch thick.
 - 5. Number of Layers: As required by thickness of roof board insulation shown.
- B. Miscellaneous Materials:
 - 1. Adhesive for Bonding Insulation: The type recommended by the roof board insulation manufacturer, and complying with fire-resistance requirements.
 - 2. Mechanical Anchors: The type recommended by the roof board insulation manufacturer for the type of deck used, and complying with fire and insurance rating requirements.
 - 3. Mastic Sealer: Type recommended by roof board insulation manufacturer for bonding edge joints between units and filling voids.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and installer shall examine the substrate and the conditions under which the roof board insulation Work is to be performed, and notify ENGINEER, in writing, of any unsatisfactory conditions. Do not proceed with the roof board insulation Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.
- B. Commencement of the Work shall be understood by ENGINEER to mean that all conditions are acceptable to the manufacturer's technical representative, CONTRACTOR, and installer to provide acceptable Work under this Contract.

3.2 PREPARATION

- A. Verify that substrate boards are in place on sloping metal decks and has been installed according to the requirements of FM Approval Guide.

- B. Verify that vapor barrier has been installed on decks, with all joints and penetrations in the vapor barrier sealed using techniques recommended by the vapor barrier manufacturer to retain full perm rating of the vapor barrier.

3.3 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's instructions for the particular conditions of installation in each case. If printed instructions are not available or do not apply to Site conditions, consult manufacturer's technical representative for specific recommendations before proceeding. Incorporate recommendations into the Work only as approved by ENGINEER. Record all such discussions and the basis for discussions in Job Conditions Report.
 - 2. Coordinate heights of wood blocking and continuous wood sleepers to provide flush transition between roof board insulation and perimeter wood blocking.
 - 3. Extend roof board insulation full thickness as shown over entire surface to be insulated.
 - 4. Cut and fit tightly around obstructions, and fill voids with roof board insulation.
- B. Board-Type Roof Board Insulation Units: Install rigid board-type roof board insulation according to FM 1-29 Wind Storm Resistance Classification specified, and the roofing warranty requirements as follows:
 - 1. Install wood nailers as required by roofing membrane manufacturer.
 - 2. Prime surface of concrete deck with asphalt primer at the rate of 3/4 gallons per 100 square feet, unless greater weight is required by roofing membrane system manufacturer, and allow primer to dry. Set each layer of roof board insulation in a solid mopping of hot roofing asphalt.
 - 3. Apply two courses of roof board insulation to make up the total required thickness under roofing.
 - 4. Coat edges of closed-cell (non-breathing) units with either adhesive or mastic sealer, and shove into place against installed units so that joints are filled and sealed.
 - 5. Extend roof board insulation full thickness as shown over entire surface of roofs.

3.4 PERFORMANCE

- A. Roof board insulation Work shall withstand the uplift forces of wind, as defined by the roofing warranty. Refer to Section 07 53 23.
- B. Failures of the roof board insulation Work in bond or anchorage to the substrate, or between courses of roof board insulation, or within the roof board insulation, will be considered failures of materials or workmanship under the Roofing Warranty.

3.5 FIELD QUALITY CONTROL

- A. Test the substrate for moisture content, in accordance with ASTM D4263, wherever there is a possibility that exposed substrate has acquired moisture in excess of the maximum content for optimum application of the insulation, as required by the roofing manufacturer.

3.6 PROTECTION

- A. Do not permit construction traffic over completed insulation Work, except as required for roofing.
- B. Protect roof board insulation Work from exposure to moisture, damage, and deterioration, primarily by prompt installation of roofing Work to be placed over the roof board insulation.

3.7 INSPECTION AND ACCEPTANCE

- A. Roof board insulation which has become wet, damaged, or deteriorated, as determined by ENGINEER, shall be promptly removed from the Site, even if already installed.
- B. Correct all improperly sloped, chipped, cracked, improperly set, ridged or rough areas in the roof board insulation to provide substrate acceptable to roofing manufacturer and ENGINEER.
- C. Final acceptance will be contingent upon the receipt by ENGINEER of a Job Conditions Report certifying conformance of the Work with the requirements of this Section and which includes all information requested by these Specifications.

+ + END OF SECTION + +

SECTION 07 53 23

ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install all EPDM roofing Work with manufacturer's standard 10 year warranty and CONTRACTOR'S two year roofing guarantee. The Work also includes:
 - a. Providing openings in EPDM roofing to accommodate the Work under this and other Sections and building into the EPDM roofing all items such as sleeves, inserts and all other items to be embedded in EPDM roofing for which placement is not specifically provided under other Sections.
 - b. Providing openings in EPDM roofing to accommodate the Work under other contracts and assisting other contractors in building into the EPDM roofing all items, such as sleeves, inserts and all other items to be embedded in EPDM roofing under other contracts.
2. Extent of EPDM roofing is shown or specified.
3. Types of products required include the following:
 - a. Adhered, EPDM membrane roofing system matching existing.
 - b. Mechanically fastened, white, EPDM membrane roofing system.
 - c. Miscellaneous materials such as vapor retarders, one-way breather vents, roof walkway pads and specialty EPDM shop fabrications, fasteners, and incidentals.
 - d. Field testing of in-place EPDM roofing.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the EPDM roofing Work.
2. Notify other contractors in advance of the installation of the EPDM roofing Work to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed before the EPDM roofing Work.

C. Related Sections:

1. Section 06 10 53, Miscellaneous Rough Carpentry.
2. Section 07 22 16, Roof Board Insulation.
3. Section 07 62 00, Sheet Metal Flashing and Trim.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. ASTM C 208, Specification for Cellulosic Fiber Insulating Board.

2. ASTM C 728, Specification for Perlite Thermal Insulation Board.
3. ASTM C 1177, Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
4. ASTM C 1278, Specification for Fiber-Reinforced Gypsum Panel.
5. ASTM C 1396, Specification for Gypsum Board.
6. ASTM D 4263, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
7. ASTM D4397, Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
8. ASTM D 4637, Specification for EPDM Sheet Used In Single-Ply Roof Membrane.
9. ASTM E 329, Specification for Agencies Engaged in Construction Inspection and/or Testing.
10. ASTM E 1980, Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
11. California Energy Commission's CEC-Title 24, CRRC-1 Standard Practice for Measuring Solar Reflectance of a Flat, Opaque, and Heterogeneous Surface Using a Portable Solar Reflectometer.
12. DOC PS2, Performance Standard for Wood-Based Structural-Use Panels.
13. DOE Energy Star Program, Roof Products Qualified Product List.
14. FM Global Loss Prevention Data Sheets, 1-28, Wind Loads to Roof Systems and Roof Deck Securement.
15. FM Global Loss Prevention Data Sheets, 1-29, Above-Deck Roof Components.
16. FM Global Loss Prevention Data Sheets, 1-28R and 1-29R, Roof Systems.
17. FM Global Loss Prevention Data Sheets, 1-49, Perimeter Flashing.
18. FM Approvals 4450, Class 1 Insulated Steel Roof Deck.
19. FM Approvals 4470, Class 1 Roof Covers.
20. FM Approvals, RoofNav.
21. FM Global Research Technical Reports.
22. UL Online Certification Directory.
23. 40 CFR 59, Subpart D (EPA Method 24): National Volatile Organic Compound Emission Standards for Architectural Coatings.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: A qualified manufacturer that is UL listed and FM Approvals approved for membrane roofing system identical to that used for this Project.
- B. Installer's Qualifications:
 1. Engage a single installer skilled, trained and with successful experience in the installation of the type of EPDM system specified, who is a recognized roofing installer with specific skill and successful experience in the type of roofing specified, and equipped to perform workmanship in accordance with the Contract Documents, manufacturer's written instructions for guaranteed construction and the approved Shop Drawings and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work.

Submit names and qualifications to ENGINEER along with the following information on a minimum of three successful projects:

- a. Names and telephone numbers of owners, architects or engineers responsible for projects.
 - b. Approximate contract cost of the EPDM roofing.
 - c. Amount of area installed.
2. The roofing installer shall be an approved roofing applicator who has qualified for appointment and has been trained by the manufacturer.
 3. Submit proof of acceptability of installer by manufacturer to ENGINEER.
- C. Testing Agency Qualifications: The independent testing agency shall demonstrate to ENGINEER'S satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work in accordance with ASTM E 329.
- D. Component Supply and Compatibility:
1. Obtain EPDM sheets from only one manufacturer, who publishes complete information on the specified roofing system, and offers to guarantee the completed roofing installation, as required.
 2. Take field dimensions prior to preparation of Shop Drawings.
- E. Requirements of Regulatory Agencies:
1. Comply with applicable insurance rating bureau requirements as required by the building code, unless more restrictive requirements are specified.
 2. Provide materials and roofing systems which have been tested, listed and labeled by Underwriters Laboratories' Incorporated for Class "A" rating, and bear the UL label on each package or are shipped to the Site with a UL Certificate of Compliance.
 3. Provide roofing materials which have been tested, listed and FM labeled for Class "A" maximum flame spread rating.
- F. Allowable Installation Tolerances:
1. Do not install Work until substrate preparation and tolerances have been approved by ENGINEER, EPDM roofing manufacturer's Technical Representative and the EPDM roofing installer and CONTRACTOR have verified to ENGINEER that substrates are within tolerances specified and acceptable to produce approved Work. Work advanced for any reason without such verification shall be stopped, removed and replaced with new material after substrate is approved, at no additional cost to OWNER.
 2. Substrate Tolerances:
 - a. Out-of-Plane: 1/8-inch maximum in 10 foot-0 inches and 1/16-inch maximum in any 12-inches measured along the plane.
 - b. Maximum Offset in Plane Alignment: 1/16-inch.
 - c. Variation From Slope: 1/8-inch maximum in 10 foot - 0 inches.
- G. Pre-Installation Meeting:
1. Prior to the installation of the EPDM roofing and associated Work, CONTRACTOR shall schedule and meet at the Site with the roofing installer,

the installer of each component of associated Work, the installers of deck and insulation to receive roofing Work, the installers of other work in and around roofing which must follow the roofing Work, including mechanical work, ENGINEER and other representatives directly concerned with performance of the Work. Review foreseeable methods and procedures related to the EPDM roofing Work, including but not necessarily limited to, the following:

- a. Review project requirements, including Contract Documents.
 - b. Review required submittals, both completed and yet to be completed.
 - c. Review status of substrate including drying, structural loading limitations and similar considerations.
 - d. Review availability of materials, tradesmen, equipment and facilities required to make progress and avoid delays.
 - e. Review required inspection, testing, certifying and accounting procedures.
 - f. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
 - g. Review regulations concerning code compliance, FM compliance, environmental protection, health, safety, fire and similar considerations.
 - h. Review procedures required for protection of roofing during the remainder of the construction period.
2. Reconvene the meeting at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings: Submit the following:
 - a. Copies of drawings completely dimensioned using field-verified dimensions on plans of each roof area and the accurate location of all roof penetrations roof mounted equipment, curbs, skylights and other features present on the roof areas specified by ENGINEER to be included under the Work of this Section and all details of construction and erection, including all flashing details coordinated with Section 07 62 00, Sheet Metal Flashing and Trim, Section 07 22 16, Roof Board Insulation, and FM Publications specified, and the location of all walkway pad patterns required by the manufacturer for warranted construction and as shown. CONTRACTOR shall submit all details requiring consideration and the performance of the details shall be approved by the EPDM roofing manufacturer for guaranteed construction as specified.
2. Product Data:
 - a. Manufacturer's specifications and product manuals indicating product information correlated to specified requirements, manufacturer's installation instructions, maintenance instructions and other data as may be required by ENGINEER.
 - b. Copies of the FM Global Loss Prevention Data Sheets and appropriate FM Global Research Technical Reports, indicating compliance with wind uplift pressure-resistant performance criteria, ballast and paver requirements and the requirements for FM Approved 1-90 system

construction and perimeter securement conditions.

3. Samples

- a. 12-inch by 12-inch sheet of each item specified and 6-inch long pieces of each required system component to be used in the Work.
- b. Each fastener type required marked as to type of material and with their intended purpose in the Work.
- c. All components of the EPDM roofing and flashing labeled with their intended use in the Work. Compliance with all other requirements is exclusive responsibility of CONTRACTOR.

B. Informational Submittals: Submit the following:

1. Certificates

- a. CONTRACTOR'S Review: Accompanying approval request, submit to ENGINEER a written statement signed by CONTRACTOR, stating that the Contract Documents for roofing, insulation, and flashing have been reviewed with an agent of the roofing material manufacturer and that they are in agreement that the selected systems are proper, compatible and that the details shown are not in conflict with the roofing manufacturer's roofing, insulation, and flashing details. Show by copy of transmittal form that a copy of the statement has been transmitted to the manufacturer.
- b. Statement of Application: Upon completion of the Work, submit a statement to ENGINEER signed by CONTRACTOR stating that the Work complies with the requirements of these Specifications and the installation methods comply with the manufacturer's printed instructions and were proper and adequate for the condition of installation and use.

2. Test and Evaluation Reports: For products specified.

3. Supplier Instructions:

- a. Installation Manuals.

4. Site Quality Control Submittals:

- a. Written reports describing results from required field testing.
- b. Final Inspection Report.

5. Qualifications Statements:

- a. Manufacturer.
- b. Installer.

C. Closeout Submittals: Submit the following:

1. Operations and Maintenance Data: For membrane roofing system to include in maintenance manuals.
2. Warranty Documentation:
 - a. Installer's two year warranty.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:

1. Deliver materials to the Site in sufficient quantities to ensure uninterrupted progress of the Work.
2. Deliver materials in manufacturer's original, unopened and undamaged containers and rolls with labels intact and legible.

3. Materials requiring fire resistance classification shall be delivered to the Site with labels attached and packaged as required by labeling service.
- B. Storage of Materials:
1. Store materials in a dry, well ventilated, weather tight place, and in a manner which will ensure that there is no possibility of significant moisture pick-up.
 2. Store in a manner which complies with fire and safety regulations.
 3. Store materials at temperatures between 60°F and 80°F.
 4. Store materials on clean raised platforms with weather protective covering when stored outdoors.
- C. Handling of Materials:
1. Handle rolled goods so as to prevent damage to edge or ends.
 2. Select and operate material handling equipment so as not to damage existing construction or applied roofing.

1.6 JOB CONDITIONS

- A. Environmental Conditions:
1. Proceed with EPDM roofing and associated Work only when weather conditions will permit unrestricted use of materials and quality control of the Work being installed, complying with these Specification requirements and with the recommendations of the roofing materials manufacturers.
 2. Proceed only when CONTRACTOR and their installer are willing to guarantee the Work as required and without additional reservations and restrictions.
 3. Record decisions, conditions and agreements to proceed with the Work when weather conditions might be unfavorable. State the reasons for proceeding, with the names of the persons involved along with the changes, if any, or revisions, requirements or terms of the Contract.
- B. Protection: Provide continuous protection of materials against damage primarily by storing materials under cover and above ground and away from other construction traffic.

1.7 SCHEDULING

- A. Proceed with the EPDM roofing and associated Work only after curbs, blocking, continuous wood sleepers, vents, drains and projections through the substrate have been installed, and when the substrate construction and framing of openings is completed.
- B. Proceed with and complete the Work only when materials, equipment and skilled tradesmen required for the installation of other EPDM roofing components are at the site and are ready to follow with the Work immediately after composite roof insulation is acceptable for installation of the complete EPDM roofing.
- C. Install all EPDM roofing and associated Work in a manner that will ensure a complete roofing system at the end of each day's Work. Do not advance the

installation of any one material beyond that which is necessary for proper sequencing of the EPDM roofing Work.

1.8 WARRANTY

- A. Provide a roofing guarantee in the form and content specified, covering the EPDM roofing and associated Work specified therein, signed by CONTRACTOR and their installer. Provide a two year roofing guarantee period, starting on the date of Final Completion of the completed construction Work, stating that for the duration of the guarantee CONTRACTOR and installer shall be responsible to fix leaks, replace EPDM roofing and roof insulation components damaged by moisture penetration, and other defects caused by improper workmanship or the improper arrangement of the various system components.
- B. Repair any damage to the roofing system resulting from the in-place water retention tests specified in Article 3.2.
- C. In addition to above, CONTRACTOR shall provide OWNER with manufacturer's standard 10 year warranty for roofing system.
 - 1. Maximum Wind Speed: 110 mph

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Design Criteria:
 - 1. General Performance: Installed membrane roofing, insulation, and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing, insulation, and base flashings shall remain watertight.
 - 2. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- B. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals' markings.
 - 1. Fire/Windstorm Classification: Class 1A-90 .
 - 2. Hail Resistance: SH.

2.2 MATERIALS AND MANUFACTURERS

- A. EPDM: ASTM D 4637, uniform, flexible, black, EPDM sheet.
 - 1. Type I, non-reinforced,
 - 2. Thickness: 60 mils, nominal.
- B. Fabric-Backed EPDM: ASTM D 4637, Type III, non-reinforced, uniform, flexible, white, EPDM sheet, laminated to a nonwoven polyester fabric backing except at selvages.
 - 1. Composite Thickness: 115 mils, nominal.
- C. Products and Manufacturers: Provide one of the following manufacturers:
 - 1. Carlisle SynTec Systems Division of Carlisle Corporation.
 - 2. Firestone Building Products
 - 3. Or Equal.

2.3 AUXILIARY MEMBRANE ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 - 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Single-Ply Roof Membrane Adhesives: 250 g/L.
 - f. Single-Ply Roof Membrane Sealants: 450 g/L.
 - g. Nonmembrane Roof Sealants: 300 g/L.
 - h. Sealant Primers for Nonporous Substrates: 250 g/L.
 - i. Sealant Primers for Porous Substrates: 775 g/L.
 - j. Other Adhesives and Sealants: 250 g/L.
- B. Sheet Flashing: Black, 60-mil-thick EPDM, partially cured or cured, according to application.
- C. Bonding Adhesive: Manufacturer's standard, water based.
- D. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing or low-rise, urethane, fabric-backed membrane adhesive: roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.

- E. Splice Tape and Primer: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch wide minimum, white EPDM splice tape with release film.
- F. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.
- G. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- H. Metal Termination Bars: Manufacturer's standard, predrilled 6063-T6 extruded aluminum, approximately 1-inch by 1/8-inch thick; with anchors.
- I. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05-inch thick, prepunched.
- J. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.
- K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.
 - 1. Wood Nailers:
 - a. Refer to Section 06 10 53, Miscellaneous Rough Carpentry.

2.4 VAPOR RETARDER

- A. Polyethylene Film: ASTM D 4397, 6 mils thick, minimum, with maximum permeance rating of 0.13 perm.
 - 1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.5 ROOF INSULATION

- A. Refer to Section 07 22 16, Roof Board Insulation.
- B. Cover Board:
 - 1. ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/4 inch, 1/2 inch, 5/8 inch thick, factory primed.
- C. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.6 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured, white walkway pads, approximately 3/16 inch thick,

and acceptable to EPDM roofing system manufacturer.

2.7 FABRICATION

- A. Shop fabricate all special flashings as shown using sheeting specified.
- B. Use manufacturer's standard sheet seaming system for "plastic welding" or lapped joints to create seams of strength equal to sheet strength.
- C. Include edge sealer to cover exposed sheet edges.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and installer shall examine the substrate and the conditions under which the EPDM roofing and base flashing Work is to be performed, and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.
- B. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation. Fasteners shall be the size and material recommended by the membrane roofing manufacturer.
 - 4. Verify that wood blocking, curbs, and nailers are separated from metal decking, flashing and membranes with EPDM membrane, recommended by the membrane roofing manufacturer.
 - 5. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 - 6. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 7. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.

3.2 PREPARATION

- A. Clean the substrate of dust, debris, substances and interferences detrimental to the Work. Where necessary to remove sharp projections, composite insulation surfaces shall be ground.

- B. Fill voids, joints and rough areas in the substrate with elastomeric sealant or other underlayment compound recommended by the EPDM roofing manufacturer.
- C. Test the substrate for excessive moisture as recommended by the EPDM roofing manufacturer.
- D. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- E. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 INSTALLATION

A. General:

- 1. Follow all applicable installation instructions and recommendations contained in the EPDM roofing manufacturer's written installation and product manuals and the information contained on approved Shop Drawings. Where CONTRACTOR requests to deviate from written installation and product manuals and approved Shop Drawings, all such deviations shall be submitted to ENGINEER for approval along with EPDM roofing manufacturer's written agreement and a statement of acceptability for compliance with guaranteed construction.
- 2. Begin installation only in the presence of the EPDM roofing manufacturer's technical representative.
- 3. Cut sheets to the maximum size possible, in order to minimize seams and to accommodate contours of the deck. Do not seam within four feet of roof drains.
- 4. Clean all splices and lap areas using manufacturer's recommended splice cleaner.
- 5. Lap sheets and bond joints using the seaming system recommended by the manufacturer.
- 6. Cover top edges of each sheet at seams with uniform fillet of special sealant.
- 7. Install one-way breather vents as recommended by the EPDM roofing manufacturer and as shown, but not less than one per 1,000 square feet.

B. Vapor-Retarder Installation

- 1. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches and 6 inches, respectively.
 - a. Continuously seal side and end laps with tape.
- 2. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

D. Insulation Installation

1. Refer to Section 07 22 16, Roof Board Insulation.
2. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
3. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

E. Adhered Membrane Roofing Installation

1. Adhere membrane roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.
2. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.
3. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
4. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.
5. Fabric-Backed Membrane Adhesive: Apply to substrate at rate required by manufacturer and install fabric-backed membrane roofing.
6. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeters.
7. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
8. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.
9. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
10. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.
11. Install membrane roofing and auxiliary materials to tie in to existing membrane roofing to maintain weather-tightness of transition and to not void warranty for existing membrane roofing system.

3.4 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.5 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing agency to perform inspections.
- B. After installing the EPDM roofing membrane, and all elastic sheet and flashing seams have been sealed, conduct in-place water retention tests.
 - 1. Plug drains and flood roof with 2-inches of water above roof high points. Let water remain in-place for 24 hours. Do not add additional water during the time of the test and schedule testing during a period when precipitation is not predicted. If precipitation occurs during the time of the test, reconduct test when precipitation is not predicted during the time of the test. Calculate expected evaporation at temperatures, humidity and wind conditions occurring during the time of the tests.
 - 2. Measure water remaining in place at the high point of roofs. Roof areas which demonstrate loss of water, that cannot be explained by loss due to evaporation, shall be inspected by a Technical Representative of the EPDM roofing manufacturer and the source of leaks determined and presented to OWNER and ENGINEER as part of a field report which shall also make recommendations for remedial Work. Where the source of leaks cannot be determined, the EPDM roofing shall be removed and replaced with new EPDM roofing at no additional cost to OWNER. All material and construction systems damaged by the results of this test shall be replaced with new, at no additional cost to the OWNER.
 - 3. After remedial repairs have been made and inspected by a Technical Representative of the EPDM roofing manufacturer and judged to be watertight, repeat the water retention test. If, this test shows that the EPDM roofing is still not retaining water according to expected results, remove the entire EPDM roofing and replace with new, at no additional cost to OWNER.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's Technical Representative to inspect roofing installation on completion.
- D. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

- E. Additional inspections, at CONTRACTOR'S expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to ENGINEER and OWNER.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.8 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: <Insert name of Owner.>
 - 2. Address: <Insert address.>
 - 3. Building Name/Type: <Insert information.>
 - 4. Address: <Insert address.>
 - 5. Area of Work: <Insert information.>
 - 6. Acceptance Date: <Insert date.>
 - 7. Warranty Period: <Insert time.>
 - 8. Expiration Date: <Insert date.>
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
 - 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. Lightning;
 - b. Peak gust wind speed exceeding <Insert wind speed> mph (m/sec);
 - c. Fire;

- d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. Vapor condensation on bottom of roofing; and
 - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
- 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 - 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 - 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 - 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 - 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
 - 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.

1. Authorized Signature: <Insert signature>.

2. Name: <Insert name>.

3. Title: <Insert title>.

+ + END OF SECTION + +

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install sheet metal flashing and trim.
2. The Work also includes:
 - a. Providing openings in sheet metal flashing and trim to accommodate the Work under this and other Sections and building into the sheet metal flashing and trim all items such as sleeves, anchor bolts, inserts and all other items to be embedded in sheet metal flashing and trim for which placement is not specifically provided under other Sections.
 - b. Providing openings in sheet metal flashing and trim to accommodate the work under other contracts and assisting other contractors in building into the sheet metal flashing and trim, piping, conduits, inserts and all other items required to penetrate sheet metal flashing and trim under other contracts.
3. Extent of the sheet metal flashing and trim is shown.
4. Types of products required include the following:
 - a. Stainless steel sheet flashing.
 - b. Aluminum sheet flashing.
 - c. Surface-mounted reglets and counterflashing.
 - d. Miscellaneous flashing not supplied under other Sections.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the sheet metal flashing and trim Work.
2. Notify other contractors in advance of the installation of the sheet metal flashing and trim Work to provide them with sufficient time for the installation of items included in their contracts that must be installed before, or with, the sheet metal flashing and trim Work.
3. Work advanced without sheet metal flashing and trim items that are specified to be cast-in-place or built-in-place as the Work advances, shall be stopped, demolished and rebuilt incorporating specified sheet metal flashing and trim Work, at no additional cost to OWNER.

C. Related Sections:

1. Section 04 05 05, Unit Masonry Construction.
2. Section 04 05 19, Masonry Anchorages and Reinforcing.
3. Section 05 50 13, Miscellaneous Metal Fabrications.

4. Section 07 53 23, Ethylene-Propylene-Diene-Monomer (EPDM) Roofing.
5. Section 07 71 00, Roof Specialties.
6. Section 07 92 00, Joint Sealants.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
1. The Aluminum Association, (AA).
 - a. AA, ASD-1 - Aluminum Standards and Data.
 - b. AA, DAF-45 - Designation System for Aluminum Finishes.
 - c. AA, SAA-46 - Anodized Architectural Aluminum.
 2. American Society for Testing and Materials, (ASTM).
 - a. ASTM A 480, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - b. ASTM A 666, Specification for Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar.
 - c. ASTM B 29, Specification for Refined Lead.
 - d. ASTM B 32, Specification for Solder Metal.
 - e. ASTM B 749, Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
 - f. ASTM D 4586, Specification for Asphalt Roof Cement, Asbestos-Free.
 3. FM Global, Loss Prevention Data for Roofing Contractors, 1-49 - Perimeter Flashing.
 4. NRCA, Low-Slope Membrane Roofing Construction Details Manual.
 5. SMACNA 1013, Architectural Sheet Metal Manual.
 6. SSPC - Paint 12, Cold Applied Asphalt Mastic (Extra Thick Film).

1.3 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Engage a single installer who is a recognized flashing and trim installer, skilled and experienced in the type of flashing and trim Work required, and equipped to perform workmanship in accordance with recognized standards so that there will be undivided responsibility for the performance of the Work. Submit name and qualifications to ENGINEER along with at least three successfully completed Projects including names and telephone numbers of owners, architects and engineers, responsible for the project and the approximate contract price for flashing and trim work.
 2. The installer of the sheet metal flashing and trim Work shall be franchised or otherwise accepted in writing by the roofing materials manufacturer for installation of fully guaranteed roofing Work in accordance with these Specifications. Refer to Section 07 53 23, Ethylene-Propylene-Diene-Monomer (EPDM) Roofing for roof warranty details.
- B. Source Quality Control:
1. Except as otherwise shown, comply with recommendations of the roofing manufacturer concerning the installation of flashing and trim that affects the roofing bond or warranty.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Drawings showing the manner of forming, jointing and securing flashings and trim. Show fully dimensioned joint details and waterproof connections to adjoining Work and details at obstructions and penetrations.
 - b. Drawings showing the coordination of the Work of this Section with Section 04 05 05, Unit Masonry Construction, and Section 07 53 23, Ethylene-Propylene-Diene-Monomer (EPDM) Roofing. Provide detailed Shop Drawings showing large scale details of sections and profiles of all sheet metal flashing and trim to be used in the Work, with all items, including fastener locations, cleats and other miscellaneous accessories necessary to complete the Work, fully dimensioned, properly located, quantified and presented such that sequence of installation is acceptable to each roofing system and adjacent construction material installer.
2. Product Data:
 - a. Copies of manufacturer's specifications, installation instructions and general recommendations for sheet metal flashing and trim required. Include manufacturer's data substantiating that the materials comply with the requirements.

B. Informational Submittals: Submit the following:

1. Qualifications Statements:
 - a. Installer's qualifications

C. Closeout Submittals: Submit the following:

1. Warranty
 - a. Submit warranty as specified in Article 1.7

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:

1. Deliver sheet metal flashing and trim materials in manufacturer's original, unopened, and undamaged containers and rolls, with labels intact and legible, indicating compliance with approved Shop Drawings.
2. Items delivered in broken, damaged, rusted, or unlabeled condition shall immediately be removed from Site and not offered again for approval by ENGINEER.

B. Storage of Materials:

1. Store materials in an area undercover and protected from construction traffic.
2. Store materials in same package in which they were shipped, off the ground and on platforms protected from dirt and other contamination.
3. Store in a manner which does not permit water to remain on sheet metal flashing and trim materials and system components.

C. Handling of Materials:

1. Protect sheet metal flashing and trim from dents, scratches, warps and bends.
2. Remove strippable protective film, immediately preceding installation of each system component.

1.6 JOB CONDITIONS

A. Scheduling:

1. Do not proceed with sheet metal flashing and trim Work until curb and substrate construction, cant strips, blocking, reglets and other construction to receive the Work is completed.
2. Deliver materials to the Site in sufficient quantities to ensure uninterrupted progress of the Work.
3. Schedule the installation of sheet metal flashing and trim to coincide with the installation of roofing, waterproofing, drains, piping, blocking, nailers, reglets, framing at openings, curbs, parapets and other adjoining and substrate Work.
4. Proceed with and complete the Work only when materials, equipment and knowledgeable tradesmen, required for the installation of sheet metal flashing and trim, are at the Site and are ready to follow, and integrate sheet metal flashing and trim Work with roofing Work, in order to maintain watertight conditions.

1.7 WARRANTY

- A. Provide reglet and counterflashing manufacturer's five year warranty against defects and workmanship.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Performance Criteria:

1. Sheet metal flashing and trim shall be permanently watertight, and not deteriorate in excess of manufacturer's published limitations.
2. Comply with fabrication details recommended by FM, SMACNA, NRCA and the requirements of the sheet metal flashing and trim manufacturer, and as shown on approved Shop Drawings.

2.2 MATERIALS

A. Sheet Metal Flashing and Trim:

1. Stainless Steel Sheet metal flashing and trim: Provide 26 gage sheet stainless steel, Type 316, complying with ASTM A 666, with No. 2D dead soft, fully annealed finish, unless required to be harder temper for proper forming and performance for application indicated.

2. Aluminum Sheet metal flashing and trim: Provide aluminum complying with ASTM B 209, alloy 3003, temper H14. Provide sheet aluminum 0.032-inches thick with AA-C22A41 finish.
- B. Embedded Sheet Flashing:
1. Refer to Section 04 05 19, Masonry Anchorage and Reinforcing.
- C. Flashing Reglets:
1. General:
 - a. Provide snap-lock type reglets of Type 304 stainless steel, 0.020-inches minimum thickness.
 - b. Provide reglets that engage counterflashing by use of a snap-lock or spring-lock profile. System shall employ only mechanical interlocking features for securing counterflashing in reglet, without the need for clips or screws.
 - c. Provide manufacturer's standard Type 304 stainless steel spring-lock profile flashing, 5-1/8-inches high, designed to incorporate a positive air break and to engage spring-lock reglet flange.
 - d. Provide reglets with 1-inch end laps and spring-lock flashing with 3-inch end laps.
 2. Surface-Mounted Stucco Reglets: Provide reglets for surface mounting that incorporates a V-edged mounting flange which projects 7/8-inch from the face of the mounting flange and permits stucco to be applied directly over the reglet.
 - a. Provide engagement flange 2-1/2-inch high by 1/2-inch wide with snap-lock profile, shaped to act as an edging bead for stucco.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Type STX Stucco Reglet by Fry Reglet Corporation.
 - 2) Surface Mounted Stucco X Reglets by National Sheet Metal Systems, Incorporated.
 - 3) Or equal.
- D. Miscellaneous Materials:
1. Solder for Stainless Steel: ASTM B 32, 60 percent tin and 40 percent lead alloy grade 60A, used with an acid flux of the type recommended by the stainless steel manufacturer. Use a non-corrosive rosin flux over tinned surfaces.
 2. Stainless Welding Rods: Type recommended by stainless steel sheet manufacturer for the type of metal sheets furnished.
 3. Nails, Screws and Rivets: Same material as flashing sheet, or as recommended by manufacturer of flashing sheet.
 4. Cleats: Same metal and gage as sheet being anchored, 2-inches wide, punched for two anchors.
 5. Bituminous Coating: SSPC-Paint 12, cold-applied solvent-type bituminous mastic coating for application in dry film thickness of 15-mils per coat.
 6. Sealants: Refer to Section 07 92 00, Joint Sealants.
 7. Roofing Cement: Provide a medium to heavy trowel-grade, cut-back asphalt mastic roof cement reinforced with non-asbestos fibers, and containing petroleum solvents and special mineral stabilizers, complying with ASTM D 4586, Type II.

8. Base Flashing Felts: Asphalt-coated, polyester/glass scrim reinforced flashing sheet or as recommended by the manufacturer of the built-up bituminous roofing.

2.3 FABRICATION

- A. Fabricated Metal Flashing: Shop-fabricate metal sheet metal flashing and trim to comply with profiles and sizes shown, and to comply with manufacturer's recommended details. Except as otherwise shown or specified, provide soldered flat-lock seams, and fold back metal to form a hem on the concealed side of exposed edges. Comply with metal producers' recommendations for tinning, soldering and cleaning flux from metal.
- B. Where fabricator does not recommend grinding welds smooth, comply with SMACNA formed metal details requiring double-lock seamed construction.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and installer shall examine the substrate and the conditions under which the sheet metal flashing and trim Work is to be performed, and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with sheet metal flashing and trim Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

- A. Before installing sheet metal flashing and trim, verify shapes, and dimensions to be covered.
- B. Prepare substrates as recommended by the sheet metal manufacturer.

3.3 INSTALLATION

- A. General:
 1. Separate dissimilar metals from each other by painting each metal surface in the area of contact with a heavy application of bituminous coating, or by other permanent separation as recommended by the manufacturers of the dissimilar metals. Comply with the following:
 - a. Separate stainless steel from dissimilar metals, including regular steel and iron, and from cementitious materials by a course of roofing felt wherever possible. Where felt application is not possible, coat the stainless steel or the other material with a 15-mil bituminous coating. Where felt is applied under sheets which will be soldered or welded, cover felt with a course of building paper before installing stainless steel. Comply with

manufacturer's recommendations for other forms of protection of the stainless steel against corrosion.

2. Provide thermal expansion for running trim, flashing, valleys, and other items exposed for more than 15 feet-0 inches continuous length. Maintain a watertight installation at expansion seams. Locate expansion seams as shown or, if not shown, at the following maximum spacing for each general flashing use:
 - a. Sheet metal flashing and trim: At 10 feet-0 inch intervals and 2 feet-0 inch each side of corners and intersections.
 3. Fabricate and install Work with lines and corners of exposed units true and accurate. Form exposed faces flat and free of buckles, excessive waves and avoidable tool marks, considering the temper and reflectivity of the metal. Provide uniform, neat flat-locked seams with minimum exposure of solder, welds and sealant. Except as otherwise shown, fold back the sheet metal to form a hem on the concealed side of exposed edges. All exposed edges of all sheet metal flashing shall be hemmed not less than 1/2-inch wide.
 4. Conceal fasteners and expansion provisions wherever possible in exposed Work, and locate so as to minimize the possibility of leakage. Cover and seal Work as required for a watertight installation.
 - a. Provide cleat-type anchorages for metal flashings and trim wherever practical, arranged to relieve stresses from building movement, and thermal expansion and contraction.
 5. On vertical surfaces lap two-piece flashings a minimum of 4-inches.
 6. On sloping surfaces, for slopes of not less than 6-inches in 12-inches, lap unsealed flashings a minimum of 6-inches. For slopes less than 6-inches in 12-inches use soldered flat locked seams.
 7. For embedment of metal flashing flanges in roofing or composition flashing or stripping, extend flanges for a minimum of 4-inches embedment.
- B. Installation of Stainless Steel Sheet Metal Flashing and Trim:
1. Tin the edges of plain stainless steel to be soldered, for a width of 1-1/2-inches, using solder for stainless steel and acid flux. Remove every trace of acid flux residue from the metal promptly after tinning or soldering.
 2. Where welded joints are shown, provide upturned, 1/2-inch wide hooked flanges, and weld between adjoining sheets; lay seam flat.
- C. Installation of Aluminum Sheet metal flashing and trim: Bed base members and flashings of aluminum in roofing cement. Comply with manufacturer's instructions for installation and anchorage of units. Provide gasket-type washers under exposed screw and bolt heads. Shim and seal under units as required to provide continuous, level, plumb and true lines.
- D. Installation of Elastic Sheet Metal Flashing and Trim:
1. Refer to Section 04 05 05, Unit Masonry.

3.4 ADJUSTMENT AND CLEANING

- A. Protect sheet metal flashing and trim until Final Acceptance of the Work.

- B. Do not permit workmen, or others, to step directly on flashing sheets in place, or to place or move equipment over sheet metal flashing and trim surfaces. Protect surfaces during installation of permanent covering work and adjoining Work.
- C. Neutralize excess flux as the Work progresses with five percent to percent washing soda solution and rinse thoroughly.
- D. Clean exposed surfaces of every substance which is visible or might cause corrosion or prevent uniform oxidation of the metal surfaces. Exercise extreme care to remove fluxes and ferrous metal particles, including welding splatter and grinding dust.

+ + END OF SECTION + +

SECTION 07 84 00

FIRESTOPPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all firestopping Work.
2. Extent of the firestopping is shown.
3. Types of firestopping Work required include, but are not necessarily limited to, the following:
 - a. Penetrations in fire-resistance-rated walls.
 - b. Joints in or between fire-resistance-rated constructions.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with or before the firestopping.

C. Related Sections:

1. Section 07 92 00, Joint Sealants.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. ASTM E 84: Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E 119: Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E 814: Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E 1966: Test Method for Fire-Resistive Joint Systems.
5. ASTM E 2174, Standard Practice for On-Site Inspection of Installed Fire Stops.
6. ASTM E-2393, Standard Practice for On-Site Inspection of Installed Fire Stop Joint Systems.
7. ASTM E 2307: Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-Story Test Apparatus.
8. 40 CFR 59, Subpart D-2005: National Volatile Organic Compound Emission Standards for Architectural Coatings.
9. FM Global 4991-2001: Approval of Firestop Contractors (FCIA) Building Materials Approval Guide. 2007.
10. Intertek ETL SEMCO, Directory of Listed Building Products. 2007.
11. UL 1479-2003: Fire Tests of Through-Penetration Firestops (ANSI).
12. UL 2079-2004: Tests for Fire Resistance of Building Joint Systems (ANSI).
13. UL Fire Resistance Directory.
14. UL Qualified Firestop Contractor Program Requirements. 2006.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

- B. Fire-Test-Response Characteristics: Penetration firestopping and fire-resistive joint systems and shall comply with the following requirements:
1. Penetration firestopping and fire-resistive joint systems tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 2. Penetration firestopping and fire-resistive joint systems are identical to those tested per testing standard referenced in "Penetration Firestopping" and "Fire-Resistive Joint Systems" Articles. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping and fire-resistive joint systems products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping and fire-resistive joint systems correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."
- C. Pre-Installation Meeting: Conduct conference at Site to review the following:
1. Status of all submittals, including samples.
 2. Status of substrate preparation.
 3. Status of environmental conditions.
 4. Review testing requirements of the Special Inspections and governing codes.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Plans indicating proposed layout and locations of all firestopping Work.
 - b. Product Schedule: For each penetration firestopping fire-resistive joint system. Include location and design designation of qualified testing and inspecting agency. Refer to Articles 3.6 and 3.7 for format of schedules to be followed.
 - 1) Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping and fire-resistive joint systems condition, submit illustration, with modifications marked, approved by penetration firestopping and fire-resistive joint systems manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
 2. Product Data:
 - a. Copies of manufacturer's technical data and installation instructions for each component of the firestopping Work, including certification that firestopping Work meets the specified requirements.
- B. Informational Submittals: Submit the following:
1. Certificates:
 - a. From Installer indicating penetration firestopping and fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.
 2. Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for firestopping.
 3. Qualification Data: For Installer.

- C. Closeout Submittals: Submit the following:
 - 1. Operations and Maintenance Data:
 - a. Manufacturer's recommended maintenance instructions. Transmit copy of instructions and recommendations to the installer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Deliver firestopping components cartoned or crated to provide protection during transit and job storage.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate firestopping.

1.8 SCHEDULING

- A. Do not install enclosing or concealing construction until after firestopping has been applied, inspected, tested, and remedial Work has been performed and approved the Coordinating Special Inspector and ENGINEER.

PART 2 - PRODUCTS

2.1 PENETRATION FIRESTOPPING PERFORMANCE

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls, and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

2.5 FIRE-RESISTIVE JOINT SYSTEMS

- A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:

1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies, and roofs or roof/ceiling assemblies.
 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
 3. Product and Manufacturer; Provide one of the following:
 - a. Firestop Systems by Hilti, Incorporated.
 - b. 3M Fire Barrier Systems by 3M Fire Protection Products.
 - c. TREMstop Systems by Tremco, Incorporated.; Tremco Fire Protection Group, an RPM Company.
 - d. Or Equal
- C. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke- developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 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 the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing firestopping to comply with manufacturer's written instructions and with the following requirements:
 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of firestopping.
 2. Clean opening 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 in writing by 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 on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 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 the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. CONTRACTOR shall provide the services of a field technical representative authorized by the manufacturer of the firestopping to perform on-Site, in-progress inspections at no additional cost to the OWNER.

- B. Certify that the completed Work is in accordance with these Specifications and without damage or deterioration at the time of Final Acceptance.
- C. Inspection – Independent inspection agency employed and paid by CONTRACTOR, will examine penetration firestopping in accordance with ASTM E – 2174, “Standard Practice for On-Site Inspection of Installed Fire Stops and ASTM E-2393, “Standard Practice for On-Site Inspection of Installed Fire Stop Joint Systems. Inspection agency to examine firestopping and will determine, in general, that firestopping has been installed in compliance with requirements of tested and listed firestop system, and installation process conforms to FM 4991 – Standard for Approval of Firestop Contractors or UL Qualified Firestop Contractor Program.
- D. The inspector shall advise the contractor of any deficiencies noted within one (1) working day.
- E. Do not proceed to enclose firestopping with other construction until inspection agency has verified that the firestop installation complies with the requirements.
- F. Where deficiencies are found, repair or replace the firestopping so that it complies with requirements of tested and listed system design.
- G. Non-Fre Rated Sealants: Refer to Section 07 92 00, Joint Sealants.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated firestopping and install new materials to produce systems complying with specified requirements.

3.7 INSPECTION AND ACCEPTANCE

- A. At the end of the construction period, or at a time when the remaining construction will in no way affect or endanger the firestopping Work, installer and manufacturer’s technical representative shall make an inspection of firestopping Work and prepare a written final inspection report to CONTRACTOR, with copy to OWNER, ENGINEER, and Coordinating Special Inspector, of deterioration or damage found in the Work.

+ + END OF SECTION + +

SECTION 07 92 00

JOINT SEALANTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install joint sealants.
2. Extent of each type of calking and sealant is shown or indicated and includes the following:
 - a. Interior and exterior joints in equipment and construction systems not filled by another material, and that are not required to be open for operation.
 - b. Exposed-to-view joints of all fire-rated sealants.
 - c. Joints specified to be recalked.

B. Coordination:

1. Review installation procedures under other Sections and coordinate installation of items to be installed with or before joint sealants.
2. Notify other contractors in advance of installation of joint sealants to provide other contractors with sufficient time for installing items included in their contracts to be installed before joint sealants.
3. Coordinate final selection of joint sealants so that materials are compatible with all calking and sealant substrates specified.

C. Related Sections:

1. Section 03 00 05, Concrete.
2. Section 04 05 11, Masonry Anchorage and Reinforcing.
3. Section 04 05 05, Unit Masonry Construction.
4. Section 07 84 00, Firestopping.
5. Section 08 81 00, Glass Glazing.
6. Section 09 51 13, Acoustical Panel Ceilings

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM C510, Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants.
2. ASTM C661, Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.
3. ASTM C793, Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants.

4. ASTM C794, Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
5. ASTM C920, Specification for Elastomeric Joint Sealants.
6. ASTM C1021, Practice for Laboratories Engaged in Testing Building Sealants.
7. ASTM C1087, Test method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
8. ASTM C1193, Guide for Use of Joint Sealants.
9. ASTM C1247, Practice for Durability of Sealants Exposed to Continuous Immersion in Liquids.
10. BAAQMD Regulation 8, Rule 51.
11. FS TT-S-00227, Sealing Compound: Elastomeric Type, Multi-component (for Calking, Sealing, and Glazing in Buildings and Other Structures).
12. FS TT-S-00230 Sealing Compound: Elastomeric Type, Single Component (for Calking, Sealing, and Glazing in Buildings and Other Structures).
13. SCAQMD Rule 1168.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Installer:
 - a. Engage a single installer, approved by product manufacturer, regularly engaged in calking and sealant installation and with successful experience in applying types of products required, and who employs only tradesmen with specific skill and successful experience in the type of Work required.
2. Testing Laboratory:
 - a. Furnish services of independent testing laboratory qualified according to ASTM C1021, for conducting testing required.

B. Component Supply and Compatibility:

1. Obtain materials only from manufacturers who will, if required:
 - a. Test joint sealants for compatibility with substrates for conformance with FS-TT-S-00227, and recommend remedial procedures as required.
2. Before purchasing each sealant, investigate its compatibility with joint surfaces, joint fillers, and other materials in joint system. Provide products that are fully compatible with actual installation condition, verified by manufacturer's published data or certification, and as shown on approved Shop Drawings and other approved submittals.

C. Product Testing: Provide test results of laboratory pre-construction compatibility and adhesion testing, as specified in Article 3.1 of this Section, by qualified testing laboratory, based on testing of current sealant formulations within a 36-month period preceding the Notice to Proceed for the Work.

1. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920 and, where applicable, to other standard test methods.

2. Test other joint sealants for compliance using specified post-construction field adhesion test.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Schedule of joint sealants installation, indication each specific surface where calking or sealants are to be provided and the material proposed for each application.
2. Product Data:
 - a. Copies of manufacturer's data sheets including color charts, specifications, recommendations, and installation instructions for each type of sealant, calking compound, and associated miscellaneous material required. Include manufacturer's published data, indicating that each product complies with the Contract Documents and is intended for the applications shown or indicated.
 - b. Product test reports.
3. Samples:
 - a. Each type of actual cured material of each calking and sealant specified, in each of manufacturer's standard colors.
 - b. Samples will be reviewed by ENGINEER for color and texture only. Compliance with other requirements is responsibility of CONTRACTOR.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Certify that materials are suitable for intended use and materials meet or exceed requirements of the Contract Documents.
 - b. Certification from manufacturer that products furnished are appropriate for surfaces and conditions to which they will be applied.
 - c. Certify that applicator is approved by manufacturer.
2. Field Quality Control Submittals:
 - a. Compatibility and adhesion test reports.
 - b. Contractor's Field Test Report Logs:
 - 1) Indicate time present at the Site.
 - 2) Include observations and results of field tests, and document compliance with manufacturer's installation instructions and supplemental instructions provided to installers.
3. Qualifications: Submit qualifications for:
 - a. Installer.
 - b. Testing laboratory.

C. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data:
 - a. Recommended inspection intervals.
 - b. Instructions for repairing and replacing failed sealant joints.
2. Warranty: Submit written warranties as specified in this Section.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with Section 01 65 00, Product Delivery Requirements, and Section 01 66 00, Product Storage and Handling Requirements, and the following:
1. Delivery of Products:
 - a. Deliver products in calking and sealant manufacturer's original unopened, undamaged containers, indicating compliance with approved Shop Drawings and approved Sample color selections.
 - b. Include the following information on label:
 - 1) Name of material and Supplier.
 - 2) Formula or Specification Section number, lot number, color and date of manufacture.
 - 3) Mixing instructions, shelf life, and curing time, when applicable.
 2. Storage of Products:
 - a. Do not store or expose materials to temperature above 90 degrees F or store in direct sunlight.
 - b. Do not use materials that are outdated as indicated by shelf life.
 - c. Store sealant tape in manner that will not deform tape.
 - d. In cool or cold weather, store containers for sixteen hours before using in temperature of approximately 75 degrees F.
 - e. When high temperatures prevail, store mixed sealants in a cool place.
 3. Handling:
 - a. Do not open containers or mix components until necessary preparatory Work and priming are complete.

1.6 JOB CONDITIONS

- A. Environmental Conditions:
1. Do not install joint sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.
 2. Proceed with the Work when forecasted weather conditions are favorable for proper cure and development of high-early bond strength.
 3. Where joint width is affected by ambient temperature variations, install elastomeric sealants when temperatures are in the lower third of manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.
 4. When high temperatures prevail, avoid mixing sealants in direct sunlight.
 5. Supplemental heat sources required to maintain both ambient and surface temperatures within the range recommended by manufacturer for material applications are not available at the Site.
 6. Provide supplemental heat and energy sources, power, equipment, and operating, maintenance, and temperature monitoring personnel.
 7. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas of calking, sealants, and painting Work, and areas where OWNER's personnel or construction personnel may work. Properly locate and vent such

heat sources to outdoors so that joint sealants and other Work are unaffected by exhaust.

1.7 WARRANTY

- A. Provide written warranty, signed by manufacturer and CONTRACTOR, agreeing to repair or replace sealants that fail to perform as air-tight and watertight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability; or appear to deteriorate in any other manner not clearly specified in approved Shop Drawings and other submittals, as an inherent quality of material for exposure indicated.
 - 1. Provide manufacturer warranty for period of one year from date of Substantial Completion of joint sealants Work.
 - 2. Provide installer warranty for period of two years from date of Substantial Completion of joint sealants Work.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Provide elastomeric joint sealants for interior and exterior joint applications that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. VOC Performance Criteria:
 - 1. VOC content of sealants used shall comply with current VOC content limits of SCAQMD Rule 1168. Sealants used as fillers shall comply with or exceed requirements of BAAQMD Regulation 8, Rule 51.
 - a. Sealants: 250 g/L.
 - b. Sealant Primers for Nonporous Substrates: 250 g/L.
 - c. Sealant Primers for Porous Substrates: 775 g/L.
- C. Provide colors selected by ENGINEER from calking and sealant manufacturer's standard and custom color charts. "Or equal" manufacturers shall provide same generic products and colors as available from manufacturers specified.

2.2 MATERIALS

- A. Exterior and Interior Vertical Joints; Non-submerged:
 - 1. Two-component Polyurethane Sealant:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Sikaflex- 2c NS by Sika Corporation.
 - 2) Dymeric 240 FC by Tremco Sealant/Waterproofing Division of RPM International, Inc.
 - 3) Or equal.
 - b. Polyurethane based, two-component elastomeric sealant complying with:

- 1) FS TT-S-00227E: Type II (non-sag) Class A and ASTM C920, Type M, Grade NS, Class 25.
- 2) Adhesion-in-Peel, FS TT-S-00227E and ASTM C794: (Minimum five pounds per linear inch with no adhesion failure): 10 pounds.
- 3) Hardness (Standard Conditions), ASTM C661: 25 to 35 (Shore A).
- 4) Stain and color change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
- 5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
- 6) Rheological Vertical Displacement at 120 degrees F, FS TT-S-00227E: No sag.
- 7) VOC Content: 100 g/L, maximum.

B. Exterior and Interior Horizontal Joints; Non-submerged:

1. Two-component Polyurethane Sealant:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Sikaflex- 2c SL by Sika Corporation.
 - 2) THC/900 by Tremco Sealant/Waterproofing Division of RPM International, Inc.
 - 3) Or equal.
 - b. Polyurethane based, two-component elastomeric, self-leveling sealant complying with the following:
 - 1) FS TT-S-00227E, Type I (self-leveling) Class A. and ASTM C920, Type M, Grade P, Class 25
 - 2) Water Immersion Bond, FS TT-S-00227E: Elongation of 50 percent with no adhesive failure.
 - 3) Hardness (Standard Conditions), ASTM C661: 35 to 45.
 - 4) Stain and Color Change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
 - 5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
 - 6) VOC Content: 165 g/L, maximum.

C. Miscellaneous Materials:

1. Joint Cleaner: As recommended by calking and sealant manufacturer.
2. Joint Primer and Sealer: As recommended for compatibility with calking and sealant by calking and sealant manufacturer.
3. Bond Breaker Type: Polyethylene tape or other plastic tape as recommended for compatibility with calking and sealant by calking and sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of calking and sealant. Provide self-adhesive tape where applicable.
4. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable nonabsorptive material as recommended for compatibility with calking and sealant by calking and sealant manufacturer. Provide size and shape of rod that will control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum

shape of sealant bead on back side, and provide highly-compressible backer to minimize possibility of sealant extrusion when joint is compressed.

5. Low-temperature Catalyst: As recommended by calking and sealant manufacturer.

F. Products for Other Applications:

1. Glazing Sealants: Refer to Section 08 81 00, Glass Glazing.
2. Fire-Rated Sealants: Refer to Section 07 84 00, Firestopping.
3. Compressible Filler: Refer to Section 04 05 11, Masonry Anchorage and Reinforcing.
4. Acoustical Sealants: Refer to Section 09 51 13, Acoustical Panel Ceilings.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine joint surfaces, substrates, backing, and anchorage of units forming sealant rabbet, and conditions under which calking and sealant Work will be performed, and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work and performance of sealants. Do not proceed with calking and sealant Work until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Protection: Do not allow joint sealants to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces including rough textured materials. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either the primer/sealer or calking and sealant materials.
- B. Joint Surface Preparation:
 1. Clean joint surfaces immediately before installing sealant compound. Remove dirt, weakly adhering coatings, moisture and other substances that would interfere with bonds of sealant compound as recommended in sealant manufacturer's written instructions as shown on approved Shop Drawings.
 2. If necessary, clean porous materials by grinding, sandblasting, or mechanical abrading. Blow out joints with oil-free compressed air or by vacuuming joints prior to applying primer or sealant.
 3. Roughen joint surfaces on vitreous coated and similar non-porous materials, when sealant manufacturer's data indicates lower bond strength than for porous surfaces. Rub with fine abrasive cloth or steel wool to produce a dull sheen.
 4. Concrete Joint Preparation: Refer to Section 03 00 05, Concrete.
- C. Mixing:
 1. Comply with sealant manufacturer's written instructions for mixing multi-component sealants.
 2. Thoroughly mix components before use.

3. Add entire contents of activator can to base container. Do not mix partial units.
4. Mix contents for minimum of five minutes or as recommended by sealant manufacturer, until color and consistency are uniform.

3.3 INSTALLATION

- A. Install joint sealants after adjacent areas have been cleaned and before joint has been cleaned and primed, to ensure calking and sealant joints will not be soiled. Replace calking and sealant joints soiled after installation.
- B. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or indicated in the Contract Documents, and except where manufacturer's technical representative directs otherwise, only as acceptable to ENGINEER.
- C. Prime or seal joint surfaces as shown on approved Shop Drawings and approved other submittals. Do not allow primer or sealer to spill or migrate onto adjoining surfaces. Allow primer to dry prior to applying sealants.
- D. Apply masking tape before installing primer, in continuous strips in alignment with joint edge to produce sharp, clean interface with adjoining materials. Remove tape immediately after joints have been sealed and tooled as directed.
- E. Confirm that compressible filler is installed before installing sealants. Refer to Section 04 05 05, Unit Masonry Construction, for locations.
- F. Do not install sealants without backer rods and bond breaker tape.
- G. Roll back-up rod stock into joint to avoid lengthwise stretching. Do not twist, braid, puncture, or prime backer rods.
- H. Employ only proven installation techniques that will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.
- I. Install sealants to depths recommended by sealant manufacturer but within the following general limitations, measured at the center (thin) section of bead.
 1. For horizontal joints in sidewalks, pavements, and similar locations sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but not more than 5/8-inch deep or less than 3/8-inch deep.

2. For vertical joints subjected to normal movement and sealed with elastomeric sealants and not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2-inch deep or less than 1/4-inch deep.
- J. Remove excess and spillage of compounds promptly as the Work progresses.
- K. Cure calking and sealant compounds in compliance with manufacturer's instructions and recommendations, to obtain high-early bond strength, internal cohesive strength, and surface durability.

3.4 EXISTING JOINTS

- A. Mechanically remove existing sealant and backer rod.
- B. Clean joint surfaces of residual sealant and other contaminants capable of affecting sealant bond to joint surface.
- C. Conduct laboratory pre-construction compatibility and adhesion testing on joint surfaces in accordance with Paragraph 3.1.B of this Section.
- D. Allow joint surfaces to dry before installing new sealants.

3.5 FIELD QUALITY CONTROL

- A. Post-construction Field Adhesion Testing: Before installing elastomeric sealants, field-test joint sealant adhesion to joint substrates as follows:
 1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform ten tests for the first 1,000 feet of joint length for each type of elastomeric sealant and joint substrate.
 - b. Perform one test for each 1,000 feet of joint length thereafter, and minimum of one test per each floor per elevation.
 - c. Test Method: Test joint sealants according to Method A, Field-applied Sealant Joint Hand Pull Tab, and Method D, Water Immersion in Appendix X1 of ASTM C1193. For joints with dissimilar substrates, verify adhesion to each substrate separately by extending cut along one side and verifying adhesion to opposite side. Repeat procedure for opposite side.
 - d. Inspect joints for complete fill, absence of voids, and joint configuration complying with specified requirements. Record results in a log of field adhesion tests.
 - e. Inspect tested joints and report on whether:
 - 1) Sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 - 2) Sealants filled the joint cavities and are free of voids.

- 3) Sealant dimensions and configurations comply with specified requirements.
- f. Record test results in a log of field adhesion tests. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
- g. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- h. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other requirements will be satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
- i. Do not proceed with installation of elastomeric sealants over joint surfaces that have been painted, lacquered, waterproofed, or treated with water repellent or other treatment or coating unless a laboratory test for durability (adhesion), in compliance with FS TT-S-00227, has successfully demonstrated that sealant bond is not impaired by the coating or treatment. If laboratory test has not been performed or shows bond interference, remove coating or treatment from joint surfaces before installing sealant.

B. Water Leak Testing: Field test for water leaks as follows:

- 1. Flood the joint exposure with water directed from a 3/4-inch diameter garden hose, without nozzle, held perpendicular to wall face, two feet from joint and connected to water system with 30 psi minimum normal water pressure. Move stream of water along joint at an approximate rate of 20 feet per minute.
- 2. Test approximately five percent of total joint system, in locations that are typical of every joint condition, and that can be inspected easily for leakage on opposite face. Conduct test in presence of ENGINEER, who will determine actual percentage of joints to be tested and actual period of exposure to water from hose, based on extent of observed leakage or lack of observed leakage.
- 3. Where nature of observed leaks indicates potential of inadequate joint bond strength, ENGINEER may direct that additional testing be performed at a time when joints are fully cured, and before Substantial Completion.

3.6 ADJUSTING AND CLEANING

- A. Where leaks and lack of adhesion are evident, replace sealant.
- B. Clean adjacent surfaces of sealant and soiling resulting from the Work. Use solvent or cleaning agent recommended by sealant manufacturer. Leave all finish Work in neat, clean condition.

- C. Protect sealants during construction so that they will be without deterioration, soiling, or damage at time of readiness for final payment of the Contract.

3.7 PROTECTION

- A. During and after curing period, protect joint sealants from contact with contaminating substances and from damage resulting from construction operations or other causes, so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original Work.

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SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install hollow metal doors and frames.
2. Extent of hollow metal doors and frames is shown.
3. Types of products required include the following:
 - a. Standard, seamless, galvanized steel, paper honeycomb core, internally reinforced, flush doors.
 - b. Standard, seamless, galvanized steel, paper honeycomb core, internally reinforced, fire-rated, flush doors.
 - c. Vision lites and Louvers.
 - d. Miscellaneous supports; special, supplemental, and standard finish hardware reinforcements and preparation items; fasteners and accessories; all for high frequency, high-endurance use.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the hollow metal doors and frames Work.
2. Notify other contractors in advance of the installation of the hollow metal doors and frames to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the hollow metal doors and frames Work.

C. Related Sections:

1. Section 04 05 05, Unit Masonry Construction.
2. Section 04 05 11, Masonry Mortaring and Grouting.
3. Section 08 71 00, Door Hardware.
4. Section 08 81 00, Glass Glazing.
5. Section 09 21 16, Gypsum Board Assemblies.
6. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. ANSI/DHI A115.1G, Installation Guide for Doors and Hardware.
2. ANSI A250.4, Test Procedures and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings.

3. ANSI/SDI A250.6 Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.8 - 2003 Recommended Specifications for Standard Steel Doors and Frames.
5. ANSI A250.10 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
6. ANSI/SDI A250.11, Recommended Erection Instructions for Steel Frames.
7. ANSI/SDI A250.13 Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies
8. ASTM A 153/A 153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
9. ASTM A 366, Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
10. ASTM A 653/A 653M, Specification for Steel Sheet, Zinc Coated (Galvannealed) or Zinc-Iron Alloy-Coated (Galvannealed) by The Hot-Dip Process.
11. ASTM A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
12. ASTM B 117, Practice for Operating Salt Spray (Fog) Apparatus.
13. ASTM C 518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
14. ASTM E 90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
15. ASTM E 329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
16. ASTM E 413, Classification for Rating Sound Insulation.
17. ASTM E 1408, Test Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems.
18. FEMA 320, Taking Shelter From the Storm: Building a Safe Room For Your Home or Small Business.
19. FEMA 361, Design and Construction Guidance For Community Shelters.
20. NFPA 80, Fire Doors and Fire Windows.
21. NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
22. NFPA 257, Standard on Fire Test for Window and Glass Block Assemblies.
22. SDI 111-B, Recommended Standard Details For Dutch Doors.
23. SDI/Door 117, Manufacturing Tolerances Standard Steel Doors and Frames.
24. SDI/Door 122, Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
25. SDI/Door 128, Guidelines for Acoustical Performance of Standard Steel Doors and Frames.
26. SSPC Paint 2, Cold Phosphate Surface Treatment.
27. SSPC Paint 27, Basic Zinc Chromate-Vinyl Butyral Wash Primer.
28. UL 10B, Fire Tests of Door Assemblies.
29. UL10C, Positive Pressure Fire Tests of Door Assemblies

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
 - 2. Provide hollow metal doors, frames, and accessories manufactured by a single firm specializing in the production of this type of Work and complying with specified standards of ANSI, NFPA, SDI and UL.
 - 3. Provide hollow metal doors and frames from a manufacturer who is a member of SDI.
- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single hollow metal doors and frames manufacturer.
 - 2. The hollow metal doors and frames equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the hollow metal doors and frames manufacturer.
- C. Testing Agency Qualifications: The independent testing agency shall demonstrate to ENGINEER'S satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated in accordance with ASTM E 329, without delaying the Work.
- D. Source Quality Control:
 - 1. Provide hollow metal door and frame products from a manufacturer who will provide test certificates for published fire, sound, hurricane and structural data covering systems designed and constructed according to its published specifications.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Door Schedule
 - 2. Shop Drawings:
 - a. Elevations of each door design.
 - b. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - c. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - d. Locations of reinforcement and preparations for hardware.
 - e. Details of each different wall opening condition.
 - f. Details of anchorages, joints, field splices, and connections.
 - g. Details of accessories.
 - h. Details of moldings, removable stops, and glazing.

- i. Details of conduit and preparations for power, signal, and control systems.
- j. Provide a schedule of doors and frames using same reference numbers for details and openings as those shown.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
 - 2. Deliver hollow metal doors and frames cartoned or crated to provide protection during transit and job storage.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store doors and frames at the Site under cover.
 - 3. Place units up off floors in a manner that will prevent rust and damage.
 - 4. Avoid the use of non-vented plastic or canvas shelters, which could create a humidity chamber. If cardboard wrapper on the door becomes wet, remove the carton immediately.
 - 5. Provide a 1/4-inch space between stacked doors to promote air circulation.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Coordinate the wiring of electrified hardware. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Criteria:

1. Standard Door Classification: Provide hollow metal doors of Grades and Models in accordance with ANSI A250.8 as follows:
 - a. Level 2, Heavy-Duty, Physical Performance Level B, Model 2, Seamless.

2.2 MANUFACTURERS

A. Products and Manufacturers: Provide one of the following:

1. Series CH Doors with Series F16 Frames and DW Frames by Pioneer Industries, Incorporated.
2. LW Series Doors and F Series frames and DW Frames by Steelcraft, an Ingersoll-Rand Business.
3. Regent Series Doors and SQ, DU or DQ Frames by Ceco Door, an ASSA ABLOY Group Company.
4. Or equal.

2.3 MATERIALS

- A. Door Faces and Frames: Cold-rolled carbon steel sheets of commercial quality, complying with ASTM A 366, hot-dipped, zinc-iron alloy-coated, ASTM A924 and ASTM A 653/A 653M, A 60.
- B. Honeycomb Core: Impregnated with 11 percent phenolic resin, nominal 1-inch hexagonal cell size, one piece, Kraft fiber core board, with 42 psi minimum crushing strength.
- C. Polystyrene Core for hurricane-resistant doors: Rigid polystyrene, density of 1.0 lb/ft³; R factor-7.142; U factor - 0.14.
- D. Grout: Refer to Section 04 05 11, Masonry Mortaring and Grouting.
- E. Glazing: Refer to Section 08 81 00, Glass Glazing. Glazing required for sound-retardant, hurricane and tornado-resistant doors are furnished and installed in this Section..
- E. Supports and Anchors: Formed sheet metal, hot-dip galvanized after fabrication complying with ASTM A 153/A 153M, Class B, and in compliance with requirements of ANSI A250.8.
- F. Inserts, Bolts and Fasteners: Sheet metal hot-dip galvanized complying with ASTM A 153/A 153M, Class C or D as applicable.

G. Miscellaneous Accessories:

1. Head Strut Supports: 3/8-inch by 2-inch hot-dipped galvanized steel.
2. Structural Reinforcing Members: Provide structural reinforcing members as part of frame assembly, where shown at mullions, transoms, or other locations that are to be built into frame.
3. Head Reinforcing: For frames over 4 feet-0 inch wide, in masonry openings, provide continuous steel channel or angle stiffener, not less than 12-gauge for full width of opening, welded to back of frame at head.
4. Spreader Bars: Provide removable spreader bar across bottom of frames, tack welded to jambs and mullions.
5. Plaster Guards: 26-gauge minimum galvanized steel.
6. Louvers, Stops and Moldings: 16-gauge minimum, cold-rolled, hot-dipped galvanized, formed sheet metal.
7. Insect Screen: 14 by 18 bronze wire mesh in a rigid, formed metal frame.

2.4 FABRICATION

A. General:

1. Fabricate hollow metal units to be rigid, neat in appearance and free for defects, warp, or buckle. Accurately form metal to required sizes and profiles.
2. Wherever practicable, fit and assemble units in the manufacturer's plant. Clearly identify Work that cannot be permanently factory-assembled before shipment, to assure proper assembly at the Site. Weld exposed joints continuously, grind, dress, and make smooth, flush, and invisible. Filler to conceal manufacturing defects shall not be acceptable.
3. Exposed Fasteners: Unless otherwise shown or specified, do not use exposed fasteners in the Work. Where exposed fasteners are shown or specified, provide countersunk flat Phillips or Jackson heads for exposed screws and bolts.

B. Doors:

1. Fabricate all hollow metal doors and panels in compliance with ANSI A250.5.
2. Provide doors of two outer stretcher-leveled sheets, (--1--) minimum. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or edges, except around glazed or louvered panel inserts. No fillers shall be used. Provide weep hole openings in the bottom of exterior doors to permit the escape of entrapped moisture.
3. Vertical edges of doors shall be continuously welded, for the whole length of the door, and ground smooth. No plastic or epoxy fillers shall be used.
4. Reinforce inside of doors with honeycomb core, unless indicated otherwise, completely filling the inside of the door and laminated to the inside of both face panels with an adhesive. The honeycomb material shall have a crushing strength not less than 6,000 pounds per square foot and the lamination shall withstand not less than 1,100 pounds per square foot in shear.
5. Fabricate all doors with flush top and bottom closing channel, without exposed fasteners. Reinforce tops and bottoms of doors with inverted, flush-mounted,

minimum 16-gauge, horizontal steel channels fastened to internal reinforcement channel and with 20-gauge closing plate spot-welded to closure channel. Close top and bottom edges to provide weather seal, as integral part of door construction or by addition of inverted steel channels and plates.

6. Hollow Metal Transoms and Panels:
 - a. Fabricate hollow metal transoms and panels of the same materials, construction, and finish as specified for hollow metal doors.
 - b. Provide astragal integral with top of door where shown.
8. Edge profiles shall be provided on both stiles of doors beveled 1/8-inch in 2-inches, except where other profiles are required for certification.
13. Electrical Requirements:
 - a. General: Coordinate electrical requirements for doors and frames. Make provisions for installation of electrical items arranged so that wiring can be readily removed and replaced.
 - b. Doors with Electric Hinges:
 - 1) General: Furnish conduit raceway to permit wiring from electric door hardware.
 - 2) Hinge Locations: Provide electric hinge at intermediate or center location. Top or bottom electric hinge locations are not acceptable.
 - 3) Refer to Section 08 71 00, Door Hardware for electrified hardware items.

C. Frame Construction:

1. Fabricate all hollow metal frames in compliance with ANSI A250.8 and as specified.
2. Form frames of cold-rolled sheet material, 16-gauge minimum. Provide seamless frames for all Work, unless specifically specified and shown as permitting exposed fasteners.
3. Provide hollow metal frames for doors, transoms, side-lights, borrowed lights, and other openings of size and profile as shown or specified.
4. Fabricate frames with reinforced, mitered corners that are continuously arc-welded for the full depth and width of the frame, with bottom spreader bar; except provide drywall frames as specified.
5. Grind all exposed welds flush and smooth.
6. Mullions and Transom Bars:
 - a. Provide closed mullions and transom bars where shown. Fasten mullions and transom bars at crossings and to jambs by butt-welding. Reinforce joints between frame members with concealed clip angles or sleeves of same metal and thickness as frame.
7. Head Reinforcing: Where installed in masonry, leave vertical mullions in frames open at the top so they can be filled with grout.
8. Floor and Head Anchors: 14-gauge minimum, and of the following types:
 - a. Monolithic Concrete Slabs: Clip-type, with two holes to receive fasteners, welded to bottom of jambs and mullions.
 - b. Separate Topping Concrete Slabs: Adjustable-type with extension clips, allowing not less than 2-inches height adjustment. Terminate bottom of frames at finish floor surface.

9. Head Strut Supports: Provide vertical steel struts extending from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable bolted anchorage to frame jamb members.
10. Jamb Anchors: 16-gauge minimum, and of the following types:
 - a. Masonry Construction: Adjustable, corrugated or perforated, T-shaped to suit frame size with leg not less than 2-inches wide by 10-inches long.
 - b. In-Place Concrete or Masonry Construction: 3/8-inch concealed bolts and expansion shields or inserts.
 - c. Gypsum Wallboard and Steel Stud Construction: Two-piece compression anchors with exposed compression fasteners.
17. Rubber Door Silencers: Drill stop to receive three silencers on single-door frames and four silencers on double-door frames. Install plastic plugs to keep holes clear during construction.
18. Plaster Guards: Provide manufacturer's standard plaster guards or dust cover boxes.
19. Electrical Requirements:
 - a. General: Coordination all electrical requirements for frames. Make provisions for installation of electrical items arranged so that wiring can be readily removed and replaced.
 - 1) Provide cutouts and reinforcements required for metal door frame to accept electric components.
 - 2) Frame with Electrical Hinges: Weld UL listed grout guard cover box welded over center hinge reinforcing. Top or bottom hinge locations are not permitted.
 - 3) Provide cutouts and reinforcements required to accept security system components.
 - 4) Refer to Section 08 71 00, Door Hardware for electrified hardware items.

D. Door Hardware Preparation:

1. General:
 - a. Prepare hollow metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing, drilling, and tapping in accordance with approved Finish Hardware Schedule and templates provided by finish hardware supplier and as specified. Comply with applicable requirements of ANSI/DHI A115.1 to A115.17 and ANSI A250.4. Refer to Section 08 71 00, Door Hardware.
 - b. Obtain approved hardware schedule, hardware templates, and samples of finish hardware where necessary to ensure correct detailing and fabrication of the hollow metal doors and frames, from finish hardware supplier.
2. Doors:
 - a. Preparation includes sinkages and cut-outs for mortised and concealed finish hardware and reinforcements for both concealed and surface-applied finish hardware.
 - b. Drill and tap mortise reinforcements at factory, using templates.

- c. Detail and fabricate reinforcements with concealed connections designed to develop full strength of reinforcements for high-frequency applications.
- d. Reinforce doors for required finish hardware, with minimum gauges of reinforcements provided as follows:
 - 1) Hinges: Steel plate 3/16-inches thick by 1-1/2-inches wide by 6-inches longer than hinge and secured by not less than six spot or projection welds with top hinge further reinforced with a high-frequency back-up reinforcement.
 - 2) Mortise Locksets and Dead Bolts: 12-gauge steel sheet, secured with not less than four spot or projection welds.
 - 3) Cylinder Locks: 12-gauge steel sheet, secured with not less than two spot or projection welds.
 - 4) Flush Bolts: 12-gauge steel sheet, secured with not less than two spot or projection welds.
 - 5) Surface-Applied Closers and Overhead Stops: 3/16-inch steel plate, not less than 10-inches long, secured with not less than six spot or projection welds.
 - 6) Push Plates and Bars: 16-gauge steel sheet secured with not less than two spot or projection welds.
 - 7) Surface Panic Devices: 16-gauge sheet steel secured with not less than two spot or projection welds.
 - 8) Automatic Door Bottoms: Reinforce for mortise-type units with 14-gauge steel, and 16-gauge for surface-applied units.

3. Frames:

- a. Reinforce frames for required finish hardware with minimum gauges as follows:
 - 1) Hinges and Pivots: Special full width of frame, 3/16-inch thick steel plate by 8-inches longer than hinge, secured to both rabbets by not less than twelve spot or projection welds.
 - 2) Strike Plate Clips: 10-gauge steel plate by 1-1/2-inches wide by 3-inches long with mortar guard boxout secured with not less than six spot or projection welds.
 - 3) Surface-Applied Closers: 3/16-inch steel plate, secured with not less than six spot or projection welds. Coordinate closer function and presence of overhead stops and weather-stripping, with location of reinforcement plate.
 - 4) 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.

E. Door Louvers:

- 1. Fabricate louvers and mount flush into doors without overlapping moldings on surface of door-facing sheets. Provide internal support as recommended by louver manufacturer. Provide profile as shown.
- 2. Interior Louvers: Sightproof, stationary type, constructed of inverted chevron-shaped blades and U-shaped frames, not less than 1-3/8-inches

- thick, formed of 18-gauge cold-rolled steel. Space louver blades not more than 3-inches on center. Assemble units by welding.
3. Exterior Louvers: Fabricate units with stationary, weatherproof Z-shaped blades and U-shaped frames, not less than 1-3/8-inch thick. Space louver blades not more than 1-1/2-inches on center. Assemble units by welding. Provide removable insect screens on the interior side of the frame.
 4. Louvers for Fire-Resistance-Rated Openings: Provide tightly fitted automatic closing, operable blades, equipped with fusible links, arranged so that metal overlaps metal at every joint, UL approved.
- F. Transoms and Panels: Fabricate transoms and panels of the same construction specified above under door construction.
- G. Stops and Moldings:
1. Provide stops and moldings around solid, glazed and louvered panels in hollow metal units and in frames to receive glass.
 2. Fabricate fixed stops and moldings integral with frame. Provide fixed stops on inside of hollow metal units exposed to exterior and on corridor side of interior units.
 3. Provide removable stops and molds at other locations, formed of not less than galvanized 20-gauge steel sheets. Secure with countersunk machine screws spaced uniformly not more than 12-inches on center. Form corners with butted hairline joints.
 4. Coordinate width of rabbet between fixed and removable stops with type of glass or panel and type of installation indicated. Refer to Section 08 81 00, Glass Glazing.

2.5 SHOP PAINTING

- A. Clean, treat and paint exposed surfaces of fabricated hollow metal units, including galvanized surfaces.
- B. Clean steel surfaces of mill scale, rust, oil, grease, dirt and other foreign materials before the application of the shop coat of paint.
- C. Refer to Section 09 91 00, Painting, for field-applied primer and finish paint for exterior or interior exposed ferrous, non-ferrous, or galvanized surfaces.
- D. Apply shop-coat of prime paint within time limits recommended by pretreatment manufacturer. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 1.5-mils.
- E. Finish shall be rust inhibitive primer capable of passing a 500-hour salt spray and a 1,000-hour humidity test in accordance with ASTM B 117 as certified by an independent laboratory.

2.6 SOURCE QUALITY CONTROL

- A. After Shop Drawings approval, manufacturer shall not make any further detailing, fabrication, or changes to approved methods of support and anchorage, nor shall doors and frames be brought to the Site, which do not conform, in all ways, to performance criteria specified.
- B. Allowable Tolerances: Provide door and frame manufacturing tolerances in compliance with SDI 117 and as follows:
 - 1. Nominal Clearance between Door and Frame Head and Jamb: 1/8-inch.
 - 2. Nominal Clearance between Meeting Edges of Pairs of Doors: 1/8-inch.
 - 3. Nominal Clearance at Bottom of Door: 3/4-inch.
 - 4. Nominal Clearance between Face of Door and Door Stop: 1/16-inch.
 - 5. Provide all Work plumb and true to adjoining surfaces with all miters and copes accurately formed.
 - 6. Provide completely water and vapor tight joints.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the substrate and conditions under which hollow metal doors and frames are to be installed and notify ENGINEER, in writing, of any conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.
- B. Frames that are bowed, twisted or otherwise unacceptable shall be removed from the Site and replaced with properly constructed frames.

3.2 PREPARATION

- A. Drilling and tapping for surface-applied, finish hardware may be done at Site.
- B. Protective Coating: Protect inside, concealed, faces of door frames in plaster or masonry construction using fibered asphalt emulsion coating. Apply over shop primer approximately 1/8-inches thick and allow to dry before installation.
- C. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

3.3 INSTALLATION

- A. Install hollow metal units and accessories in accordance with approved Shop Drawings, SDI 105, and ANSI/SDI A250.11 as shown and specified.
 - 1. Do not install doors and frames until all the Work, which could damage doors and frames, has been completed.
 - 2. Provide temporary doors until construction sequencing allows installation of permanent doors and frames.
 - 3. Do not proceed with the installation of permanent hollow metal doors until CONTRACTOR can provide finished Work complying with all requirements of these Specifications.
 - 4. Protect built-in frame Work with temporary wood protection.
- B. Placing Frames:
 - 1. Install frames plumb, level, rigid, and in true alignment in accordance with ANSI A250.11 and DHI A115.1G.
 - 2. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged. Remove spreader bars only after frames have been properly set and secured.
 - 3. Make field splices in frames as detailed on approved Shop Drawings, welded, and finished to match factory work.
- C. Setting Masonry Anchorage Devices:
 - 1. In masonry construction, building in of anchors and grouting of frames is included in Section 04 05 05, Unit Masonry Construction.
 - 2. Set anchorage devices opposite each anchor location, in accordance with details on approved Shop Drawings and anchorage device manufacturer's instructions as follows:
 - a. Masonry Walls: Install at least three jamb anchors per jamb up to 7 feet-6 inches height; four anchors up to 8 feet-0 inch jamb height; one additional anchor for each 2 foot-0 inch or fraction thereof over 8 feet-0 inch height.
 - b. Cast-In-Place Concrete and Existing Rough Openings: Anchor frame jambs with concealed bolts into expansion shields or inserts at 6-inches from top and bottom and 2 foot-0 inches on center. Apply removable stop to cover anchor bolts.
 - c. Structural Steel: Secure frames to structural steel framing using machine bolts inserted through tubular steel pipe sleeves reinforcement concealed in hollow metal frames at 6-inches from top and bottom and 2 foot-0 inches on center. Apply removable stop to cover anchor bolts.
 - d. Steel Stud Construction: Secure knocked-down-type drywall frames to gypsum wallboard metal studs using compression anchor assemblies. Install at least three jamb anchors per jamb up to 7 feet-6 inches height; four anchors up to 8 feet-0 inch jamb height; one additional

anchor for each 2 foot-0 inch or fraction thereof over 8 feet-0 inch height.

3. Floor anchors may be set with powder-actuated fasteners instead of masonry anchorage devices and machine screws, if so indicated on approved Shop Drawings.

D. Door Installation:

1. Fit hollow metal doors accurately 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: 3/4-inch, where no threshold or carpet.
 - d. Bottom: At threshold or carpet, 3/8-inch.
2. Finish hardware installation is specified under Section 08 71 00, Door Hardware. Locate finish hardware as shown on approved Shop Drawings, in accordance with hardware templates provided by finish hardware manufacturers and in accordance with Door and Hardware Institute, Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames.
3. Locate finish hardware for hurricane and tornado-resistant doors in compliance with applicable codes and testing agencies.
4. Install glazing, required to be factory glazed, to meet code and testing requirements.

3.4 ADJUSTMENT AND CLEANING

- A. Check and readjust operating finish hardware items in hollow metal door and frame Work just prior to final inspection. Leave Work in complete and proper operating conditions.
- B. Where problems of installation or damage are cause for rejection of hollow metal door and frame Work, consult SDI 122 and the recommendations of the hollow metal door and frame manufacturer, for suggestions concerning required adjustments in the Work. Submit recommendations to ENGINEER for approval. Replace and repair unacceptable Work, as directed by ENGINEER, so that there will be no doubt as to the acceptability of the Work at the time of Substantial Completion.
- C. Prime Coat Touch-Up: Immediately after installation, sand smooth all rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
- D. Protection: Protect installed hollow metal doors and frames against damage from other construction activities.

+ + END OF SECTION + +

SECTION 08 31 00

ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all access doors and panels Work.
 - 2. Extent of access doors and panels is shown.
 - 3. Types of products required include the following:
 - a. Universal wall and ceiling access doors.
 - b. Miscellaneous hardware, accessories, and fasteners.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the access doors and panels Work.
 - 2. Notify other contractors in advance of the installation of the access doors and panels to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the access doors and panels Work.
- C. Related Sections
 - 1. Section 09 26 16, Gypsum Board Assemblies.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 3. ASTM A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 4. ASTM E 329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer shall have a minimum of five years' experience producing substantially similar access doors and shall be able to show evidence of at

least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of the component manufacturer from a single access door manufacturer.
2. The access door manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the access door manufacturer.

C. Testing Agency Qualifications: The independent testing agency shall demonstrate to ENGINEER'S satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated in accordance with ASTM E 329, without delaying the Work.

D. Source Quality Control:

1. Provide access door products from a manufacturer who will provide test certificates for published fire data covering systems designed and constructed according to its published specifications.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Copies of manufacturer's technical data and installation instructions for each type of access door and panel assembly. Transmit copy of the instructions for each type to the installer. Provide setting drawings, templates, instructions and directions for installation of anchorage devices.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
2. Deliver access doors and frames cartoned or crated to provide protection during transit and job storage.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
2. Store access doors at the Site under cover.
3. Place units up off floors in a manner that will prevent rust and damage.

4. Avoid the use of non-vented plastic or canvas shelters, which could create a humidity chamber. If cardboard wrapper on the door becomes wet, remove the carton immediately.
5. Provide a 1/4-inch space between stacked doors to promote air circulation.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate installation of anchorages for access door frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Universal Non-Fire-Rated Wall and Ceiling Access Doors: Products and Manufacturers: Provide products of one of the following:
1. Model DSC- 214M Karp Associates, Incorporated.
 2. B-NT Series by Babcock- Davis Incorporated.
 3. Or equal.

2.2 MATERIALS

- A. Metallic-Coated Steel Sheet: ASTM A 653, Commercial Steel (CS) with A60 (ZF180) zinc-iron-alloy (galvannealed) coating or G60 (Z180) mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924.
1. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.

2.3 FABRICATION

- A. Description:

1. Provide access door and panel assemblies manufactured as integral units and complete with all components and accessories ready for installation.
 2. Provide anchors or make provisions in frame for anchoring to adjacent construction. Provide size, number and location of anchors on four sides to secure access door in opening. Provide anchors as required by fire test.
- B. Universal Non-fire-rated Wall and Ceiling Access Doors: Provide the following for concrete, masonry, and wallboard:
1. Flush Door Panels: 16-gauge factory-primed, galvanized steel door recessed 1-inch for wallboard.
 2. Frames: 16-gauge factory-primed, galvanized steel with continuous wallboard bead with concealed flanged.
 3. Finish Hardware:
 - a. Hinge: Exposed continuous stainless steel piano hinge.
 - b. Screwdriver-operated cam latch.
 4. Size:
 - a. Wall: 16-inches by 16-inches.
 - b. Ceiling: 24-inches by 24-inches.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR must examine the areas and conditions under which access doors are to be installed and notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions for installation of access doors and panels.
- B. Coordinate installation with work of other trades. Refer to Section 09 21 16, Gypsum Board Assemblies for substrate installation.
- C. Set frames accurately in position and securely attach to support with face panels plumb or level in relation to adjacent finish surfaces.

3.3 ANCHORAGE

- A. Secure frames to adjacent construction using anchors attached to frames or by use of bolts or screws through the frame members.

B. Type, size, and number of anchoring device suitable for the material surrounding the opening, maintain alignment, and resist displacement during normal use of access door.

C. Anchors for fire rated access doors shall meet requirements of applicable fire test.

3.4 ADJUSTMENT AND CLEANING

A. Adjust hardware and panels after installation for proper operation.

B. Remove and replace panels or frames, which are warped, bowed or otherwise damaged.

+ + END OF SECTION + +

SECTION 08 44 13

GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install glazed aluminum curtain walls and storefronts.
2. Extent of glazed aluminum curtain walls and storefronts are shown.
3. Types of products required include the following:
 - a. Thermal barrier glazed aluminum curtain wall and storefronts, fully glazed with glass types shown and specified in Section 08 81 00, Glass Glazing.
 - b. Gaskets, pressure plates and snap covers in conjunction with each of the above components.
 - c. Manual-swing entrance doors and hardware.
 - d. Anchors, inserts, support brackets, expansion devices, fasteners, flashings, weeps, and similar elements in conjunction with each of the above components.
 - e. Polyvinylidene fluoride finishes and colors, with extended-life topcoat.
 - f. Miscellaneous aluminum closure and transition plates, and other components and accessories shown to be provided by glazed aluminum curtain wall and storefront manufacturer.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the glazed aluminum curtain wall and storefront Work.
2. Notify other contractors in advance of the installation of the glazed aluminum curtain walls and storefronts to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the glazed aluminum curtain wall and storefront Work.

C. Related Sections:

1. Section 04 05 05, Unit Masonry Construction.
2. Section 07 92 00, Joint Sealants.
3. Section 08 51 13, Aluminum Windows.
4. Section 08 71 00, Door Hardware.
5. Section 08 81 00, Glass Glazing.
6. Section 09 91 00, Painting.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
1. AA ASD-1, Aluminum Standards and Data.
 2. AA SAA-46, Standards for Anodized Architectural Aluminum.
 3. AA DSA-45, Designation System for Aluminum Finishes.
 4. AAMA 501.1 - Test Method for Exterior Windows, Curtain Walls and Doors for Water Penetration Using Dynamic Pressure.
 5. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage.
 6. AAMA 605.2 - Voluntary Specification for High Performance Organic Coatings on Architectural Aluminum Extrusions and Panels.
 7. AAMA CW-DG-1 - Curtain Wall Design Guide Manual.
 8. AAMA CWG-1 - Installation of Aluminum Curtain Walls.
 9. AAMA MCWM-1 - Metal Curtain Wall Manual.
 10. AAMA TIR-A9 - Metal Curtain Wall Fasteners.
 11. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."
 11. AMP 501, Finishes for Aluminum.
 12. ASCE 7, Minimum Design Loads for Buildings and Other Structures.
 13. ASTM A 123/A 123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 14. ASTM B 117, Practice for Operating Salt Spray (Fog) Apparatus.
 15. ASTM B 136, Test Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum.
 16. ASTM B 137, Test Method for Measurement of Coating Mass per Unit Area of Anodically Coated Aluminum.
 17. ASTM B 209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 18. ASTM B 221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
 19. ASTM B 244, Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments.
 20. ASTM B 429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 21. ASTM D 395, Test Methods for Rubber Property- Compression Set.
 22. ASTM D 412, Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 23. ASTM D 522, Test Methods for Mandrel Bend Test of Attached Organic Coatings.
 24. ASTM D 523, Test Method for Specular Gloss.
 25. ASTM D 573, Test Method for Rubber - Deterioration in an Air Oven.

26. ASTM D 624, Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
27. ASTM D 746, Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
28. ASTM D 968, Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive.
29. ASTM D 1149, Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber.
30. ASTM D 1308, Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
31. ASTM D 2240, Test Method for Rubber Property- Durometer Hardness.
32. ASTM D 2244, Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
33. ASTM D 2247, Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
34. ASTM D 3363, Test Method for Film Hardness by Pencil Test.
35. ASTM D 4213, Test Method for Scrub Resistance of Paints by Abrasion Weight Loss.
36. ASTM E 283, Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences Across the Specimen.
37. ASTM E 330, Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
38. ASTM E 331, Test Method for Water Penetration of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
39. ASTM E 783, Test Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors.
40. ASTM E 1105, Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Doors, Skylights and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference.
41. AWS D1.2/D1.2M, Structural Welding Code - Aluminum.
42. AWS D10.7/D10.7M, Guide for Gas Shielded-Arc Welding of Aluminum and Aluminum Alloy Pipe.
43. FM 1-7, Wind Forces on Buildings and Other Structures.
44. NAAMA Architectural Metal Products Division, AMP 500 - Introduction to Metal Finishing.
45. NAAMA, Architectural Metal Products Division, AMP 505 - Applied Coatings.
46. SSPC Systems and Specifications Surface Preparation Guide and Paint Application Specification, SSPC - Steel Structures Painting Council.
47. SSPC Paint 12 - Paint Specification No. 12: Cold-Applied Asphalt Mastic (Extra Thick Film).

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
- B. Installer's Qualifications:
 - 1. Engage a single installer regularly performing installation of glazed aluminum curtain walls and storefronts and with successful and documented experience in the erection of glazed aluminum curtain wall and storefront systems of similar scope and type to the required Work; and who agrees to employ only tradesmen with documented skill, training and successful experience in this type of Work. Submit name and qualifications to ENGINEER along with the following information on a minimum of three successful projects:
 - a. Names and telephone numbers of owners, architects, or engineers responsible for projects.
 - b. Approximate contract cost of the aluminum window wall and storefront system.
 - c. Amount of area installed.
 - 2. Engage a single installer for the entire glazed aluminum curtain wall and storefront Work including aluminum doors specified in glass specified in Section 08 81 00, Glass Glazing, with undivided responsibility for performance and other requirements.
- C. Finish Applicator Qualifications:
 - 1. Provide glazed aluminum curtain wall and storefront finish applicator experienced in the handling and application of the finish coatings specified, acceptable to the coating or aluminum manufacturer.
 - 2. Engage a firm with documented successful experience in the manufacturer of glazed aluminum curtain wall and storefront Work of similar scope and type to the required Work.
- D. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."
- F. Source Limitation: All products provided under this Section shall be obtained from a single supplier or manufacturer who, with CONTRACTOR, shall assume full responsibility for the completeness of the system. The supplier or manufacturer shall be the source of information on all equipment furnished regardless of the manufacturing source of that equipment.
 - 1. Use the same aluminum alloys throughout the Work. Choose sheet and extrusion alloys for color producing compatibility.

2. Prepare range samples, to show the highest level of color control feasible, as determined by the licensor of the finishing process specified and selected, on actual extrusion and sheet members.
 3. Maintain visual intention of glazed aluminum curtain walls and storefronts as shown.
- G. Codes: Comply with the applicable requirements of codes referenced in Section 01 42 00, References.
- H. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
1. Provide NFRC-certified glazed aluminum curtain walls with an attached label.
- I. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- J. Pre-Installation Conference:
1. Prior to the installation of the glazed aluminum curtain walls and storefronts and associated Work, CONTRACTOR shall schedule and meet at the Site with the glazed aluminum curtain wall and storefront installer, the installer of each component of associated work, the installers of substrate construction to receive the Work, the installers of other Work in and around glazed aluminum curtain walls and storefronts that follows the glazed aluminum curtain wall and storefront Work, including mechanical Work, ENGINEER and other representatives directly concerned with performance of the Work. Review foreseeable methods and procedures related to the aluminum window wall Work, including but not necessarily limited to, the following:
 - a. Review Project requirements, including Contract Documents.
 - b. Review required submittals, both completed and yet to be completed.
 - c. Review status of mock-up.
 - d. Review availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
 - e. Review required inspection, testing, certifying and accounting procedures.
 - f. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
 - g. Review regulations concerning code compliance, field testing requirements and similar considerations.
 - h. Review procedures needed for protection of glazed aluminum curtain wall system during the remainder of the construction period.
 2. Reconvene the conference at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

3. Record any revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings: Submit the following:
 - a. Shop Drawings for the assembly and erection of the entire glazed aluminum curtain wall and storefront system, showing all dimensions, gauges, finishes, location of joints, connections, fasteners, expansion provisions, and locations and types of glazing gaskets, pressure plates, internal reinforcements, snap covers and other related items as required.
 - b. Provide wall elevations at 1/2-inch scale, and full size detail sections of every typical composite member. Coordinate the submittal of Shop Drawings for component parts (as specified in other Sections) with this submittal. Show anchorages and alignments not shown on Shop Drawings of the components.
 - c. Indication, in a manner highlighted to ENGINEER, clearly identifying all deviations from Contract Documents.
2. Product Data:
 - a. Calculations of analysis required to show compliance with loading requirements, deflection requirements, and other anticipated movements in the glazed aluminum curtain wall and storefront system and supporting system, and other system performance criteria specified.
 - 1) Provide gauges of material specified for all Work or of heavier gauge if calculations based on performance criteria submitted as part of Shop Drawing approval process indicate the need for heavier gauge material. All such modifications shall be at no additional cost to OWNER. Where compliance with performance criteria indicates that materials of lesser gauge or size may be adequate, provide specified gauges and sizes as minimum acceptable standard. Where compliance with performance criteria indicates the need for materials of greater gauge or thickness, provide greater gauge or thickness at no additional cost to OWNER.
 - b. Copies of manufacturers' specifications and installation instructions for required materials and components, which are not included in the other submittals, specified in other Sections of these Specifications. Coordinate the submittal of such other data with this submittal, and with the submittal of Samples required by other Sections.
 - c. Entrance Door Hardware Schedule.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Licensed Professional Engineer who prepares, signs and stamps their seal shall provide a written statement confirming responsibility for the Work and attest that the Work prepared meets these Specifications and

- the requirements of governing authorities having jurisdiction at the Site, and conforms to the prevailing standards of practice for the type of Work specified.
- b. Welders certificates indicating that welders comply with requirements specified.
 - c. Energy Performance Certificates: For glazed aluminum curtain walls accessories, and components, from manufacturer.
 - 1) Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
- 2. Test and Evaluation Reports:
 - a. Laboratory test reports for specified performance tests.
 - b. Field Quality-Control Reports.
 - 3. Qualifications Statements:
 - a. Manufacturer.
 - b. Installer.
 - c. Finish applicator.
- C. Closeout Submittals: Submit the following:
- 1. Operations and Maintenance Data: Detailed maintenance manual including the following information:
 - a. Product name and number.
 - b. Name, address, e-mail address and telephone number of manufacturer and local distributor.
 - c. Detailed procedures for routine maintenance and cleaning.
 - d. Detailed procedures for light repairs such as dents, scratches and staining.
 - 2. Warranty Documentation:
 - a. Written guarantees, as specified.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
- 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
 - 2. Deliver window wall materials, components and accessories dry and undamaged, with manufacturer's original protective wrapping intact with information accurately representing package contents as accepted by ENGINEER.
 - 3. Deliver glazed aluminum curtain wall and storefront components in cartons or crated to provide protection during transit and storage at Site.
 - 4. Inspect products upon delivery for damage. Minor damage may be repaired provided that exposed-to-view finished items are not damaged. Remove damaged components from the Site immediately and replace with new undamaged material at no additional cost to OWNER.

5. Do not subject glazed aluminum curtain wall and storefront components to bending or stress.
 6. Do not damage edges or handle material in a manner that will cause scratches, warps or dents.
 7. Handle material throughout the duration of the Work using appropriate handwear that does not damage finish of items to remain exposed in the finished Work.
- B. Storage and Protection:
1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 2. Do not store glazed aluminum curtain wall and storefront components in contact with concrete or other materials that might cause corrosion or staining or in a location where they may be damaged by construction activity.
 3. Store all glazed aluminum curtain wall and storefront components in an area protected from the weather and with good air circulation around each piece. Avoid the use of non-vented plastic or canvas shelters, which could create a humidity chamber. Immediately remove wrapping if it becomes wet.
 4. Provide a 1/4-inch space between glazed aluminum curtain wall and storefront system components in order to promote air circulation.
- C. Acceptance at Site:
1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

- A. Special Assembly Warranty: Standard form in which manufacturer agrees to repair or replace components of glazed aluminum curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond

- normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
- 1. 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. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Description:
- 1. Glazed aluminum curtain wall and storefront system is defined to include extruded, thermally improved, exterior glazed aluminum curtain walls and storefronts with rain-screen pressure equalization chambers, and all associated trim and accessories.
 - 2. The complete glazed aluminum curtain wall and storefront system shall include all internal reinforcements, fasteners, trim, dry-seal joint gaskets, pressure plates, closure plates, snap covers, anchors, inserts, support brackets, expansion devices, weeps, factory-formed transition plates and flashing, fascias, and all other components as necessary to complete the Work in a manner that provides a completely functioning system integrated into, and maintaining the continuity of, weather- and water-resistant perimeter wall construction, and with the ability to span vertically between supports as shown, and in compliance with performance criteria specified.
- B. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
- 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 2. Dimensional tolerances of building frame and other adjacent construction.
 - 3. Failure includes the following:
 - a. Deflection exceeding specified limits.

- b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Noise or vibration created by wind and by thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units.
- C. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- D. Structural Loads: Refer to Contract Documents.
- E. Deflection of Framing Members:
 - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to $L/360$ of clear span or 1/8 inch.
- F. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
 - 1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- G. Windborne-Debris-Impact-Resistance Performance: Provide aluminum-framed systems that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone 2.
 - 1. Large-Missile Impact: For aluminum-framed systems located within 30 feet of grade.
 - 2. Small-Missile Impact: For aluminum-framed systems located more than 30 feet above grade.
- H. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. Component Importance Factor is 1.15.
- I. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.
- J. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 12 psi of positive wind-load design pressure, as defined by AAMA 501.
- K. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 12 psi (10 psi for storefronts) of positive wind-load design pressure.
 1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.
- M. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation 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.
 2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal- surface temperature of 180 deg F.
 - b. Low Exterior Ambient-Air Temperature: 0 deg F.
 3. Interior Ambient-Air Temperature: 75 deg F.
- N. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 65 (60 psi for storefronts) when tested according to AAMA 1503.
- O. Thermal Conductance: Provide aluminum-framed systems with fixed glazing

and framing areas having an average U-factor of not more 0.45 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

- P. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.

2.2 MANUFACTURERS

- A. Products and Manufacturers: Provide one of the following:
1. 1600 Curtain Wall System¹, with Glass Vent, and TriFab VG 451 T Storefront with 360 InsulClad Heavy Wall Medium Stile Entrance by Kawneer Company, Incorporated - an Alcoa Company.
 2. YCW 750 XT Curtain Wall, YCW 750 Concealed Vent and Series YES 45 TU Storefront with 35XT Medium Stile Entrance by YKK AP America Incorporated, a YKK Corporation of America.³ System 5900 T Curtain Wall, with Concealed Vents, and Series 403 (T) Storefront with D302 Heavy-Duty Medium Stile Entrance by EFFCO Corporation, a Pella Company.
 3. Or equal.

2.3 MATERIALS

- A. Extrusions:
1. Provide aluminum tubular extruded mullions, pressure plates, snap covers, and glazing stops and trim, in compliance with ASTM B 221 and ASTM B 429, and equal to 6063-T6 alloy and temper, or as recommended by the glazed aluminum curtain wall manufacturer to comply with the requirements of performance, fabrication, application of finish and control of color.
 2. Provide thicknesses as necessary to comply with the structural loading performance requirements, but not less than the following:
 - a. Principal Extrusions:
 - 1) Side Walls: 0.100-inches, minimum thickness.
 - 2) Front and Rear Walls: 0.187-inches, minimum thickness.
 - b. Glazing Bar: 0.125-inches, minimum thickness.
 - c. Extruded Snap-On Glazing Bar Caps, Stops and Trim: 0.063-inches, minimum thickness.
 3. Provide extrusions within commercial tolerances, formed true to details shown and free of defects impairing strength, durability, color or finish.
 4. Framing Dimensions:
 - a. Curtain Wall: Vertical and horizontal framing members shall have nominal dimensions of 2-1/2-inches by 8-inches and 2-1/2-inches by 6-inches, as shown.
 - b. Storefront: Vertical and horizontal framing members shall have nominal dimensions of 2-inches by 4 1/2-inches and 2-inches by 6-inches, as shown.
 5. Framing Dimensions: Impact Resistant:

- a. Curtain Wall: Vertical and horizontal framing members shall have nominal dimensions of 3-inches by 8-inches and 3-inches by 6-inches, as shown.
 - b. Storefront: Vertical and horizontal framing members shall have nominal dimensions of 2 1/2-inches by 5-inches, as shown.
- B. Sheets:
 - 1. Provide aluminum sheet flashings, closures, and accessories, in compliance with ASTM B 209, and equal to 5005 alloy for exposed sheet and 3003 alloy for non-exposed sheet, or as recommended by the glazed aluminum curtain wall manufacturer to comply with the requirements of performance, fabrication, application of finish and control of color.
 - 2. Provide thicknesses as necessary to comply with the structural loading requirements, but not less than the following:
 - a. Principal Formed Sheet Members: 0.125-inches, minimum thickness.
 - b. Formed Glazing Stops and Trim: 0.050-inches, minimum thickness.
 - 3. Provide sheet free of defects impairing strength, durability, color or finish.
- C. Thermal Separators: Manufacturer's standard elastomeric thermal breaks.
- D. Non-Structural Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- E. Fasteners: Provide type and size required for proper support and performance, fabricated in compliance with AAMA TIR-A9 of aluminum or non-magnetic stainless steel. Provide Phillips flat-head screws where exposed, unless otherwise shown. Finish exposed aluminum fasteners to match aluminum Work.
- F. Brackets and Reinforcements: Provide aluminum brackets and reinforcements wherever possible. Where steel units are required for higher strength or other unavoidable necessity, hot-dip galvanize the pieces after fabrication, with 2.0 ounces zinc coating, complying with ASTM A 123/A 123M.
- G. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, compounded for 30-mil thickness per coat.
- H. Slip-Joint Linings: Provide plastic sheets, spacers or bearing pads as required to ensure free movement between surfaces where expansion and deflection movements are intended. Provide fluorocarbon resin or equivalent plastic units of the sizes and thicknesses recommended by the manufacturer to permanently prevent "freeze-up" of joints.
- I. Inserts for Anchorage in Concrete and Masonry: Furnish stainless steel anchors of the type required for proper anchorage based on performance criteria specified. Refer to Section 04 05 05, Unit Masonry Construction, for installation of inserts.

- J. Expansion Anchor Devices: Where inserts have not been provided in supporting concrete or masonry structure, provide drilled-in expansion bolt anchors of toothed stainless steel design.

2.4 FABRICATION

- A. Complete the fabrication and assembly of glazed aluminum curtain wall and storefront Work at the shop to the greatest extent possible, so as to minimize on-Site cutting, splicing, fastening, sealing, finishing and similar Work. Maintain provisions for expansion and movement as required. Disassemble only as necessary for shipment and erection. Maintain true continuity of line and accurate relation of planes and angles. Provide secure attachment and support at mechanical joints, with hairline fit of contacting members.
- B. Provide sizes, shapes and profiles as shown and required to fabricate glazed aluminum curtain wall and storefront Work.
- C. Provide tubular mullions as shown, projecting inside the plane of the glass with one pressure plate section per mullion. There shall be no through metal in horizontal rails or vertical mullions.
- D. Reinforce the Work internally with continuous structural sections, as may be necessary to comply with performance criteria specified, and for support of the system. Separate dissimilar metals with bituminous paint to prevent corrosion. Separate metal surfaces at moving joints with plastic inserts or other non-abrasive concealed inserts which will permanently prevent "freeze-up" of the joint.
- E. Provide mullions fabricated for on-Site connection at intersections, using screws and channel clips furnished by the manufacturer.
- F. Fabricate pressure plates for screw attachment, with snap covers provided for application over pressure plates to eliminate exposed fasteners.
- G. Provide snap covers of the following depth:
 - 1. 3/4-inch .
- H. Complete the cutting, fitting, forming, drilling, and grinding of all metal prior to cleaning, finishing, treatment, and application of coatings.
- I. Welding:
 - 1. Follow recommendations of AWS D10.7, to avoid discoloration at welds. Grind exposed welds smooth. Remove arises from cut edges and ease edges and corners to a radius of approximately 1/64-inch.
 - 2. Weld components to comply with referenced standards and approved Shop Drawings. Weld before finishing components. Weld in concealed locations

to the greatest extent possible. Remove all weld spatter and welding oxides from exposed joint surfaces by descaling and grinding. Restore finish to match adjacent surfaces so that weld location will not be visible on final finish.

- J. Conceal fasteners wherever possible, except as otherwise shown.
- K. Provide glazed aluminum curtain walls and storefronts capable of accommodating thicknesses of glass products specified in Section 08 81 00, Glass Glazing, operating vents, louvers and doors, as shown.
- L. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 - 1. Door Construction: 2-inch overall thickness, with minimum 3/16-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design: Medium stile; 3-1/2-inch nominal width.
 - a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
 - 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

2.6 ENTRANCE DOOR HARDWARE

- A. General: Provide entrance door hardware and entrance door hardware sets indicated in Article 3.6, List of Entrance Door Hardware Items, for each entrance door to comply with requirements in this Section.
 - 1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and product designations.
 - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 - 3. Opening-Force Requirements:
 - a. Accessible Interior Doors: Not more than 5 lbf to fully open door.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "List of Entrance Door Hardware Items". Products are identified by using entrance door hardware designations as follows:
 - 1. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

- C. Opening-Force Requirements:
 - 1. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force of not more than 15 lbf for not more than 3 seconds.
 - 2. Latches and Exit Devices: Not more than 15 lbf required to release latch.
- D. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.
- E. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- F. Cylinders: As specified in Section 08 71 00, Door Hardware.
- G. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- H. Operating Trim: BHMA A156.6.
- I. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet field conditions and requirements for opening force.
- J. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- K. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - 2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- L. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- M. Silencers: BHMA A156.16, Grade 1.
- N. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.
- O. Products and Manufacturers: Provide entrance door manufacturer's standard product in conformance with Section 08 71 00, Door Hardware.

2.8 GLAZED ALUMINUM CURTAIN WALL AND STOREFRONT FINISHES

- A. General:
 - 1. After fabrication of the glazed aluminum curtain wall and storefront Work, prepare surfaces for finishing in accordance with recommendations of the aluminum producer and the finisher or processor.
 - 2. Finish all components of each assembly simultaneously to attain complete uniformity of color.
 - 3. Sequence the finishing and processing of materials in a predetermined bay-by-bay, floor-by-floor, wall-by-wall plan, which will minimize color and texture differences between adjacent components.
- B. Three Coat Fluorocarbon Coating:
 - 1. Glazed aluminum curtain walls and storefronts to be finished with a minimum 1.4 mil thick full strength 70% resin, 3 coat Fluoropolymer system, meeting AAMA 2605 performance requirements.
 - 2. All aluminum shall be thoroughly cleaned, etched and given a chromated conversion pretreatment before application of the Kynar/Hylar coating. The coating shall consist of a primer, a color coat and a clear PVF2 topcoat. It shall receive a bake cycle of 17 minutes at 4500F. All finishing procedures shall be one continuous operation in the plant of the manufacturer.
 - 3. Provide the following colors:
 - a. Glazed Aluminum Curtain Wall and Storefront Mullions and Adapters: Silversmith
 - b. Snap Covers and Closures: Silversmith.
 - c. Exposed Fasteners: Color and finish to match substrate.
 - 4. Products and Manufacturers: Provide one of the following:
 - a. Duranar XL 3 Coat System by PPG Industries Coatings and Resins Division, Incorporated.
 - b. Fluoropon Premeire by Valspar Corporation.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the supporting structure and other elements of the substrate and conditions under which the glazed aluminum curtain wall and storefront Work is to be performed and notify ENGINEER, in writing, of unsatisfactory tolerances, which exceed specified limits in other work adjoining aluminum window wall and storefront Work, and other conditions detrimental to proper and timely completion of the Work. Do not proceed with erection until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

- A. Take field measurements prior to completion of shop-fabrication and finishing of glazed aluminum curtain wall and storefront Work. Do not delay progress of the

Work. Allow for erection tolerances corresponding with specified tolerances where final dimensions cannot be established before fabrication.

3.3 ERECTION TOLERANCE

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.4 INSTALLATION

- A. Comply with manufacturer's specifications and recommendations for the installation of glazed aluminum curtain wall and storefront components as shown on approved Shop Drawings.
- B. Do not install component parts, which are observed to be defective in any way, including warped, bowed, dented, abraided and broken members, and including glass with edge damage.
- C. Do not cut, or trim, component parts during erection, in a manner, which would damage the finish, decrease the strength, or result in a visual imperfection or a failure in performance of the glazed aluminum curtain walls and storefronts. Return component parts, which require alteration to the shop for re-fabrication, if possible, or for replacement by new parts.
- D. Install component parts level, plumb, true to line and with uniform joints and reveals. Secure to structure with non-staining and non-corrosive shims, anchors, fasteners, spacers and fillers. Use erection equipment, which will not mar or stain finished surfaces, and will not damage the component parts.
- E. Apply two coats of bituminous paint of approximately 30-mil dry film thickness per coat, or other suitable permanent separator, on concealed contact surfaces of dissimilar materials before installation, wherever there is the possibility of corrosive or electrolytic action.
- F. Anchor component parts securely in place as shown, by bolting, or other permanent mechanical attachment system, which will comply with performance requirements

- and permit movements, which are intended or necessary. Install slip-joint linings to ensure movement as intended or necessary.
- G. Clean debris, dust and other substances from behind the glazed aluminum curtain walls and storefronts as it is erected, and provide temporary closures if necessary to prevent the accumulation of such substances in the void spaces behind the glazed aluminum curtain walls.
 - H. Install thermal barrier between pressure plate and mullion.
 - I. Attach pressure plate with screws. Install snap covers over pressure plates.
 - J. Install glass using dry glazing retainers, which provide a firm but resilient clamping grip on the glass.
 - K. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install mortised cylinder according to entrance door hardware manufacturers' written instructions.
 - L. Final Adjustment: Make a final check and adjustment of all operable vents, entrance doors, and door hardware items. Clean and re-lubricate operating items as necessary to restore proper function and finish of door hardware and doors. Adjust door control devices with devices with items furnished in Section 28 00 05, Electronic Security System.
 - M. Maintain the glazed aluminum curtain walls and storefronts in a clean condition throughout the construction period, so that it will be without any evidence of deterioration or damage, other than the effects of normal weathering, at the time of final acceptance. Select methods of cleaning which will promote the achievement of uniform appearance and stabilized colors and textures for materials that weather or age with exposure.
 - N. Remove and replace with new material glazed aluminum curtain wall and storefront components, which have been damaged, including finish, beyond successful repair, as directed by ENGINEER. Repair minor damage.
 - O. Immediately before Substantial Completion, the installer shall clean the glazed aluminum curtain walls and storefronts thoroughly, inside and out, and demonstrate proper cleaning methods to OWNER'S maintenance personnel during this final cleaning.
 - P. At the completion of the Work, clean or replace adjacent Work, marred by the Work of this Section.

Q Remove all materials and debris and leave the Site of the Work in clean condition.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Services: Furnish the services of a manufacturer's technical representative who shall:

1. Be present at the start of the Work in order to provide clarification of manufacturer's approved installation instructions and assistance in establishing acceptable procedures and methods for erection of glazed aluminum curtain wall and storefront components.
2. Inspect the completed Work of the glazed aluminum curtain wall and storefront installer and assist ENGINEER with opinions on acceptability of completed installation.

B. Site (Field) Tests:

1. Water Spray Test: Perform test in accordance with AAMA 501.2, except limit test area to one bay wide (but not less than 20 feet-0 inches or more than 40 feet-0 inches) by one story high, located from mid-bay to mid-bay and from mid-story-height to mid-story-height.
2. Water Penetration Test: In addition to water spray testing, CONTRACTOR shall engage a qualified independent testing agency, approved by ENGINEER, to perform additional field-testing, as follows:
 - a. Test areas of installed system as shown for compliance with system performance requirements according to ASTM E 1105 at minimum differential pressure of 20 percent of inward acting wind load design pressure as defined by ASCE 7, but not less than 6.24 pounds per square foot.
3. Air Penetration Test: Test areas of installed system shown for compliance with system performance requirements according to ASTM E 783.
4. Depending upon the prevalence or absence of leakage in the initial water and air penetration tests, and upon measures adopted by the glazed aluminum curtain wall and storefront installer to eliminate sources of leakage from subsequently erected Work, ENGINEER will determine the necessity, and scope of, additional tests. In no case will the total of tested area amount to less than 1.0 percent, nor more than 20.0 percent of the glazed aluminum curtain wall and storefront area, except as subsequently authorized by ENGINEER.
5. Submit the results of all field-testing to ENGINEER for approval, including recommended remedial Work as may be required to comply with performance criteria specified. Glazed aluminum curtain wall and storefront Work that fails to meet specified performance criteria shall be removed and replaced with new Work in compliance with performance criteria specified, at no additional cost to the OWNER.

3.6 LIST OF ENTRANCE DOOR HARDWARE ITEMS

- A. Scheduled items for each door are generic and rely on information specified in ARTICLE 2.6, above. The listing of hardware functions and types provided are only a general guideline for the final Door Hardware Schedule. CONTRACTOR shall submit a Door Hardware Schedule acceptable to all governing authorities having jurisdiction at the Site.
- B. Provide the following door hardware items:
 - 1. Admin Facility, Lobby.
 - a. Exterior, Medium Stile.
 - 1) Continuous Geared Hinges.
 - 2) Exit Device (F04).
 - 3) Overhead, Surface-Mounted Door Closer.
 - 4) Stripping and Seals.
 - 5) Wall Stop.
 - 6) Threshold.
 - 7) Weather Sweep.
 - 8) Door Stop.

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SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install door hardware. Furnish door hardware for all doors in compliance with these Specifications herein.
2. Extent of door hardware is specified. Door hardware is defined to include all items known commercially as door hardware, except special types of unique and non-matching hardware specified in the same Section as the door and door frame.
3. Types of products required include the following:
 - a. Mortise hinges.
 - c. High-security mortise locksets.
 - d. High-security mortise latchsets.
 - e. Panic exit devices.
 - g. Heavy-duty, overhead, surface-mounted, door closers.
 - l. Electrified hardware.
 - m. Cylinders for doors specified in other Sections.
 - q. Door pulls, push plates and protection armor plate.
 - r. Stripping and seals.
 - s. Thresholds.
 - t. Silencers.
 - u. Floor-type stops with automatic hold-open operation.
 - v. Floor stops.
 - w. Wall stops.
 - x. Miscellaneous items and accessories for a complete installation functioning in compliance with the requirements of governing authorities having jurisdiction at the Site.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, the door hardware.
2. Notify other contractors in advance of the installation of the door hardware to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the door hardware.
3. Coordinate the Work of other Sections to provide clearances and accurate positioning of recessed or cast-in-place items.

C. Related Sections:

1. Section 08 11 13, Hollow Metal Doors and Frames.

2. Section

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
1. ANSI A117.1, Accessible and Usable Buildings and Facilities.
 2. ANSI/BHMA A156.1, Butts and Hinges.
 3. ANSI/BHMA A156.3, Exit Devices.
 4. ANSI/BHMA A156.4, Door Controls - Closers.
 5. ANSI/BHMA A156.5, Auxiliary Locks and Associated Products.
 6. ANSI/BHMA A156.6, Architectural Door Trim.
 7. ANSI/BHMA A156.7, Template Hinge Dimensions.
 8. ANSI/BHMA A156.8, Door Controls - Overhead Stops and Holders.
 9. ANSI/BHMA A156.13, Mortise Locks and Latches, Series 1000.
 10. ANSI/BHMA A156.16, American National Standard for Auxiliary Hardware.
 11. ANSI/BHMA A156.18, Hardware - Materials and Finishes.
 12. ANSI/BHMA A156.21, Thresholds.
 13. ANSI/BHMA A156.22, Door Gasketing and Edge Seal Systems.
 14. ANSI/BHMA A156.24, Delayed Egress Locks.
 15. ANSI/BHMA A156.25, Electrified Locking Devices.
 16. ANSI/BHMA A156.26, Continuous Hinges.
 17. ANSI/DHI A115.1, Preparation of Mortise Locks in 1-3/8-inch and 1-3/4-inch Standard Steel Doors and Frames.
 18. ANSI/NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
 19. ASTM E329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
 20. BMHA, Certified Product Directory.
 21. DHI, Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames.
 22. DHI, Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames.
 23. DHI, Sequencing and Format for the Hardware Schedule.
 24. FF-TT-S-00227,
 25. HMMA 830, Hardware Preparation and Locations for Hollow Metal Doors and Frames.
 26. NIST, U. S. Standard.
 27. NFPA 70, National Electric Code.
 28. NFPA 80, Fire Doors and Fire Windows.
 29. NFPA 101, Life Safety Code.
 30. SDI 109, Hardware for Standard Steel Doors and Frames.
 31. SDI 118, Basic Fire Door Requirements.
 32. UL 10B, Fire Tests of Door Assemblies.
 33. UL 10C, Positive Pressure Fire Tests of Door Assemblies.
 34. UL 305, Panic Hardware.
 35. UL, Building Materials Directory.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Provide door hardware and accessories manufactured by firms specializing in the production of this type of Work and complying with specified standards of ANSI, BHMA, DHI, NFPA, HMMA, SDI and UL.
2. Provide door hardware from manufacturers who are members of BHMA and participate in BHMA certification programs.

B. Installer's Qualifications:

1. The door hardware installer shall have in his employ an architectural hardware consultant. The architectural hardware consultant shall be a member of the Door and Hardware Institute, (DHI), who has passed the DHI certification examine and successfully completed an apprenticeship program. The architectural hardware consultant shall be responsible for preparing door hardware schedules and Shop Drawings and be present at the Site for the purpose of checking and supervising the Work of the installer during the time of installation and adjustment of the door hardware Work, and shall prepare a written field report on status of completed door hardware installation as specified.
2. Submit name and qualifications of the installer to ENGINEER.

C. Architectural Hardware Consultant Qualifications:

1. A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations and electrified door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

D. Component Supply and Compatibility:

1. Finish hardware equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
2. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the finish hardware manufacturer.
3. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

E. Testing Agency Qualifications: The independent testing agency shall demonstrate to ENGINEER'S satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated in accordance with ASTM E 329, without delaying the Work.

F. Regulatory Requirements:

1. Provide door hardware for fire-resistance-rated openings in compliance with NFPA 80.

2. Provide only door hardware that has been tested, listed and labeled by UL for the types and sizes of doors required, and complies with the requirements of the door and door frame labels.
 3. Modify features of door hardware items specified, and provide additional accessories and features as required to meet UL and NFPA requirements, at no additional cost to the OWNER.
 4. Codes: Comply with applicable requirements of codes.
- G. Source Quality Control:
1. Obtain each type of door hardware item from only one manufacturer.
 2. Provide door hardware schedule, for submission to, and for approval by, ENGINEER, prepared in compliance with DHI standards.
 3. Comply with specified BHMA standards.
- H. Requirements of Regulatory Agencies:
1. Provide only finish hardware that has been tested, listed and labeled by UL for the types and sizes of doors required, and complies with the requirements of the door and door frame labels.
 2. Modify features of finish hardware items specified, and provide additional accessories and features as required to meet UL and NFPA 80 requirements, at no additional cost to the OWNER.
 3. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches or less above the sill.
- I. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- J. Preconstruction and Keying Conference: Conduct conference at Project site. In addition to OWNER, CONTRACTOR, and ENGINEER, conference participants shall also include Architectural Hardware Consultant and OWNER's security consultant. Review methods and procedures related to electrified door hardware including, but not limited to, the following:
1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
 2. Review sequence of operation for each type of electrified door hardware.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review required testing, inspecting, and certifying procedures.
 5. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.

- d. OWNER entities responsible for signing off on keying and authorization to allow copies of keys.
- e. Address for delivery of keys.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

- a. Copies of the Door Hardware Schedule in the manner and format specified, complying with the actual construction Progress Schedule requirements (for each draft). Include explanation of abbreviations, symbols, and codes used to present scheduled information.
1) Prepare and submit Door Hardware Schedule in compliance with HDI standards.
- b. Based on the door hardware requirements specified, organize the final Door Hardware Schedule into "hardware sets," indicating complete designation of every item required for each door or opening. Furnish initial draft of schedule at the earliest possible date, in order to facilitate the fabrication of other Work (such as hollow metal frames) which may be critical in the Project Schedule. Furnish final draft of schedule after Samples, manufacturer's data sheets, coordination with Shop Drawings for other Work, delivery schedules and similar information have been completed and accepted.
- c. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
- d. Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.
- e. Include a separate key schedule, showing clearly how OWNER'S final instructions on keying of locks have been fulfilled.
- f. Door Hardware Schedules are intended for coordination of the Work. Review and acceptance by ENGINEER does not relieve CONTRACTOR of responsibility to fulfill the requirements as shown and specified.

2. Product Data:

- a. Copies of manufacturer's data for each item of door hardware. Include whatever information may be required to show compliance with specified requirements, and include instructions for installation and for maintenance of operating parts and exposed finishes. Include mounting heights and locations for each item of door hardware. Provide ENGINEER with latest complete technical catalogue of all available door hardware manufactured by proposed manufacturers, even if manufacturer specified by ENGINEER is submitted by CONTRACTOR to perform the Work. Furnish templates to fabricators of other Work, which is to receive door hardware.
- b. Details of electrified door hardware, indicating the following:

- 1) Wiring Diagrams: Power, signal, and control wiring. Include the following:
 - a) System schematic.
 - b) Point-to-point wiring diagram.
 - c) Riser diagram.
 - d) Elevation of each door.
- 2) Detail interface between electrified door hardware and fire alarm, access control, security, building control system.
- 3) Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Certify that electrified door hardware approved for use on types and sizes of labeled fire doors complies with listed fire door assemblies.
2. Test and Evaluation Reports:
 - a. Certified independent laboratory test reports for BHMA certification program and certification tests for each type of product specified.
3. Site Quality Control Submittals:
 - a. Field Report: Architectural Hardware Consultant's Report.
4. Qualifications Statements:
 - a. Installer.

C. Closeout Submittals: Submit the following:

1. Operation and Maintenance Documentation: Upon completion of the Work, furnish five copies of detailed maintenance manuals, including the following information:
 - a. Product name and manufacturer.
 - b. Name, address, e-mail address and telephone number of manufacturer and local distributor.
 - c. Detailed procedure for routine maintenance and cleaning.
 - d. Detailed procedures for repairs such as dents, scratches and staining.
 - e. Parts identification manual and maintenance manuals for each piece of door hardware.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work. Deliver recessed floor pivot hinge boxes which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
2. Deliver all items of door hardware in manufacturer's original, undamaged packages, bearing accurate representation of the item within each package.
3. Pack each piece of door hardware separately, complete with screws, keying, instructions and templates, tagged to correspond with items submitted on approved Shop Drawings and as specified.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
2. Provide secure storage area for door hardware items, secured by locks and accessible only to door hardware installer, ENGINEER and CONTRACTOR.
3. Store door hardware in manufacturers' original packages.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Items that arrive in a damaged condition shall be removed from the Site and not offered again for acceptance. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 COORDINATION

- A. Coordinate layout and installation of recessed pivots and closers with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Section 03 00 05, Concrete.
- B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system and building control system.
- D. Existing Openings: Where new hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide for proper operation.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of operators and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: 3 years from date of Substantial Completion, except as follows:
 - a. Electrified Locks: One year from date of Substantial Completion.
 - b. Exit Devices: 2 years from date of Substantial Completion.
 - c. Manual Closers: 10 years from date of Substantial Completion.
 - d. Concealed Floor Closers: 25 years from date of Substantial Completion.

1.8 MAINTENANCE

- A. Extra Materials
 1. Furnish full-size units of door hardware described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Finish Hardware: One unit of each type of hardware specified.
 - b. Electrical Parts: One unit of each type of hardware specified.
- B. Maintenance Service
 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
 2. Maintenance Service: Beginning at Substantial Completion, provide 6 months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Design Criteria:
 1. Where the door, shape, size, fire-resistance-rating, frequency of use, or function of a member receiving door hardware is such as to prevent, or make unsuitable, the types of door hardware specified, furnish similar types having as nearly as practicable the same operation but of type or kind more appropriate to the design intention and requirements of governing authorities having jurisdiction at the Site. Clearly identify and highlight to ENGINEER all such required modifications on Shop Drawings submitted for approval.
 2. If door hardware for any location is not specified, provide door hardware equal in design and quality to adjacent door hardware specified for comparable openings at no additional cost to OWNER.
 3. Furnish door hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements, as necessary for proper installation and function.

4. Unless otherwise specified, comply with DHI, Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames and Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames.

2.2 DETAILS OF CONSTRUCTION

A. General:

1. Hand of Door: The Drawings show the swing or hand of each door leaf (left, right, reverse bevel, etc.). Furnish each item of door hardware for proper installation and operation of the door swing as shown.
2. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with labels required by governing authorities having jurisdiction at the Site.
3. Base Metals: Produce door hardware units of the basic metal and forming method specified, using the manufacturer's standard metal alloy, composition, temper and hardness. Do not substitute materials or forming methods for those specified.
4. Fasteners: Manufacture door hardware to conform to published templates, generally prepared for machine screw installation. Do not provide door hardware, which has been prepared for self-tapping sheet metal screws, except as specifically indicated.
5. Furnish screws for installation, with each door hardware item. Provide Phillips flat-head screws except as otherwise specified. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces on other Work, to match the finish of such other Work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
6. Provide fasteners which are compatible with both the unit fastened and the substrate, and which will not cause corrosion or deterioration of door hardware, base material or fastener.
7. Provide concealed fasteners for door hardware units, which are not exposed when the door is closed, except to the extent no standard manufacturer units of the type specified are available with concealed fasteners. Do not use through bolts for installation where the bolt head or the nut on the opposite face is exposed in other Work under any condition, except where it is not possible to adequately reinforce the Work and use machine screws or concealed fasteners of another standard type to satisfactorily avoid the use of through bolts.
8. Tools for Maintenance: Furnish two complete sets of specialized tools as required for OWNER'S continued adjustment, maintenance, removal and replacement of door hardware.

2.3 HARDWARE TYPES

A. Mortise Hinges:

1. Templates and Screws: Provide only template-produced units.
2. Base Metal: Except as otherwise specified, fabricate hinges from stainless steel and finish to match the latch and lock set.

3. Number of Hinges: Provide three hinges on each door leaf of less than 60-inches in height; provide one additional hinge for next 30-inches of door height or fraction thereof; provide two additional hinges for each 30-inches, or fraction thereof, for doors above 90-inches tall.
 4. Hinge Size: Except as otherwise specified or as required to comply with UL and NFPA, provide hinges of the following sizes:
 - a. Interior Doors:
 - 1) Average Use, Maximum 36-Inches Wide: 4-1/2-inch standard weight (0.134-inches).
 - 2) Heavy Use, Maximum 36-Inches Wide: 4-1/2-inch heavy-weight (0.180-inches).
 - b. Exterior Doors, Maximum 36-Inches Wide: 4-1/2-inch heavy-weight (0.180-inch).
 - c. Wide Exterior and Interior Doors:
 - 1) Maximum 48-inches wide: 5-inch heavyweight (0.190-inch).
 - 2) Over 48-inches wide: 6-inch heavy weight (0.203-inch).
 5. Types of Hinges: Provide full-mortise type, ball-bearing hinges, swaged for mortise applications, inner leaf beveled, square cornered, unless manufacturer's recommendations indicate that half-mortise, half-surface, full-surface or other type should be used for the frame and door type or condition.
 6. Hinge Pins: Except as otherwise specified, provide hinge pins as follows:
 - a. Pins: Stainless steel.
 - b. Exterior Doors: Non-removable pins. Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed.
 - c. Tips: Slope ends of hinge barrel.
 7. Conform to ANSI/BHMA A156.7.
 8. Comply with UL, List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
 9. Products and Manufacturers: Provide one of the following:
 - a. FBB 199, FBB 191 and CECSFBB 199, CECS FBB 191 by Stanley Commercial Hardware, Division of The Stanley Works.
 - b. T4B3386, TB3313 and QC+MMT4B3386, QC+MM TB3313 by McKinney Products Company, an ASSA ABLOY Group company.
 - c. Or equal.
- E. High-Security Mortise Locks and Latch Sets:
1. Accessibility Requirements: Where indicated to comply with accessibility requirements, comply with ADAAG.
 2. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 3. Strikes: Provide manufacturer's standard wrought box strike, for each location and use shown. Provide stainless steel curved lip strikes, unless otherwise recommended by manufacturer, finished to match lock or latch set trim.
 4. Lock Throw: Provide minimum of 3/4-inch anti-friction latch bolt and 1-inch dead bolt throw. Comply with UL requirements for throw of latch bolts and deadbolts on fire-resistance-rated openings.
 5. Materials: Provide the following features and materials:

- a. Latch Bolt: Two-piece; mechanical; anti-friction, stainless steel.
 - b. Dead Bolt: One-piece, stainless steel with two enclosed hardened-steel roller armor pins.
 - c. Case: Wrought steel, zinc dichromatized.
 - d. Cylinders: High-security; brass; pick- and drill-resistant; ANSI/BHMA A156.5 - E09211A.
 - e. Armor Front: 8-inches by 1-1/4-inches wide, minimum; steel.
 - f. Escutcheon: 8-inches by 2-1/2-inches wide by 3/16-inches thick, minimum; stainless steel, US 32D.
 - g. Hubs: Sintered steel, copper infiltrated.
 - h. Lever with Stop Pin: Brass, plated to match stainless steel, with additional built-in stop to prevent over-torquing of lever.
 - i. All components shall be of marine quality, wherever possible.
- 6. Backset: 2-3/4-inches.
 - 7. Modify specified locks and latches to comply with UL, Building Materials Directory, and List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
 - 8. Latches and Locks for Means of Egress Doors: Comply with NFPA 101.
 - 9. Electrified Locking Devices: BHMA A156.25.
 - 10. Finish: US 32D satin.
 - 11. Conform to ANSI/BHMA A156.13, Series 1000, Security Grade 1.
 - 12. Products and Manufacturers: Provide one of the following:
 - a. High Security SL8800 Mortise Lockset with Augusta - AUSL Lever Handles and Trim by Yale Commercial Locks and Hardware, an ASSA ABLOY Group company.
 - b. ML2000 Series Mortise Lockset with Newport NSM Lever Handles and Trim by Corbin Russwin Architectural Hardware, an ASSA ABLOY Group Company.
 - c. Or equal.

F. Panic Exit Devices:

- 1. Strikes: Provide manufacturer's standard wrought stainless steel jamb-mounted top latch bolt and bottom latch bolt for each location and use shown to allow independent opening and closing of each leaf of double doors with panic exit devices; complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
- 2. Lock Throws: Provide minimum of 3/4-inch latch bolt throw complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
- 3. Strikes: Provide manufacturer's standard wrought stainless steel jamb-mounted top latch bolt and bottom latch bolt for each location and use shown to allow independent opening and closing of each leaf of double doors with panic exit devices; complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
- 4. Lock Throws: Provide minimum of 3/4-inch latch bolt throw complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.

5. Provide concealed vertical rod type exit device and mortise type exit devices as specified.
6. Provide the following features and materials:
 - a. Latch Bolt: Two-piece; mechanical; anti-friction, stainless steel.
 - b. Dead Bolt: One-piece, stainless steel with two enclosed hardened-steel roller armor pins.
 - c. Case: Wrought steel, zinc dichromatized.
 - d. Cylinders: High-security; brass; pick- and drill-resistant; ANSI/BHMA A156.5 - E09211A.
 - e. Armor Front: 8-inches by 1-1/4-inches wide, minimum; steel.
 - f. Escutcheon: 8-inches by 2-1/2-inches wide by 3/16-inches thick, minimum; stainless steel, US 32D.
 - g. Hubs: Sintered steel, copper infiltrated.
 - h. Crossbar: Oval, seamless with interlocking expansion collets and roll pins; knurled, satin stainless steel, 0.062-inches minimum thickness, with steel reinforcing tube.
 - i. Concealed bolts: Minimum 1/2-inch diameter, stainless steel.
7. Backset: Provide minimum backset of 2-3/4-inches.
8. Finish: US 32D satin.
9. ANSI/BHMA: A156.3, Type 3 and Type 8, Grade 1; F08, entrance by lever, key locks or unlocks lever for entrances shown as accessible to people with disabilities as required by ADAAG; and F05, entrance by thumb piece, key locks or unlocks thumb piece.
8. Electrically Controlled Devices: ANSI A156.3 & A156.24.
9. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
10. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
11. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
12. Products and Manufacturers: Provide one of the following:
 - a. 1530-L8 (F) and -T8 (F) Series Mortise Exit Devices and 1520(F) CVR Concealed Vertical Rod Exit Devices; with Escutcheon Trim and Augusta - ASL Lever Handles and Thumbpiece/Handle/Cylinder Unit by Yale Commercial Locks and Hardware, an ASSA ABLOY Group company.
 - b. ED6600Series Mortise Exit Devices and ED 6800 Concealed Vertical Rod Exit Devices; with Escutcheon Trim and Newport – N4M Lever Handles and D Grip T7M Thumb piece/Handle/Cylinder Unit by Corbin Russwin Architectural Hardware, an ASSA ABLOY Group company.
 - c. Or equal.

G. Electric Strikes:

1. Standard: BHMA A156.
2. Products and Manufacturers: Provide one of the following:

- a. 7000 Series by Adams Rite Manufacturing Company.
- b. 300 and 700 Series by Folger Adam Security Inc.; an ASSA ABLOY Group company.
- c. Or Equal.

H. Cylinders and Keying System:

- 3. Existing System: Grandmaster key or great-grandmaster keys the locks to OWNER'S existing system, with a new master key for the Project.
- 4. Review the keying system with OWNER'S and provide the type required (master, grandmaster or great grandmaster), either new or integrated with OWNER'S existing system.
- 5. Furnish all locks with manufacturer's cylinders for interchangeable-core pin tumbler inserts. Furnish only temporary inserts for the construction period, and remove these before Substantial Completion. Construction control keys and cores shall not be part of OWNER'S permanent keying system. Permanent cores and keys shall be furnished to OWNER prior to Substantial Completion.
- 6. Comply with the OWNER'S instructions for master keying and, except as otherwise specified, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.
- 7. Permanent keys and cores shall be stamped with the applicable key mark for identification. These visual key control marks or codes shall not include the actual key cuts. Permanent keys shall also be stamped "DO NOT DUPLICATE".
- 8. Cylinder Material: Brass, bronze or Series 300 stainless steels.
- 9. Cylinder Features: Seven-pin, high-security, removable core.
- 10. Key Material: Nickel silver.
- 11. Key Quantity: Furnish three keys for each lock and five keys for each master and grandmaster system. Provide one extra key blank for each lock.
- 12. Provide a key control system including envelopes, labels, tags with self-locking key clips, receipt forms, three-way visible card index, temporary markers, permanent markers and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150 percent of the number of locks required for the Project. Provide a hinged-panel type cabinet, for wall mounting.

J. Overhead, Surface-Mounted, Door Closers:

- 1. Provide all doors, unless specially shown or specified as being provided with floor-mounted or concealed overhead closers, with surface-mounted overhead door closers. Provide both active and inactive door leafs with closers.
- 2. Size of Units: Except as otherwise specified, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather, and anticipated frequency of use.
- 3. Where parallel arms are specified, and for closers on exterior doors, provide closer unit one size larger than recommended for use with standard arms.
- 4. Use parallel arm arrangement for doors that would otherwise have the door closer appearing in finished corridors or entries.
- 5. Comply with UL, Building Materials Directory, and List of Inspected Fire Protection Equipment and Materials, and NFPA 80. Modify closers specified as required.

6. Provide hold open feature for all non-fire-resistant-rated doors, unless otherwise specified.
7. Provide corner bracket mounting on exterior doors. Select all arms to clear weather-stripping, and overhead door holders.
8. Provide long arm to allow door to swing 180 degrees where long arm will eliminate floor-mounted stops.
9. Provide closers with spring power adjustment feature capable of increasing spring power 15 percent minimum in all closer sizes.
10. Provide individual regulating valves for closing and latching speeds, and separate adjustable back check valve.
11. Provide delayed closing action feature on all door closers. Position valve at top of closure.
12. Provide the following materials and features:
 - a. Full Metal Cover: Aluminum.
 - b. Case: Cast-iron.
 - c. Arms: Plated to match full metal covers.
 - d. Other Parts: Steel.
 - e. Extreme temperature fluid.
 - f. Security torx machine screws.
 - g. Ten-year warranty.
 - h. Provide manufacturer's optional corrosion protection.
13. Finishes: US 26D satin chrome. Color coordinate all arms and other accessories.
14. Highly Corrosive Atmospheres: Provide all closers with specified manufacturer's optional corrosion protection.
15. ANSI/BHMA: A156.4, C02011, in compliance with PT 1 and PT 4.
16. Products and Manufacturers: Provide one of the following:
 - a. DC8000 Series by Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - b. 4040 Series by LCN Closers, an Ingersoll Rand Company.

R. Protection Armor:

1. Protection Armor:
 - a. Provide one armor plate per leaf of each door scheduled to receive armor-plate protection.
 - b. Provide 16-gauge stainless steel with No. 4 finish 2 foot-0 inches high by 12-inches less in width than width of door.
 - c. ANSI/BHMA: A156.6, J101; B3E.
 - d. Products and Manufacturers: Provide one of the following:
 - 1) 193S Beveled Stainless Steel Armor Plates by Hager Companies.
 - 2) 8400 Series Protection Plates by IVES Hardware, an Ingersoll-Rand Company.
 - 3) Or equal.

S. Weatherstrip Gasketing:

1. Provide perimeter weather stripping at all exterior doors. Provide stripping and seals for interior doors where scheduled in List of Door Hardware Items at end of Part 3.

2. Continuity of Stripping: Except as otherwise specified, stripping at each opening shall be continuous and without unnecessary interruptions at door corners and hardware.
3. Replaceable Seal Strips: Resilient or flexible seal strip of every unit shall be easily replaceable and readily available from stocks maintained by the manufacturer.
4. Provide bumper-type weather-stripping at jambs and head, including a resilient insert and metal retainer strip, surface-applied, of the following metal, finish and resilient bumper material:
 - a. Housing: Extruded aluminum with clear anodized finish; 0.062-inch minimum thickness of main walls and flanges.
 - b. Dimensions: 1-3/8-inches by 7/8-inches, stop-mounted.
 - c. Seals: Closed-cell extruded silicone.
 - d. ANSI/BHMA: A156.22, R3E264.
 - e. Products and Manufacturers: Provide one of the following:
 - 1) No. 2891 APK (for parallel arms) by Pemko Manufacturing Company.
 - 2) No. 429A (for parallel arms) by Zero International.
 - 3) Or equal.
5. Provide heavy-duty automatic drop-seal sound-stripping door-bottom unit of manufacturer's standard design, with operating seal bar of the following material, retained in an extruded metal bar and capable of operating to close a 3/4-inch gap (from door bottom to floor or threshold). House mechanism and operating bar in the following metal housing, for mounting in doors as follows:
 - a. Housing: Extruded aluminum, 0.062-inch thick, with mill aluminum finish.
 - b. Seal: Closed-cell extruded silicone.
 - c. Mounting: Full-mortise.
 - d. ANSI/BHMA: A156.22, R3E344.
 - e. Products and Manufacturers: Provide one of the following:
 - 1) No. 434APKL by Pemko Manufacturing Company.
 - b) No. 369 A by Zero International.
 - 2) Or equal.
6. Provide heavy-duty, surface-mounted, automatic drop-seal door-bottom unit of manufacturer's standard design, with operating seal bar of the following material, retained in an extruded metal bar and capable of operating to close a 3/4-inch gap (from door bottom to floor or threshold). House mechanism and operating bar in the following metal housing, for mounting in doors as follows:
 - a. Housing: Extruded aluminum, 0.062-inch thick, with mill aluminum finish.
 - b. Seal: Neoprene.
 - c. Mounting: Surface-mounted.
 - d. ANSI/BHMA: A156.22, R3E344.
 - e. Products and Manufacturers: Provide one of the following:
 - a) No. 4301 DPKL by Pemko Manufacturing Company.
 - b) No. 367 D by Zero International.
 - c) Or equal.

7. Provide adhesive-backed, surface-mounted, fire/smoke compression bulb and separate intumescent strips of manufacturer's standard design, for mounting on door frames as follows:
 - a. Seal: Extruded compression silicone bulb.
 - b. Intumescent Strip: Surface-mounted.
 - c. Smoke Test: UL1784-01; NFPA 105 "Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives".
 - d. Fire Test: UL10B, UL10C, UBC 7-2.
 - e. Air Infiltration Test: ASTM E-283-04. Air infiltration is only .09 CFM / ft of crack.
 - e. Products and Manufacturers: Provide one of the following:
 - 1) No. PK 33 PemkoPrene Adhesive Perimeter Gasketing, Fire/Smoke Seal SiliconSeal with HSS2000 Hot Smoke Seal Intumescent Fire Seal by Pemko Manufacturing Company.
 - 2) No. 188 Seals and No. 3125750PSA Soft Puff Inument by Zero International.
 - 3) Or equal.

T. Standard Thresholds:

1. All exterior and interior doors shall be provided with thresholds.
2. Metal: Mill finish extruded bronze.
3. Surface Pattern: Fluted tread, manufacturer's standard.
4. Provide countersunk stainless steel screws and expansion shields.
5. Width: Five-inches wide and of length sufficient to span full width of rough openings, coped and scribed neatly at and around door frames.
6. Construction:
 - a. Single-piece, complying with manufacturer's recommendations.
7. Profile: Provide manufacturer's unit, which conforms to the minimum size and profile requirements specified.
 - a. Floor Drop: Except where no change in floor elevation is shown from one side of threshold to the other, provide profile that accommodates 1/2-inch drop in floor elevation, unless another dimension is shown.
 - b. For doors equipped with panic hardware, including floor bolts, provide profile with stop bar of proper size and shape to function as the strike plate for the floor bolts.
8. Thickness: 1/2-inch, minimum.
9. ANSI/BHMA: A156.21, J12100.
10. Products and Manufacturers: Provide one of the following:
 - a. 171B by Pemko Manufacturing Company.
 - b. 8655 A by Zero International.
 - b. Or equal.

U. Thermal Barrier Thresholds:

1. All exterior doors shall be provided with thermal barrier thresholds.
2. Metal: Extruded aluminum.
3. Surface Pattern: Fluted tread, manufacturer's standard.
4. Provide countersunk stainless steel screws and expansion shields.

5. Width: 5 1/8-inches wide and of length sufficient to span full width of rough openings, coped and scribed neatly at and around door frames.
6. Construction:
 - a. Two-piece, with rigid vinyl key complying with manufacturer's recommendations.
7. Profile: Provide manufacturer's unit, which conforms to the minimum size and profile requirements specified.
 - a. For doors equipped with panic hardware, including floor bolts, provide profile with stop bar of proper size and shape to function as the strike plate for the floor bolts.
8. Thickness: 1/2-inch.
9. ANSI/BHMA: A156.21, J12100.
10. Products and Manufacturers: Provide one of the following:
 - a. 252X2AFG by Pemko Manufacturing Company.
 - b. 625 A by Zero International.
 - b. Or equal.

W. Silencers:

1. Provide silencers for all door frames.
2. Provide pneumatic design that, once installed, forms an air pocket to reduce noise.
3. Provide minimum of three per strike side of door jambs.
4. ANSI/BHMA: A156.16, BHMA 6.5, L03011.
5. Products and Manufacturers: Provide one of the following:
 - a. SR64 by IVES Hardware, an Ingersoll-Rand Company.
 - b. Series 307D by Hager Companies.
 - b. Or equal.

X. Floor-type Stop with Automatic Hold-open Operation: Provide the following where scheduled in List of Door Hardware at end of Part 3:

1. Semi-automatic cast bronze extra heavy-duty floor mounted door holder, one per leaf.
2. Activation of holder accomplished automatically when door is opened. Release by firmly pushing door.
3. Finish: US 26D satin chrome.
4. ANSI/BHMA: A156.16, L 11301.
5. Products and Manufacturers: Provide one of the following:
 - a. FS F40A by IVES Hardware, an Ingersoll-Rand Business.
 - b. Series 326F Floor Holder/Stop by Hager Companies.
 - b. Or equal.

Y. Wall and Floor Stops: Provide the following where scheduled in List of Door Hardware Items at end of Part 3:

1. Dome-Type Floor Stops:
 - a. Cast bronze extra heavy-duty wall mounted door stop, one per leaf.
 - b. Coordinate height of dome-type floor mounted doors stops with threshold condition and undercut of door.
 - c. Finish: US 26D satin chrome.

- d. ANSI/BHMA: A156.16, L12161.
- e. Products and Manufacturers: Provide one of the following:
 - 1) FS13/ R14, FS17 by IVES Hardware, an Ingersoll-Rand Company.
 - 2) Trimco BL243F by Triangle Brass Manufacturing Company.
 - 2) Or equal.
- 2. Wall Stops:
 - a. Cast bronze extra heavy-duty wall mounted door stop, one per leaf.
 - b. Convex rubber bumper.
 - c. ANSI/BHMA: A156.16, L12101.
 - d. Products and Manufacturers: Provide one of the following:
 - 1) WS401CVX by IVES Hardware, an Ingersoll-Rand Company.
 - 2) 2) Trimco 230W by Triangle Brass Manufacturing Company 2) Ø equal.

AA. Sealants: Provide elastomeric sealant complying with FS TT-S-00227, Type 2 (non-sag) Class A for use with thresholds.

2.3 HARDWARE FINISHES

- A. Provide matching finishes for door hardware units at each door or opening, to the greatest extent possible in compliance with ANSI/BHMA A156.18.
- B. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of door hardware exposed at the same door or opening. In general, match all items to the manufacturer's standard finish for the latch and lock set for color and texture.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the substrate to receive door hardware, and the conditions under which the Work will be performed, and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the door hardware Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

- A. Templates: Furnish door hardware templates to each fabricator of doors, frames and other Work to be factory-prepared for the installation of door hardware. Check the Shop Drawings of such other Work, to confirm that adequate provisions are made for the proper installation of the door hardware.
- B. Prepare Work to receive door hardware Work in compliance with ANSI/DHI A115.1.

- C. Surface-Applied Door Hardware: NFPA 80: Drill and tap doors and frames according to ANSI A250.6.

3.3 INSTALLATION

- A. Installer shall check and approve the installation before operation. Installer shall assure that the system operates to the OWNER'S satisfaction.
- B. Mount door hardware units at heights recommended in, Door and Hardware Institute, "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames" and "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames", except as otherwise specified or required to comply with governing authorities having jurisdiction at the Site, HMMA 830 and ADAAG requirements.
- C. Install each door hardware item in compliance with the manufacturer's instructions and recommendations and approved Shop Drawings. Wherever cutting and fitting is required to install door hardware onto or into surfaces that are later to be painted or finished in another way, install each item completely, then remove, and store in a secure place during the finish application. After completion of the finishes, re-install each item. Do not install surface-mounted items until finishes have been completed on the substrate.
- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Cut and fit threshold and floor covers to profile of door frames, with mitered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.
- G. Screw thresholds to substrate with No. 10 or larger screws, of the proper type for permanent anchorage and of bronze or stainless steel that will not corrode in contact with the threshold metal.
- H. Set thresholds in a bead of elastomeric sealant to completely fill concealed voids and exclude moisture from every source. Do not plug drainage holes or block weeps. Remove excess sealant before sealant cures to a firm set.
- I. Initial Adjustment: Adjust and check each operating item of door hardware and each door, to ensure proper operation or function of every unit. Lubricate moving parts with the type lubrication recommended by manufacturer (graphite-type if no other recommended). Replace units that cannot be adjusted and lubricated to operate freely and smoothly as intended for the application. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 2. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- J. Final Adjustment: Where door hardware installation is made more than one month prior to Substantial Completion, return to the Work during the week prior to acceptance or occupancy, and make a final check and adjustment of all door hardware items in each space and area. Clean and re-lubricate operating items as necessary to restore proper function and finish of door hardware and doors. Adjust door control devices to compensate for final operating of heating and ventilating equipment.
- K. Provide manufacturer's authorized representative to instruct and train OWNER'S personnel in proper adjustment and maintenance of door hardware during the final adjustment of door hardware.
- L. Door hardware, which is blemished or defective, will be rejected even though it was set in place before defects were discovered. Remove and replace with new door hardware. Repair all resultant damage to other Work.
- M. Continued Maintenance Service: Approximately six months after the acceptance of door hardware in each area, the installer, accompanied by the representative of the latch and lock manufacturer, shall return to the Project and re-adjust every item of hardware to restore proper function of doors and door hardware. Consult with and instruct OWNER'S personnel in recommended additions to the maintenance procedures. Clean and lubricate operational items wherever required. Replace door hardware items that have deteriorated or failed due to faulty design, materials or installation of door hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the door hardware.

3.4 FIELD QUALITY CONTROL

- A. Provide a written field report, prepared by installer's architectural hardware consultant, identifying actual condition, location, manufacturer, and product designation for each item of door hardware actually present on each door at the Site, including whether door hardware is adjusted and operating properly, compared with each item referenced to approved Shop Drawings and Contract requirements.
- B. Installer's hardware consultant shall provide opinions to, and assist ENGINEER in determining, acceptability of installation as Work proceeds. All comments and discussions, conversations and meetings with ENGINEER shall be included in written field report for submission to ENGINEER for review and approval at completion of door hardware installation.

- C. As part of written field report to be submitted to ENGINEER for approval, recommend remedial actions for Work not in compliance with these Specifications. No payment for Work shall be made until remedial recommendations and actions have been approved by ENGINEER and incorporated into the Work.

3.5 LIST OF DOOR HARDWARE ITEMS

- A. Scheduled items for each door are generic and rely on information specified above. The listing of hardware functions and types provided are only a general guideline for the final Door Hardware Schedule. CONTRACTOR shall submit a Door Hardware Schedule acceptable to all governing authorities having jurisdiction at the Site.

- B. Provide the following door hardware items:

1. Operations Admin Facility.
 - a. Interior, Hollow Metal.
 - 1) Mortise Hinges.
 - 2) Mortise Latch (F04).
 - 3) Overhead, Surface-Mounted Door Closers.
 - 4) Stripping and Seals.
 - 5) Wall Stop.
 - 6) Threshold.
 - b. Exterior, Aluminum.
 - 1) Mortise Hinges.
 - 2) Mortise Lock (F10).
 - 3) Overhead, Surface-Mounted Door Closers.
 - 4) Stripping and Seals.
 - 5) Wall Stop.
 - 6) Threshold.
 - 7) Access Control compatible door.
 - i) Electrical Strike prepared.
 - c. Exterior, Hollow Metal.
 - 1) Mortise Hinges.
 - 2) Panic Exit Device(F05).
 - 3) Overhead, Surface-Mounted Door Closers.
 - 4) Overhead, Surface-Mounted Door Stop.
 - 5) Stripping and Seals.
 - 6) Threshold.
 - 7) Access Control compatible door.
 - i) Electrical Strike prepared.
 - d. Interior, Hollow Metal.
 - 1) Mortise Hinges.
 - 2) Mortise Lock (F19).
 - 3) Overhead, Surface-Mounted Door Closers.
 - 4) Overhead, Surface-Mounted Door Stop.
 - 5) Threshold.

+ + END OF SECTION + +

SECTION 08 81 00

GLASS GLAZING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install glass glazing.
2. Extent of glass glazing is shown.
3. Types of products required include the following.
 - a. Clear, monolithic, heat-treated, float glass.
 - b. Tinted, monolithic, Low E, heat-treated, float glass.
 - c. Clear, tempered, laminated, fire-rated safety, float glass.
 - d. Tinted, Low E, heat-treated, insulated, float glass. float glass.
 - e. Non-structural glazing sealants.
 - f. Miscellaneous glazing, gaskets, spacers, tapes, and other materials.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the glass glazing Work.
2. Notify other contractors in advance of the installation of the glass glazing to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the glass glazing Work.

C. Related Sections:

1. Section 07 92 00, Joint Sealants.
2. Section 08 11 13, Hollow Metal Doors and Frames.
3. Section 08 51 13, Aluminum Windows.
4. Section 08 44 13, Glazed Aluminum Curtain Walls.
5. Section 10 28 05, Toilet and Bath Accessories.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. AAMA, GDSG-1, Glass Design for Sloped Glazing.
2. AAMA, TIR-A7, Sloped Glazing Guidelines.
4. AAMA 806.3, Voluntary Specification for. Bonding-Type Back-Bedding Glazing Tapes.
5. ANSI Z97.1, Safety Glazing Materials Used in Buildings.
6. ANSI/ASTM E 1300, Practice for Determining Load Resistance of Glass in Buildings.
7. ASCE 7, Minimum Design Loads for Buildings and Other Structures.

8. ASTM C 509, Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
9. ASTM C 716, Specification for Installing Lock-Strip Gaskets and Infill Glazing Materials.
10. ASTM C 793, Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants.
11. ASTM C 794, Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
12. ASTM C 920, Specification for Elastomeric Joint Sealants.
13. ASTM C 963, Specification for Packaging, Identification, Shipment, and Storage of Lock-Strip Gaskets.
14. ASTM C 1021, Practice for Laboratories Engaged in Testing of Building Sealants.
15. ASTM C 1036, Specification for Flat Glass.
16. ASTM C 1048, Specification for Heat-Treated Flat Glass-Kinds HS, Kind FT Coated and Uncoated Glass.
17. ASTM C 1087, Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
18. ASTM C 1115, Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.
19. ASTM C 1172, Specification for Laminated Architectural Flat Glass.
20. ASTM C 1249, Guide for Secondary Seal for Sealed Insulating Glass Units for Structural Sealant Glazed Applications.
21. ASTM C 1330, Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
22. ASTM E 548, Guide for General Criteria Use for Evaluating Laboratory Competence.
23. ASTM E 1886, Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
24. ASTM E 1996, Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
25. ASTM E 2190, Specification for Insulating Glass Unit Performance and Evaluation
26. 16 CFR, Consumer Product Safety Commission, CPSC Part 1201, Safety Standard for Architectural Glazing Materials.
27. 40 CFR 59 Subpart D, National Volatile Organic Compound Emission Standards for Consumer and Commercial Products.
28. GANA, Glazing Manual.
29. GANA, Laminated Glazing Reference Manual.
30. GANA, Glass Tempering Division, GTA 95-1-31, Specification for Decorative Architectural Flat Glass.
31. GANA, Membership List.
32. IGCC, Certification Program.
33. IGMA Publication for Sloped Glazing: IGMA TB-3001, Guidelines for Sloped Glazing.
34. IGMA Publication for Insulating Glass: SIGMA TM-3000, North American Glazing Guidelines for Sealed Insulating Glass Units for

Commercial and Residential Use.

35. LBL-35298 Window 4.1, "A PC Program for Analyzing the Thermal Performance of Fenestration Products."
36. NFRC, Certification Program.
37. NFRC 100, Procedure for Determining Fenestration Product U-Factors.
38. NFRC 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
39. NFRC 300, Procedures for Determining Solar Optical Properties of Simple Fenestration Products.
40. NGA, Glazier Certification Program.
41. UL Building Materials Directory.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in inches according to ASTM C 1036.
- C. Interspace: The space between lites of an insulating glass unit that contains dehydrated air or a specified gas.
- D. Sealed Insulated Glass Unit Surfaces:
 1. Side 1: Exterior surface of outer plane.
 2. Side 2: Interior surface of outer plane.
 3. Side 3: Interior surface of inner plane.
 4. Side 4: Exterior surface of inner plane.

1.4 QUALITY ASSURANCE

- A. Primary Glass Manufacturer and Glazing Materials Manufacturer Qualifications:
 1. Provide glass glazing materials manufactured by firms specializing in the production of the types of glass glazing products specified, in compliance with specified standards.
 2. Provide glass from manufacturers who are certified under NGA's Certified Glass Installer Program.
 3. Obtain glass glazing materials from manufacturers who will send a qualified technical representative to the Site, for the purpose of advising the installer of proper procedures and precautions for the use of the materials and who will assist ENGINEER with opinions on the acceptability of materials and Work.
- B. Fabricator Qualifications:
 1. Provide laminated and insulating glass fabrications from fabricators who are licensed by primary glass manufacturer to produce specified units and with documented skill and successful experience in this type of Work and who agree to employ only tradesmen who are trained, skilled and have successful experience in this type of Work.

2. Provide laminated and insulating glass fabrications from fabricators who are members of GANA and participate in certification programs.
 3. Obtain laminated and insulating glass fabrications from fabricators who will, if required, send a qualified technical representative to the Site, for the purpose of assisting ENGINEER with opinions on the acceptability of materials and installation methods.
- C. Installer's Qualifications:
1. The installer of the glass glazing materials shall be a firm with documented skill and successful experience in the installation of the types of materials required and who agrees to employ only tradesmen who are trained, skilled and have successful experience in the types of materials and glazing systems specified and who are certified under the NGA Certified Glass Installer Program.
 2. Submit records of experience and certifications to ENGINEER.
- D. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing specified, as documented according to NFRC CAP 1 Certification Agency Program.
- E. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct testing specified.
- F. Source Limitation: All materials provided under this Section, to the extent possible, shall be obtained from a single supplier or manufacturer who, with CONTRACTOR, shall assume full responsibility for the completeness of the Work. The supplier or manufacturer shall be the source of information on all material furnished regardless of the manufacturing source of that material.
- G. Source Limitations for Glazing Accessories: As much as possible, obtain from single source from single manufacturer for each product and installation method.
- H. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

- I. Regulatory Requirements:
 - 1. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
 - 2. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to the glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg, and the fire-resistance rating in minutes
- J. Insulating Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- K. Codes: Comply with applicable requirements of codes referenced in Section 01 42 00, References.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Plans and elevations showing location of each type and kind of glass specified and details of glazing system. Include manufacturer's recommendations for glazing.
 - b. Dimensions and details of manufacturer's glue line thickness and bite dimensions and verifications.
 - 2. Product Data:
 - a. Copies of manufacturers' specifications and installation instructions for each type of glass, glazing sealant or compound, gasket and associated miscellaneous material and all recommended installation precautions for required materials and components, which are not included in other submittals, specified in other Sections. Coordinate the submittal of such other data with this submittal, and with the submittal of samples required by other Sections.
 - b. Structural performance calculations indicating that detailing and fabrication have been based on the results of the required analysis and performance criteria specified.
 - c. Glass Schedule, listing types of glass and locations, similar to Article 3.11.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Low-E glass fabricator shall provide a letter of compliance verifying performance characteristics of each glass unit.

- b. Certification that all glass materials subject to the applicable standards of the CPSC are in compliance. The certification shall be issued in conformance with procedures stated in the standard.
- c. Include primary glass manufacturer's and fabricator's published data, and letters of certification, based on certified test laboratory reports, indicating that each material complies with specified requirements and is acceptable for the applications shown.
- d. Certification that fabricated products comply with manufacturer's published performance.
- e. Age of silicone sealant.
- 2. Test Reports:
 - a. Certified laboratory test reports for required performance tests in compliance with NFRC CAP 1 Certification Agency Program.
 - b. Provide low-E glass manufacturer's computer-aided sheet engineering analysis to determine deflection and rabbet depth for individual applications, specified loadings, performance requirements, support criteria and other parameters, in order to indicate compliance with these Specifications.
 - c. Low-E glass fabricator's computer performance analysis of each glass configuration including argon-filled interlayers for insulating glass units.
 - d. Adhesion and compatibility test report from glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glazing channel substrates and for compatibility with glass and other glazing material.
 - e. Performance analysis of each configuration of insulating glass incorporating wavelength selective interlayer or low E coating using LBL-35-298, Window 4.1.
- 3. Qualifications Statements:
 - a. Manufacturer.
 - b. Fabricator.
 - c. Installer.
 - d. Testing Agencies.

C. Closeout Submittals: Submit the following:

- 1. Operation and Maintenance Data:
 - a. Recommended inspection intervals.
 - b. Instructions for repairing and replacing failed sealant joints.
- 2. Warranty Documentation:
 - a. Manufacturer's and fabricator's guarantees, as specified.

1.6 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

- 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

B. Storage and Protection:

- 1. Store materials to permit easy access for inspection and identification. Keep all

material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

2. Protect glass glazing materials according to manufacturer's and fabricator's written instructions to prevent damage to glass glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
3. For insulating glass that will be exposed to substantial altitude changes, comply with insulating glass fabricator's written recommendations for venting and sealing to avoid hermetic seal ruptures.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.8 WARRANTY

A. General: The special warranties specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents.

B. Special Warranties:

1. Laminated Glass: Provide written warranty, signed by the fabricator and CONTRACTOR and running to benefit of OWNER, agreeing to replace, for a period of ten-years from the date of Substantial Completion, glass units that show deterioration, as specified. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
2. Insulating Glass: Provide written warranty, signed by the fabricator and CONTRACTOR and running to the benefit of OWNER, agreeing to replace, for a period of ten-years from the date of Substantial Completion, glass that shows signs of deterioration, as specified. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
3. Coated Glass: Provide written warranty, signed by the fabricator and

CONTRACTOR and running to the benefit of OWNER, agreeing to replace, for a period of ten-years from the date of Substantial Completion, glass that shows signs of deterioration, as specified. Defects include peeling, cracking, and other indications of deterioration in coating.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Design Criteria: For glass performance, manufacture, size, type, construction and thickness, comply with the following:
1. Provide glass glazing systems capable of withstanding normal thermal movements and wind and impact loads without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants (both structural and weather-resisting) to remain watertight, airtight and to maintain structural performance characteristics specified; deterioration of glazing materials; or other defects in construction.
 2. Normal Thermal Movement: Provide glass that allows for thermal movements resulting from a maximum temperature range of 120°F in ambient and 180°F surface temperature acting on glass framing members and glazing components. Base structural performance calculations on surface temperatures of materials caused by both solar heat gain and nighttime-sky loss.
 3. Comply with requirements of Consumer Product Safety Commission, Part 1201, Safety Standards for Architectural Glazing Materials and the applicable building code, for all the Work.
 4. Structural Performance: Provide structural calculations for analysis of required glass thicknesses for glass lites shown, that are used to establish final fabricating and detailing requirements. Indicate compliance with the following minimum criteria for all glass shown:
 - a. Project Wind Speed: 120 miles per hour (Basic design wind speed per the 2022 New York State Building Code.
 - b. Risk Category III.
 - c. Exposure Category: Exposure C.
 - d. Short-Duration Load, Fga: In accordance with ASTM E1300.
 - e. Probability of Breakage for Vertical Glazing: Eight lites per 1,000 under wind action.
 - f. Maximum Lateral Deflection: For glass supported on all four edges, provide thickness required to limit center deflection at design wind pressure to 1/50 times the short side length or 1-inch, whichever is less.
 5. Glass thicknesses shown are minimums. Confirm glass thicknesses by analyzing Project structural loadings and in-service conditions using glass manufacturer's recommended load tables and other structural performance criteria specified. Where manufacturer's load tables indicate acceptability of lesser thickness material than required by performance criteria specified, provide specified thicknesses and features as a minimum. Where load tables indicate the need for greater thickness, or additional features, than specified, provide greater thicknesses and features at no additional cost to OWNER.

Comply with practice for determining minimum thickness and types of glass, to resist loadings required by governing authorities having jurisdiction at the Site, according to ANSI/ASTM E 1300.

6. Provide each configuration of insulating glass incorporating low-E coatings.
7. Glazing Sealant System Compatibility:
 - a. Glazing sealants shall be compatible with the channel surfaces, joint fillers, insulating glass sealing system, laminated glass interlayer material and other materials in contact with the glazing channel in compliance with ASTM C 1087.
 - b. Provide only materials and manufacturer's recommended variation of the specified materials, which are known to be fully compatible with the actual installation conditions, as shown by manufacturer's published data or certification submitted to ENGINEER for approval.
8. Adhesion of Elastomeric Joint Sealants: Comply with ASTM C 793 and ASTM C 794.
9. Center-of-Glass U-Values: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer-aided software design, expressed as Btu/square foot by height by degree F.
10. Center-of-Glass Solar Heat Gain Coefficient: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer-aided software design.
11. Solar Optical Properties: NFRC 300.

2.2 GLASS PRODUCTS, GENERAL

- A. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-strengthened float glass, or Kind FT fully tempered float glass as needed to comply with "Design Criteria" Article.
- B. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes basic- protection testing requirements in ASTM E 1996 for the appropriate wind zone when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.
 1. Large-Missile Test: For glazing located within 30 feet of grade.
 2. Small-Missile Test: For glazing located more than 30 feet of grade.
 3. Large-Missile Test: For all glazing, regardless of height above grade.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 1. For monolithic-glass lites, properties are based on units with lites 1/4-inch thick, minimum.
 2. For laminated-glass lites, properties are based on products of construction indicated.
 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.

5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS

A. Clear, Float Glass:

1. Uncoated, Monolithic, Clear, Fully tempered, Float Glass: Provide clear glass, with roll-wave distortion parallel to bottom edge of glass, in compliance with ASTM C 1048, Type I (transparent glass, flat), Class 1 (clear), Quality Q³ (glazing select), Kind FT.
2. Provide heat-treated glass that has been fully tempered by manufacturer's special process (after cutting to final size,) to achieve a flexural strength of two times that of annealed glass strength.
3. For uncoated glass, comply with requirements for Condition A.
4. Thickness: 1/4-inch thick, minimum.
5. Visible Light Transmission: < 91 %.
6. Products and Manufacturers: Provide one of the following:
 - a. Clear, Fully tempered, Float Glass by PPG Industries, Incorporated.
 - b. Clear, Fully tempered, Float Glass by Pilkington North America, Incorporated.
 - c. Or equal.

B. Clear, Laminated, , Glass: Laminated glass made from multiple plies of uncoated, clear float glass; complying with ASTM C1172 and the testing requirements in 16 CFR 1201 for Category II materials; ANSI Z97.1.

1. Total Thickness: 1/2 inch, minimum.
2. Clear laminated glass with two plies of FT float glass. Kind FT.
 - a. Thickness of Each Glass Ply: 1/4 inch.
 - b. Interlayer Thickness: 0.060 inch.
3. Visible Light Transmittance: 77 percent minimum.
4. Winter Nighttime U-Factor: .46, maximum.
5. Summer Daytime U-Factor: .48, maximum.
6. Solar Heat Gain Coefficient: .66, maximum.
7. Provide safety glazing labeling.
8. Products and Manufacturers: Provide one of the following:
 - a. Clear, Fully tempered, Laminated Glass by PPG Industries, Incorporated.
 - b. Clear, Fully tempered, Laminated Glass by Pilkington North America, Incorporated.
 - c. Or equal.

H. Low-E, Tinted, Fully tempered, Insulating, Float Glass Units:

1. Insulating Glass Units: Provide preassembled units consisting of two lites of glass separated by a dehydrated interspace, and complying with ASTM E 2190 for Class C units, permanently and hermetically sealed together at edges with spacers and sealant.

2. System Sealing: Dual seal with polyisobutylene primary sealant and silicone secondary sealant, complying with ASTM C 1249.
2. Overall Unit Thickness: 1 inch.
3. Thickness of Each Glass Lite: 1/4 inch.
4. Outdoor Lite: Tinted, Fully tempered, float glass, Kind FT.
5. Interspace Content: Argon.
6. Indoor Lite: Clear, Low-E, Fully tempered, float glass; Kind FT.
7. Low-E Coating: Pyrolytic on third surface.
8. Visible Light Transmittance: 56 percent minimum.
9. Winter Nighttime U-Factor: .35.
10. Summer Daytime U-Factor: 0.25 maximum.
11. Solar Heat Gain Coefficient: 0.35, maximum.
12. Light to Solar Gain Ratio: 1.78
13. Shading Coefficient: 0.41.
14. Outdoor Visible Light Reflectance: 12 percent.
15. Provide safety glazing labeling.
16. Products and Manufacturers: Provide one of the following:
 - a. Sungate 500, Atlantica, Fully tempered, Insulating Glass by PPG Industries, Incorporated.
 - b. Energy Advantage, EverGreen, Fully tempered, Insulating Glass by Pilkington North America, Incorporated.
 - c. Or equal.

2.4 GLAZING SEALANTS, TAPES AND GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, gaskets in compliance with ASTM C 1115, Type C.
- B. 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 963, black.
- C. Preformed Butyl Rubber Back-Bedding Mastic Glazing Tape:
 1. Preformed tape of polymerized butyl or mixture of butyl and polyisobutylene with inert fillers with built-in spacer of synthetic rubber, solvent-based with minimum 95 percent solids, non-sag consistency, tack-free time of 24 hours or less, paintable, non-staining, complying with AAMA 806.3.
- D. Exterior, One-Part, Silicone Rubber Sealant:
 1. Silicone rubber-based, one-part elastomeric sealant, complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT, M, G, A and O.

2.5 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standards, requirements of manufacturers of glass glazing materials for applications shown, and approved Shop Drawings. Provide materials with a proven record of compatibility with surfaces shown and specified.

- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers and Edge Blocks: Elastomeric blocks or continuous extrusions, with a Shore A durometer hardness recommended by glass manufacturer to maintain lites in place and to limit lateral movement for installation shown, and with proven compatibility with sealants used in the Work.
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- F. Cleaners, Primers and Sealers: Type recommended by sealant, gasket and glass manufacturer.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire- protection rating indicated.

2.6 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Glass manufacturer's recommended glazing channel dimensions are intended to provide for necessary minimum bite on the glass, minimum edge clearance and adequate sealant thicknesses, with reasonable tolerances. CONTRACTOR shall be responsible for correct glass size for each opening, within the tolerances and necessary dimensions established on approved Shop Drawings.

2.7 TOLERANCES

- A. Allowable Tolerances: Provide fully tempered and heat-strengthened glass, formed by horizontal roller-hearth process, free of tong marks, and not exceeding the following flatness tolerances (either face, any direction, any location) based on 1/4-inch glass thickness with inversely proportionate tolerances for other thicknesses:
 - 1. For 12-inch Run: 1/16-inch bow.
 - 2. For 3-foot Run: 1/8-inch bow.
 - 3. For 7-foot Run: 1/4-inch bow.
 - 4. For 10-foot Run: 3/8-inch bow.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the framing and glazing channel surfaces, backing, removable stop design, and the conditions under which the glass glazing is to be performed, and notify ENGINEER, in writing, of any conditions detrimental to the proper and timely completion of the Work. Do not proceed with the glazing until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.
 - 1. Examine for compliance with the following:
 - a. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - b. Presence and functioning of weep systems.
 - c. Minimum required face and edge clearances.
 - d. Effective sealing between joints of glass-framing members.

3.2 PREPARATION

- A. Clean the glazing channel, or other framing members to receive glass, immediately before glazing. Remove coatings, which are not firmly bonded to the substrate. Remove lacquer from metal surfaces wherever elastomeric sealants are used.
- B. Apply primer or sealer to joint surfaces wherever recommended by sealant and glass manufacturer.
- C. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set

blocks in thin course of compatible sealant suitable for heel bead.

- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.

- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.5 GASKET GLAZING (DRY)

- A. Gaskets: Refer to Section 08 51 13, Aluminum Windows and Section 08 44 13, Glazed Aluminum Curtain Walls.
- B. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- C. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- D. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- F. Install gaskets so they protrude past face of glazing stops.
- G. Dry Gasket Glazing: Install glass in gaskets as recommended by the glass and window manufacturer. Refer to Section 08 11 13, Hollow Metal Doors and Frames.
- H. Mirror Glazing: Refer to Section 10 28 05, Toilet and Bath Accessories.

3.6 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.7 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to

glass surface. 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 substances immediately as recommended in writing 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 than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 FIELD QUALITY CONTROL

- A. Watertight and airtight installation of each piece of glass is required, except as otherwise shown. Each installation must withstand normal temperature changes, wind loading, impact loading (for operating sash and doors) without failure of any kind including loss or breakage of glass, failure of sealants or gaskets to remain watertight and air-tight, deterioration of glazing materials and other defects in the Work.
- B. After nominal cure of exterior glazing sealants, which are exposed to the weather, test for water leaks. Flood the joint exposure with water directed from a 3/4-inch hose held perpendicular to wall face, 2 foot-0 inches from joint, connected to a water system with 30 psi minimum normal water pressure. Move stream of water along joint at an approximate rate of 20 foot-0 inches per minute.
- C. Test approximately five percent of total glazing system, in locations which are typical of every joint condition, and which can be inspected easily for leakage on opposite face. Conduct tests in the presence of ENGINEER, who will determine the actual percentage of joints to be tested and the actual period of exposure to water from the hose, based upon the extent of observed leakage, or lack thereof.
- D. Repair glazing installation at leaks or, if leakage is excessive, replace glazing sealants as directed by ENGINEER.
- E. Wherever nature of observed leakage indicates the possibility of inadequate glazing joint bond strength, ENGINEER may direct that additional testing be performed at a time when joints have been fully cured, followed by natural exposure through both extreme temperatures, and returned to the range of temperature in which it is feasible

to conduct testing. Repair or replace Work as required and directed by the ENGINEER.

3.9 GLASS SCHEDULE

- A. Exterior Windows: Tinted, low-e, heat-strengthened, insulated float glass.
- B. Exterior Doors and Sidelights: Tinted, low-e, fully tempered, insulated float glass.
- C. Exterior Door Lites: Tinted, low-e, fully tempered, insulated float glass.
- D. Interior Door Lights: Clear, fully tempered, float glass.
- E. Interior Borrowed Lights: Clear, fully tempered, float glass.

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SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install gypsum board assemblies. The Work also includes:
 - a. Providing openings in gypsum board assemblies to accommodate the Work under this and other Sections, and building into gypsum board assemblies all items to be embedded in or penetrate gypsum board assemblies.
 - b. Providing openings in gypsum board assemblies to accommodate work under other contracts and assisting other contractors in building into gypsum board assemblies all items furnished under other contracts to be embedded in or penetrate gypsum board assemblies.
2. Extent of gypsum board assemblies is shown.
3. Types of products required include:
 - a. Various types of interior wall and ceiling gypsum board.
 - b. Various types of exterior wall, ceiling and soffit gypsum board.
 - c. Various types of tile backing boards.
 - d. Sound attenuation blankets.
 - e. Joint reinforcement and finish system.
 - f. Sealant system for restriction of air, sound, or smoke passage through joints.
 - g. Auxiliary materials, trim, and fasteners.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before gypsum board assemblies Work.
2. Coordinate furnishing and installing products for maintaining fire-resistance rating of gypsum board assemblies at perimeters and penetrations where built-in and recessed items and transitions with other building components occur in the Work.
3. Notify other contractors in advance of constructing gypsum board assemblies Work to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before gypsum board assemblies Work.

C. Related Sections:

1. Section 07 21 05, Building Insulation.
2. Section 07 92 00, Joint Sealants.
3. Section 09 22 16, Non-Structural Metal Framing.

4. Section 09 30 13, Ceramic Tiling.
5. Section 09 91 00, Painting.

1.2 REFERENCES

- A. Standards referenced in this Section are:
1. ANSI A108.11, Interior Installation of Cementitious Backer Units.
 2. ANSI A118.9, Test Methods and Specifications for Cementitious Backer Units.
 3. ASTM C11, Terminology Relating to Gypsum and Related Building Materials and Systems.
 4. ASTM C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 5. ASTM C475/C475M, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 6. ASTM C514, Specification for Nails for the Application of Gypsum Board.
 7. ASTM C665, Specifications for Mineral Fiber Blanket, Loose-Fill and Spray-Applied Insulation.
 8. ASTM C754, Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 9. ASTM C834, Specification for Latex Sealants.
 10. ASTM C840, Specification for Application and Finishing of Gypsum Board.
 11. ASTM C919, Practice for Use of Sealants in Acoustical Applications.
 12. ASTM C954, 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 (2.84mm) in Thickness.
 13. ASTM C1002, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Metal Studs.
 14. ASTM C1047, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 15. ASTM C1177/C1177M, Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 16. ASTM C1178/C1178M, Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
 17. ASTM C1396, Specification for Gypsum Board.
 18. ASTM D578, Specification for Glass Fiber Strands.
 19. ASTM D3273, Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 20. ASTM D4977, Test Method for Granule Adhesion to Mineral Surfaced Roofing by Abrasion.
 21. ASTM D5034, Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test).
 22. ASTM D5035, Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method).

23. ASTM D5420, Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).
24. ASTM E84, Test Method for Surface Burning Characteristics of Building Materials.
25. ASTM E90, Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
26. ASTM E119, Test Methods for Fire Tests of Building Construction and Materials.
27. ASTM E413, Classification for Rating Sound Insulation.
28. ASTM E488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.
29. ASTM E695, Test Method of Measuring Relative Resistance of Wall, Floor and Roof Construction to Impact Loading.
30. GA-214, Recommended Levels of Gypsum Board Finish.
31. GA-216, Application of Gypsum Board.
32. GA-235, Gypsum Board Typical Mechanical and Physical Properties.
33. GA-530, Design Data.
34. UL, Fire Resistance Directory.

1.3 DEFINITIONS AND TERMINOLOGY

- A. Definitions: The following terms are defined for this Section and supplement the terms defined in the General Conditions:
 1. Level of Finish: The designated finish of gypsum board assemblies established in ASTM C840.
- B. Terminology:
 1. Terminology used in this Section is in accordance with ASTM C11, ASTM C754 and ASTM C840.
 2. The following words or terms are not defined but, when used in this Section, have the following meaning:
 - a. “Critical lighting” is strong side lighting from windows or surface-mounted light fixtures.
 - b. “Joint photographing” is the shadowing of finished joint areas through the surface decoration.
 - c. “Drywall primer” is paint material specifically formulated to fill pores and equalize the suction difference between gypsum board surface paper and the compound used on finished joints, angles, fastener heads, and accessories and over skim coats.
 - d. “Skim coat” is thin coat or joint compound, or material manufactured especially for this purpose, applied over the entire surface to fill imperfections in the joint Work, smooth the paper texture, and provide a uniform surface for decorating. Excess compound shall be immediately sheared off, leaving a film of skim coating compound completely covering the paper.
 - e. “Spotting” is to cover fastener heads with joint compound.
 - f. “Texture” is decorative treatment on gypsum board surface.

- g. “Texturing” is regular or irregular patterns typically produced by applying a mixture of joint compound and water, or proprietary texture materials including latex base texture paint, to a gypsum board surface previously coated with primer/sealer.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

- a. Provide gypsum board, accessories and trim manufactured by firms specializing in production of types of products specified, in compliance with reference standards listed in this Section.
- b. Provide gypsum board assemblies manufactured by firms that are members of the Gypsum Association (GA) and participate in GA’s certification programs.

2. Installer:

- a. Engage a single installer that regularly performs gypsum board assemblies installation, with documented skill and successful experience in installing types of materials required; and that employs only tradesmen who are trained, skilled, and have successful experience in installing types of materials specified.
- b. Submit name and qualifications with the following information for at least three successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for projects.
 - 2) Approximate contract cost of the gypsum board assemblies.
 - 3) Quantity (area) installed.

B Component Supply and Compatibility:

- 1. Furnish gypsum board assemblies materials from manufacturers who retains qualified technical personnel who will visit the Site for purpose of advising installer of proper procedures and precautions for using materials and who will assist ENGINEER with opinions on whether gypsum board assemblies Work conforms to the Contract Documents and manufacturer’s recommendations.
- 2. Provide gypsum board assemblies materials from manufacturer who furnishes test certificates for published fire, sound, and structural data covering systems designed and constructed according to manufacturer’s published specifications.
- 3. Furnish gypsum board assemblies materials from manufacturers whose products comply with GA-235.

C. Regulatory Requirements:

- 1. Where fire resistance classification (four-hour, three-hour, and similar designations) is shown or scheduled which includes gypsum board assemblies, provide components complying with applicable requirements for materials and installation established by UL and authorities having jurisdiction.

2. UL Compliance: Comply with UL Fire Resistance Directory for applicable fire-resistant construction systems.
3. Comply with 40 CFR 59, Subpart D, National Volatile Organic Compound Emission Standards for Architectural Coatings.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Show locations, fabrications, and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other units of Work.
2. Product Data:
 - a. Manufacturer's product data, specifications, and performance data for gypsum board assembly component required. Indicate compliance with requirements of reference standards included in this Section and requirements of authorities having jurisdiction.
 - b. Include copies of certified test reports and other data as may be required to show compliance with the Contract Documents, including specified performance characteristics and physical properties.
 - c. Submit UL Design Numbers, descriptions of fire-resistive construction systems and of each proposed fire-resistive system component.
 - d. Where sound transmission coefficients (STC-rating) for gypsum board assemblies are shown or specified, submit complete data on all required system components and final STC-rating achieved by the system.
 - e. Manufacturer's design criteria for transverse loading capabilities of system assemblies indicating compliance with requirements of authorities having jurisdiction at the Site, for unbraced supported partition heights shown and system performance criteria specified.
3. Samples: Sample submittals will be reviewed by ENGINEER for color, texture, and pattern only. Compliance with all other requirements is the responsibility of CONTRACTOR. Submit the following:
 - a. Full-size Sample, each 12-inch long, for each trim accessory used in the Work.

B. Informational Submittals: Submit the following:

1. Certificates.
 - a. Certificates signed by manufacturer stating that materials meet or exceed requirements of the Contract Documents, including performance characteristics and criteria and physical requirements, and stating that materials have been provided as specified to meet fire-resistance-ratings, thickness requirements, and application requirements.
2. Supplier Instructions:
 - a. Step-by-step joint treatment installation instructions for each Level of Finish specified for each area of the Work.
3. Site Quality Control Submittals:

- a. Results of specified inspections and observations.
 - b. Refer to Section 01 45 33.00CAOH, Code-Required Special Inspections and Procedures for reporting requirements.
- 4. Qualifications Statements:
 - a. Manufacturer, when required by ENGINEER.
 - b. Installer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with applicable requirements of reference standards used in this Section, Section 01 65 00, Product Delivery Requirements, and Section 01 66 00, Product Storage and Handling Requirements

1.7 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Temperature: Comply with the more stringent of ASTM C840 and manufacturer's written recommendations.
 - 2. Ventilation:
 - a. Provide ventilation during and following application of adhesives and joint treatments.
 - b. Use temporary air circulators in enclosed areas that lack natural ventilation.
 - c. Under slow drying conditions, allow additional drying time between coats of joint treatment.
 - d. Protect installed materials from drafts during hot, dry weather.
 - 3. Do not install panels that are any of the following: wet, moisture damaged, or mold damaged.
 - a. Indications that panels are wet or moisture damaged includes, but is not limited to, discoloration, sagging, or irregular shape.
 - b. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.8 SEQUENCING

- A. Prior to starting installation of gypsum board, coordinate Work requiring openings, chases, frames, access panels, support, and similar integrated requirements, including heating and ventilating and electrical work.
- B. Do not proceed with gypsum board installation until blocking, framing, bracing, and other supports for subsequently applied Work are installed.
- C. Do not install gypsum board until thermal insulation to be concealed by board has been installed.
- D. Install sound attenuation blankets where indicated and where required to achieve STC ratings or fire-resistance ratings, before installing gypsum board, unless blankets can be readily installed after board has been installed.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Description:

1. Gypsum board assemblies include finishing systems for walls, columns and ceilings that consists of panels with various types of specially treated, hydrated calcium sulfate cores reinforced with paper laminated to both faces of panels and manufactured for direct application of decorative finishes, including a joint treatment system known as self-setting drywall finishing and other drywall trim system accessories, and a system of metal studs, furring and bracing.
2. Complete systems shall conform to combined performance criteria in the Contract Documents.
3. Recycled Content: Provide gypsum panel products with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes minimum of:
 - a. Gypsum: 25 percent by weight.
 - b. Paper: 100 percent.
4. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. Performance Criteria:

1. General:
 - a. Standards: Comply with GA-530 and ASTM standards specified in this Section, except when more-stringent requirements are mandated by authorities having jurisdiction.
2. Level of Finish for Gypsum Board Assemblies: In accordance with ASTM C840, provide the Level of Finish for all gypsum board assemblies indicated in Paragraph 3.6.A.5 of this Section.
3. Sound Transmission Characteristics (STC): For gypsum board assemblies with STC-ratings, provide materials and construction identical to those tested in assemblies indicated, complying with ASTM E90 and classified according to ASTM E413 by a qualified independent testing agency.
 - a. STC-Rated Assemblies: As shown or indicated on the Contract Documents.
4. Fire-Test-Response Characteristics of Gypsum Board Assemblies: For gypsum board assemblies with fire-resistance-ratings, provide materials and construction identical to those tested in assemblies by an independent testing and inspecting agency acceptable to authorities having jurisdiction at the Site, and in compliance with ASTM E119.
 - a. Fire-Resistance-Rating: As shown or indicated on the Contract Documents, conforming to UL Fire Resistance Directory.

2.2 MANUFACTURERS

- A. Gypsum Board Products, Accessories and Trim: Provide products as manufactured by one of the following:
 - 1. Gold Bond Building Products, by National Gypsum Company.
 - 2. ToughRock Products, by G-P Gypsum Corporation.
 - 3. SHEETROCK Brand Products, by United States Gypsum Company, Subsidiary of USG Corporation.
 - 4. Or equal.
- B. Metal Support System Components: Refer to Section 09 22 16, Non-Structural Metal Framing.

2.3 SUSPENDED CEILING AND SOFFIT FRAMING

- A. Refer to Section 09 22 16, Non-Structural Metal Framing.

2.4 INTERIOR GYPSUM BOARD

- A. Exposed Gypsum Board: Provide the following types of interior gypsum board with two edge configurations where available from manufacturers specified; with 100 percent recycled paper on front, back, and long edges bonded to the core; complying with ASTM C1396:
 - 1. Panel Size: Provide all panels in maximum lengths and widths available that minimize joints in each area and correspond with spacing of support system components.
 - 2. Surface Burning Characteristics, ASTM E84: Flame Spread: 15, Smoke Development: Zero.
 - 3. Fire-Rated Abuse-Resistant Mold-Resistant Gypsum Board: Gypsum core wall panel with additives to enhance fire resistance, mold resistance, surface indentation resistance, and impact resistance of the core and surfaced with abrasion, moisture-, mold-, and mildew-resistant paper on front, back, and long edges, Type X.
 - a. Surface Abrasion Resistance: Not greater than 0.009 inches depth when tested at 50 cycles in accordance with ASTM D4977, Modified.
 - b. Indentation Resistance: No greater than 0.132 inches depth when tested with impact load of 72 in.-lbs. in accordance with ASTM D5420.
 - c. Impact/Penetration Resistance: No less than 210 ft.-lbs. when tested in accordance with ASTM E695, Modified.
 - d. Mold and Mildew Resistance: Panel score of 10, when tested in accordance with ASTM D3273.
 - 4. Fire-Rated Impact/Penetration-Resistant Mold-Resistant Gypsum Board: Gypsum core wall panel with additives to enhance fire resistance, water resistance, mold resistance, surface indentation resistance, and impact resistance of the core; surfaced with abrasion, moisture- and mold-resistant paper on the front, back, and long edges with fiberglass mesh embedded in the board to enhance impact/penetration resistance, Type X.
 - a. Surface Abrasion Resistance: No greater than 0.009-inch depth when tested at 50 cycles in accordance with ASTM D4977, Modified.

- b. Indentation Resistance: No greater than 0.114-inch depth when tested with impact load of 72 in.-lbs. in accordance with ASTM D5420.
- c. Impact/Penetration Resistance: No less than 540 ft.-lbs. when tested in accordance with ASTM E695, Modified.
- d. Mold and Mildew Resistance: Panel score of 10, when tested in accordance with ASTM D3273.
- 5. Gypsum Ceiling Board: Gypsum core ceiling panel with additives to enhance sag resistance of the core and surfaced with paper on front, back, and long edges; ASTM C1396 (Section 12).
- 6. Thickness: 5/8-inch, except 1/2-inches for regular gypsum board and 1/4-inch for double layer installations and flexible gypsum board.
- 7. Long-Edge Profile: Tapered.

2.5 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Exposed Gypsum Board: Provide the following types of exterior gypsum board with two edge configurations where manufactured for the product by manufacturers specified, with 100-percent recycled paper on front, back, and long edges; in compliance with ASTM C1396:
 - 1. Panel Size: Provide panels in maximum lengths and widths available that minimize joints in each area and correspond with spacing of support system components.
 - 2. Surface Burning Characteristics, ASTM E84: Flame Spread: 25, Smoke Development: Zero.
 - 3. Exterior Gypsum Soffit Board: Provide water-resistant gypsum board, intended for indirect weather exposure on exterior ceiling/soffit areas, covered on both sides with water-repellent paper and sag-resistant gypsum core; ASTM C1396 (Section 8).
 - 4. Gypsum Sheathing Board: Gypsum core sheathing panel with additives to enhance water-resistance of the core; surfaced with water repellent paper on front, back, and long edges.
 - 5. Fire-Rated, Exterior Gypsum Board: Where exterior gypsum board is shown or indicated with fire-resistive-rating, provide gypsum core panels with special additional non-combustible fibers to maintain integrity of the core as water volume is lost. To enhance fire resistance of the core and surfacing paper on front, back, and long edges and complying with definition for Type X (fire-resistant) when tested in accordance with ASTM E119.
 - 6. Glass-Mat Gypsum Sheathing Board: Gypsum core sheathing panel with additives to enhance water-resistance of the core; surfaced with fiberglass mat on front, back, and long edges: ASTM C1177.
 - a. Product and Manufacturer, provide one of the following:
 - 1) Dens Series Products by G-P Gypsum Corporation.
 - 2) Or equal.
 - 7. Thickness: 5/8-inch unless otherwise specified; 1/2-inch for non-fire-resistant exterior board.
 - 8. Long-Edge Profile: Tapered, round-edge configuration to reduce beading and ridging of joint treatment.

2.6 TILE BACKING PANELS

- A. Gypsum Backing Board: Provide the following types of moisture-resistant interior gypsum board for use as base for applying ceramic tile, with 100-percent recycled paper on front, back, and long edges, complying with ASTM C1396:
 - 1. Panel Size: Provide panels in maximum lengths and widths available that minimize joints in each area and correspond with spacing of support system components.
 - 2. Surface Burning Characteristics, ASTM E84: Flame Spread: 25, Smoke Development: Zero.
 - 3. Fire-rated Water-Resistant Gypsum Backing Board: Gypsum core wall panel with additives to enhance fire resistance of the core and the water resistance of the core; surfaced with water repellant paper on front, back, and long edges, Type X.
 - 4. Cement Backer Board: Aggregated Portland cement board with woven glass fiber mesh facing; complying with ANSI A118.9.
 - a. Product and Manufacturer: Provide one of the following:
 - 1) DUROCK Cement Board by USG Gypsum Corporation.
 - 2) Wonderboard by Custom Building Products.
 - 3) Or equal.
 - 5. Thickness: 1/2-inch unless otherwise specified; 5/8-inches for fire-resistance-rated, moisture-resistant gypsum board.
 - 6. Long-Edge Profile: Tapered.

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475.
- B. High-Strength Joint Reinforcing Tape for Exterior and Interior Applications: Fiberglass, self-adhering, two inches wide, in compliance with ASTM D578, ASTM D5034, and ASTM D5035.
- C. Joint Compound for Exterior and Interior Applications: Provide dry-powder, sandable, self-setting chemical hardening compounds for all gypsum board assemblies Work, recommended by manufacturer as being unaffected by humidity after hardening and drying.
 - 1. For each coat use formulation compatible with other compounds applied previously, and compatible with successive coats.
 - 2. Provide special chemical-hardening-type, slow-setting, or regular-setting-type compounds for gypsum board assemblies.
 - a. Prefilling: At open joints, rounded panel edges, and damaged surface areas, use setting-type taping compound.
 - b. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges use setting-type taping compound.
 - c. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - d. Finish Coat: For third coat, use setting-type, sandable topping compound.

- e. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.
- D. Joint Compound for Tile Backing Panels:
- 1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
 - 2. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
 - 3. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.8 TRIM ACCESSORIES

- A. General: Comply with ASTM C1047.
- B. Products: Provide manufacturer's standard trim accessories of types shown or indicated for gypsum board assemblies, formed of hot-dipped galvanized steel or zinc, with either knurled and perforated or expanded flanges for nailing or stapling, and beaded for concealment of flanges in joint compound. Provide corner beads, L-type edge trim-beads, U-type edge trim-beads, special L-kerf-type edge trim-beads, J-type wallboard casings and one-piece control joint beads.
- 1. Finishing Type: Manufacturer's standard trim units to be finished with joint compound.

2.9 GYPSUM BOARD FASTENERS

- A. Gypsum Board Fasteners: Comply with GA-216, and with gypsum board manufacturer's recommendations; choice is installer's option where more than one type is recommended for application specified.
- 1. Annular Ring Nail: ASTM C514.
 - 2. Smooth Shank Nail: ASTM C514.
 - 3. Steel Drill Screws: Self-drilling, self-tapping, bugle-head complying with ASTM C954 and ASTM C1002, for use with power-driven tools.
 - a. Type S for wallboard to sheet metal.
 - b. Type W for wallboard to wood.
 - c. Type G for wallboard to wallboard.

2.10 SOUND ATTENUATION

- A. Acoustical Sealant for Exposed and Concealed Joints: Non-shrinking, non-migrating, non-staining, sealant of either non-drying or permanently-elastic type, complying with ASTM C834, that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
- 1. Where exposed-to-view, provide paintable type acoustical sealant, either latex or acrylic based type, or acrylic-latex type.
 - 2. Provide sealants that have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- B. Sound Attenuation Blankets: Semi-rigid, friction-fit, spun mineral fiber blanket complying with ASTM C665, Type 1 (blankets without membrane facing); flame-spread, smoke and fuel contributed ratings of less than 25; manufactured by combining thermosetting resins with mineral fibers obtained from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 - 2. Recycled Content: Provide blankets with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes minimum of 25 percent by weight.

2.11 AUXILIARY MATERIALS

- A. Laminating Adhesive: Setting-type, for directly adhering gypsum boards to continuous substrate. Use adhesives that have VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Water-resistant Sealant: Type recommended by gypsum board manufacturer for sealing cut edges and holes in water-resistant gypsum board. Provide sealants that have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Isolation Strips: Adhesive-backed, closed-cell, vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch thick in width to suit stud size.
- D. Thermal Insulation: Refer to Section 07 21 05, Building Insulation.
- E. Vapor Barrier: Refer to Section 07 21 05, Building Insulation.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine substrates and spaces to receive gypsum board assemblies, and conditions under which gypsum board assemblies will be installed, and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Verify that spacing of installed, non-load-bearing steel framing does not exceed maximum allowable for types of gypsum board assemblies approved for the Work.

- B. Verify that doorframes are set for thicknesses of gypsum board shown on approved Shop Drawings and in the Contract Documents.
- C. Repair protrusions of framing, twisted framing members, and unaligned members before commencing gypsum board installation.
- D. Protect adjacent surfaces against damage and stains.

3.3 INSTALLATION OF METAL SUPPORT SYSTEMS

- A. Refer to Section 09 22 16, Non-Structural Metal Framing.

3.4 INSTALLATION OF GYPSUM BOARD

- A. General:
 - 1. Standards: Comply with ASTM C840. Comply with requirements for fire resistance-ratings and STC-ratings shown.
 - 2. Provide sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
 - 3. Provide ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
 - 4. Provide gypsum panels with face side out. Butt panels together for light contact at edges and ends with not more than 1/16-inch of open space between panels. Do not force into place.
 - 5. 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. Do not make joint other than control joints at corners or framed openings.
 - 6. Attach gypsum board to steel studs and blocking so leading edge or end of panel is attached to open (unsupported) edges of stud flanges first.
 - 7. Attach gypsum panels to framing provided at openings and cutouts.
 - 8. Cut back paper; do not tear or snap.
 - 9. Control Joints: Form control joints and expansion joints with 1/2-inch continuous opening between edges of adjacent boards for insertion of control joint trim accessory. Provide control joints as shown; if not otherwise shown or indicated, provide at the following locations:
 - a. Ceilings:
 - 1) Areas exceeding 2,500 square feet.
 - 2) Not more than 50 feet on centers.
 - 3) Where ceiling framing or furring changes direction.
 - 4) In furred assemblies where control joints occur in structural ceiling.
 - 5) Where expansion joints occur in steel framing.
 - b. Walls:
 - 1) In partitions and wall furring runs exceeding 30 feet.
 - 2) Not more than 30 feet on centers.

- 3) In furred assemblies where control joints occur in base exterior wall.
 - 4) Where expansion joints occur in steel framing.
 - c. Do not locate joints within eight inches of corners or openings, except where control joints are shown at jamb lines or where openings occur adjacent to corners in partition/wall layout. Where necessary, provide a single vertical joint over center of wide openings.
 - 10. Provide gypsum board on both faces of steel stud partition framing above ceilings and in similar concealed spaces, except in chase walls that are properly braced internally.
 - a. Where partitions in concealed spaces are not required for STC-ratings, fire resistance-ratings, or control of air distribution, smoke or heat, studs may be faced with scraps of gypsum board applied in a single layer. Apply each piece with two or more screws in each stud, 12-inch maximum screw spacing. Cover at least 75 percent of each face.
 - 11. Provide perimeter isolation where non-load-bearing partitions abut structural decks or ceilings, or vertical structural elements. Allow not less than 1/4-inch, or more than 1/2-inch gap between gypsum and structure. Finish edges of face layer with J-Type (semi-finishing) casing bead. Seal space between casing bead and structure with continuous acoustical sealant bead. Attach gypsum board to studs not less than 1/2-inch below bottom edge of ceiling track flanges and to first stud adjacent to vertical tracks. Do not attach board directly to tracks.
 - 12. Where concrete columns are to be enclosed with gypsum board assemblies, provide freestanding vertical steel stud furring as required supporting gypsum board with not less than 1/2-inch clearance between concrete and furring, and between concrete and gypsum board.
 - 13. Floating Construction: Where feasible, and recommended by manufacturer, provide gypsum board with “floating” internal corner construction, unless isolation of intersecting boards or control or expansion joints are shown.
- B. STC-Rated Gypsum Board Assemblies: Comply with ASTM C919 and the following:
- 1. Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with continuous bead of acoustical sealant.
 - 2. Provide acoustical sealant at both faces of partitions at perimeters and through penetrations.
 - 3. Comply with manufacturer’s written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
- C. Space fasteners in gypsum panels according to manufacturer’s written recommendations and reference standards used in this Section.
- 1. Space screws maximum of 12 inches on centers for vertical applications.
 - 2. Space fasteners in panels that are ceramic tile substrates a maximum of eight inches on centers.

D. Panel Installation Methods:

1. General: In addition to complying with reference standards used in this Section, comply with specific requirements indicated for each type or arrangement of gypsum board assembly shown.
2. Single-Layer Applications:
 - a. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible, and at right angles to framing, unless otherwise shown or indicated.
 - b. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise shown or required by fire-resistance-rated assembly, and minimize end joints.
 - 1) Stagger abutting end joints not less than one framing member in alternative courses of board.
 - 2) At stairwells and other high walls, provide panels horizontally (perpendicular to framing), unless otherwise shown or required by fire-resistance-rated assembly.
 - c. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate end joints over furring members.
 - d. For parallel applications, locate edge joints over supports; for right angle applications, stagger end joints over supports.
 - e. Apply gypsum panels to supports with steel drill screws.
3. Multi-Layer Applications:
 - a. On ceilings, apply gypsum board base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise shown or required by fire-resistance-rated assembly.
 - b. On partition/walls, apply gypsum board base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise shown or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - c. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either 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.
 - d. Laminate face layer to base layer with laminating adhesive and supplemental permanent screw fasteners penetrating through base layer and into supports. Apply in direction which results in minimum end joints, and offset joints (both directions).
 - e. Apply gypsum panels to supports with steel drill screws.
4. Direct-Bonding to Substrate: Where gypsum board is shown or indicated to be directly laminated to substrate, other than studs, joists, furring members or base layer of gypsum board, comply with gypsum board manufacturer's recommendations, and temporarily brace or fasten gypsum board until laminating adhesive has set.

5. Exterior Soffits and Ceilings: Install exterior gypsum board at right angles with supports, with end joints staggered over supports. Install with 1/4-inch open space where boards abut other work. Seal cut edges of each piece with water-resistant sealant before installation and seal edges at penetrations and other cut-outs in each sheet.
 6. Tile Backing Panels: Provide water-resistant backing board confirming to Laws and Regulations, as follows:
 - a. Water-Resistant Gypsum Backing Board: Install at showers, tubs, and where indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.
 - b. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.
 7. Cementitious Backer Units: ANSI A108.11, at showers, tubs, and where indicated.
 8. Ceramic Tile: Refer to Section 09 30 13, Ceramic Tiling.
 9. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.
 10. Where tile-backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
- E. Allowable Tolerances:
1. Gypsum Board Faces: 1/16-inch offsets between planes of board faces, and 1/8-inch in eight feet for plumb, level, warp, and bow.
 1. Gypsum Board Faces: 1/8-inch offsets between planes of board faces, and 1/4-inch in eight feet for plumb, level, warp, and bow.
 2. Suspended Ceilings: Level main carrying channels to 1/8-inch in 12 feet measured lengthwise on each member and transversely between parallel members.

3.5 INSTALLATION OF TRIM ACCESSORIES

- A. General: Provide trim accessories in accordance with ASTM C840. Coordinate, and integrate where possible installation of trim accessories with installation of gypsum board. Use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports. Otherwise, fasten flanges by nailing in accordance with manufacturer's written instructions.
- B. Install metal corner beads at external corners of gypsum board assemblies.
- C. Install metal edge trim where edge of gypsum board would otherwise be exposed or semi-exposed.
 1. Provide L-Type trim-beads, for joint compound, where edge is shown to be tightly fitted to abutting Work, without reveal or sealant pocket.
 2. Provide J-Type semi-finishing trim, not for joint compound, at the following locations and where shown:

- a. Edges of exterior gypsum board not covered by applied moldings.
 - b. On interior wall panels of exterior walls at juncture with ceilings.
 - c. At sealant-filled isolation joints and sound control joints, where gypsum drywall work abuts other construction including walls and ceilings.
 - d. At sealant-filled or gasket-filled building expansion joints, install back-to-back units spaced as shown or, if not shown, at 1/4-inch spacing.
- D. Install control joint bead units where control joints are shown.
- E. Miter corners of exposed molding and trim (semi-finishing) units. Align joints and support to eliminate offsets.

3.6 FINISHING OF GYPSUM BOARD ASSEMBLIES

- A. General:
- 1. Comply with GA-214 and finishing materials manufacturer's written instructions for mixing, handling, and applying materials. Machine- or hand-application is installer's option.
 - 2. Apply treatment at joints in both directions, flanges of trim accessories, but not semi-finishing types, gypsum board penetrations, electrical boxes, piping and similar work, fastener heads, surface defects, and elsewhere as shown or specified. Apply in manner that will result in each of these being concealed when applied decoration has been completed.
 - 3. Where open joints of more than 1/16-inch occur, including edges of boards with rounded or beveled corners, prefill joint with chemical-hardening-type bedding compound, prior to bedding of joint tape.
 - 4. Apply joint tape at joints between gypsum boards, except where trim accessory is shown.
 - 5. Level of Finish for Gypsum Board: As established by ASTM C840, provide the following Level of Finish for all gypsum board assemblies:
 - a. Level 2: All joints and interior angles shall have tape embedded in joint compound and wiped with joint knife leaving a thin coating of joint compound over joints and interior angles. Fastener heads and accessories shall be covered with a coat of joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable. Joint compound applied over the body of the tape at time of tape embedment shall be considered separate coat of joint compound and will satisfy the conditions of this Level. Provide for the following areas:
 - 1) All tile areas
 - b. Level 5: All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over flat joints and one separate coat of joint compound applied over interior angles. Cover fastener heads and accessories with three separate coats of joint compound. Apply to entire joint surface a thin skim coat of joint compound, or material manufactured especially for

this purpose. Surface shall be smooth and free of tool marks and ridges. Coat prepared surfaces with drywall primer prior to applying finish paint. Coordinate with Section 09 91 00, Painting. Provide in all areas except as noted above

6. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
7. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.
8. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 APPLYING TEXTURED FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving textured finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Textured Finish Application: Mix and apply finish using powered spray equipment recommended by textured finish materials manufacturer to provide uniform texture free of starved spots and other evidence of thin application, and without indicating application pattern.
- C. Prevent textured finishes from contacting surfaces not shown to receive textured finish by covering them with masking agents, polyethylene film, or other effective means of protecting surfaces not identified to receive textured finish. If, despite these precautions, textured finishes contact surfaces not designated to receive textured finish, immediately remove droppings and overspray according to textured finish manufacturer's written recommendations.

3.8 FIELD QUALITY CONTROL

- A. Before installing gypsum board ceilings, inspect ceiling support framing accompanied by ENGINEER and submit written report of deficiencies. Do not proceed with installing gypsum board on ceiling support framing until deficiencies are corrected.
 1. Notify ENGINEER 14 days in advance of the date and time when Work, or part of Work, will be ready for above ceiling observation.
 2. Before notifying ENGINEER, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation of insulation, and successful testing of piping conveying fluids and automatic fire suppression system.
 - c. Installation of ventilation duct system.
 - d. Installation of air distribution devices.
 - e. Installation of ceiling support framing.

3.9 ADJUSTING AND CLEANING

A. Nail Pop:

1. Repair nail pop by driving new nails approximately 1.5 inches from popped nail and reseal nail.
2. When face paper is punctured, drive new nail or screw approximately 1.5 inches from defective fastening and remove defective fastening.
3. Fill damaged surface with self-setting joint filler compound.

B. Ridging:

1. Do not repair ridging until condition has fully developed, approximately six months after installation or one heating season.
2. Sand ridges to reinforcing tape without cutting through tape.
3. Fill concave areas on both sides of ridge with topping compound.
4. After fill is dry, blend in topping compound over repaired area. Fill cracks with compound and finish smooth and flush.
5. Installer shall advise CONTRACTOR, who shall advise ENGINEER, of required procedures for protecting completed gypsum board assemblies from damage and deterioration during remainder of construction. CONTRACTOR shall provide required protection.

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SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, professional services, and incidentals as shown, specified, and required to furnish and install non-structural metal framing. The Work also includes:
 - a. Providing openings in non-structural metal framing to accommodate the Work under other Sections and building into non-structural metal framing items such as sleeves, anchorage devices, inserts, and all other items to be embedded in non-structural metal framing for which placement is not specifically provided under other Sections.
 - b. Providing openings in non-structural metal framing to accommodate work under other contracts and assisting other contractors in building into non-structural metal framing items such as sleeves, anchorage devices, inserts, and all other items required to be embedded in non-structural metal framing under other contracts.
2. Provide the following types of products:
 - a. Runner channel ceiling suspension systems.
 - b. Interior steel stud partition systems.
 - c. Exterior steel stud partition systems.
 - d. Furring members.
 - e. Auxiliary products.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before non-structural metal framing Work.
2. Coordinate furnishing and installing products for maintaining fire-resistance rating of non-structural metal framing at perimeters and penetrations where built-in and recessed items, and transitions with other building components, occur in the Work.
3. Notify other contractors in advance of constructing non-structural metal framing Work to provide them with sufficient time for installing items included in their contracts to be installed with or before non-structural metal framing Work.

C. Related Sections:

1. Section 06 10 53, Miscellaneous Rough Carpentry.
2. Section 09 24 00, Portland Cement Plastering.
3. Section 09 21 16, Gypsum Board Assemblies.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM A366/A366M, Specification for Commercial Steel Sheet, Carbon (0.15 Maximum Percent), Cold-Rolled.
3. ASTM A510, Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
4. ASTM A570/A570M, Specification for Structural Steel, Sheet and Strip, Carbon, Hot-Rolled.
5. ASTM A641/A641M, Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
6. ASTM A645/A645M, Specification for Pressure Vessel Plates, Five Percent Nickel Alloy Steel, Specially Heat Treated
7. ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM C645, Specification for Nonstructural Steel Framing Members.
9. ASTM C754, Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
10. ASTM C840, Specification for Applying and Finishing Gypsum Board.
11. ASTM C841, Specification for Installation of Interior Lathing and Furring.
12. ASTM C955, 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.
13. ASTM C1063, Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster.
14. ASTM D226, Specification for Asphalt-saturated Organic Felt Used in Roofing and Waterproofing.
15. ASTM E90, Test Methods for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
16. ASTM E119, Test Methods for Fire Tests of Building Construction and Materials.
17. ASTM E413, Classification for Rating Sound Insulation.
18. ASTM E488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.
19. ISO 9002, Quality Systems – Model for Quality Assurance in Production, Installation and Servicing.
20. UL, Fire Resistance Directory.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Provide non-structural metal framing, furring and auxiliary products and accessories manufactured by firms specializing in producing types of products specified, in compliance with the Contract Documents.

- b. Provide non-structural metal framing, furring and auxiliary products and accessories manufactured by firms that are members of ML/SFA and AWCI, and participate in certification programs.
 - c. Obtain materials from manufacturers who will, when required, furnish services of qualified technical representative at the Site, for purpose of advising installer of proper procedures and precautions for using the materials.
 - d. Provide products from manufacturers who participate in ISO 9002 Quality Control Programs.
2. Professional Engineer:
- a. Engage a registered professional engineer legally qualified to practice in the jurisdiction where the Site is located and experienced in providing engineering services of the kind indicated.
 - b. Submit qualifications data.
 - c. Responsibilities include but are not necessarily limited to:
 - 1) Carefully reviewing non-structural metal framing performance and design criteria stated in the Contract Documents.
 - 2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to ENGINEER by CONTRACTOR.
 - 3) Preparing or supervising preparation of design calculations and related drawings, Shop Drawings, interpretation of quality control results, and a comprehensive engineering analysis verifying compliance of the non-structural metal framing with the requirements of the Contract Documents.
 - 4) Signing and sealing all calculations and design drawings, and Shop Drawings.
 - 5) Certifying that:
 - a) It has performed the design of the non-structural metal framing in accordance with performance and design criteria stated in the Contract Documents, and the said design conforms to Laws and Regulations, and to the prevailing standards of practice.
3. Installer:
- a. Engage a single installer regularly performing non-structural metal framing and furring installation, and with documented skill and successful experience in installing types of materials required; and who employs only tradesmen who are trained, skilled, and have successful experience in installing types of materials specified.
 - b. Submit name and qualifications with the following information for at least three successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for each project.
 - 2) Approximate contract cost of non-load-bearing steel framing.
 - 3) Quantity (area) installed.

B. Component Supply and Compatibility:

- 1. Furnish all components of non-structural metal framing and furring from a single manufacturer, and from a single supplier, where possible, with

adequate resources to provide products of consistent performance characteristics, physical properties and appearance, without delaying the Work.

C. Regulatory Requirements:

1. Where fire-resistance classification (four-hour, three-hour and similar designations) is shown or indicated which includes non-load-bearing steel framing, provide components complying with applicable requirements for materials and installation established by UL and authorities having jurisdiction at the Site.
2. UL Compliance: Comply with UL Fire Resistance Directory for applicable fire-resistant construction systems.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Drawings locating all hangers and support anchors for suspension. Include locations of all accessories and framing components; and location of control joints based on the Contract Documents.
2. Product Data:
 - a. Manufacturer's product data and specifications for each item and each system specified.
 - b. Test Reports: Certified test reports on materials identical to those to be furnished demonstrating compliance with specified performance characteristics and physical properties
 - c. Include reports and other data as may be required to show compliance with the Contract Documents.
3. Delegated Design Submittals:
 - a. Calculations for complete structural analysis of non-structural metal framing systems including calculations showing compliance with system performance criteria specified. Calculations shall be signed and sealed by professional engineer. Professional engineer's seal shall be clearly legible, including state of registration, registration number, and name on seal.
4. Samples:
 - a. Twelve-inch lengths of non-load-bearing steel framing.
 - b. Twelve-inch length of wire hanger, rod, or strap.
 - c. Each type of insert or attachment device.
 - d. Twelve-inch lengths of each auxiliary system component.
 - e. Mock-up(s).

B. Informational Submittals: Submit the following:

1. Certificates.
 - a. Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria, and physical requirements.
2. Supplier Instructions:

- a. Manufacturer's installation instructions for each material specified
- 3. Site Quality Control Submittals:
 - a. Results of inspection upon completion of installation.
 - b. Refer to Section 01 45 33.00, Code-Required Special Inspections and Procedures, for reporting requirements.
- 4. Qualifications Statements:
 - a. Manufacturer, when required by ENGINEER.
 - b. Professional engineer.
 - c. Installer.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Design Criteria:
 - 1. Limiting Heights of Walls: Comply with ASTM C754 and ASTM C955 based on loading requirements according to Laws and Regulations and authorities having jurisdiction at the Site, and lateral pressure of 15 psf. Limit deflection of gypsum board assemblies to L/360.
 - 2. Concrete Inserts: Size anchorage devices for ceiling hangers for five times supported load, unless requirements that are more stringent are required by Laws and Regulations or required by authorities having jurisdiction.
 - 3. Fabricator is responsible for structural analysis and detailing of non-structural metal framing curtain wall system. Submit complete structural calculations and verification of other system performance criteria at same time as Shop Drawings submittal, for all non-structural metal framing members, anchorage devices, and all other support from manufacturer's certified load tables signed and sealed by professional engineer.
 - 4. Sound Transmission Characteristics (STC): For non-structural metal framing with STC ratings, provide materials and construction identical to those tested in assemblies indicated, complying with ASTM E90 and classified according to ASTM E413 by a qualified independent testing agency.
 - a. STC-rated Assemblies: As shown or indicated in the Contract Documents.
 - 5. Fire-Test-Response Characteristics of Non-Structural Metal Framing: For non-load-bearing steel framing with fire-resistance-ratings, provide materials and construction identical to those tested in assemblies by an independent testing and inspecting agency acceptable to authorities having jurisdiction, and complying with ASTM E119.
 - a. Fire-Resistance-Rating: As shown or indicated in the Contract Documents.

2.2 MANUFACTURERS

- A. Non-Structural Metal Framing Components and Accessories: Provide products of one of the following:

1. Dietrich Metal Framing, Inc.
2. Marino\Ware, Division of Ware Industries, Inc.
3. Or equal.

2.3 MATERIALS

A. General:

1. Manufacturer's Recommendations: Except where otherwise required to comply with requirements of authorities having jurisdiction or where more stringent requirements are shown or specified, provide type, weight, grade and finish of materials recommended by manufacturer, and include for each system clips, fasteners, ties, reinforcing, stiffeners, shoes, tracks, hangers, brackets, anchors, trim, and accessories as recommended by manufacturer for the application shown or indicated.
2. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.
3. Metal and Finishes: Manufacturer's standard for steel products, unless otherwise shown or indicated as solid zinc alloy or other metal. Provide manufacturer's standard galvanized finish on steel products.

B. Ceiling Suspension/Furring Materials:

1. Wire Ties: ASTM A641, Class 1, galvanized soft steel wire, 0.0625-inch diameter wire or double strand 0.0475-inch diameter wire.
2. Carrying Channels: 1-inch cold-rolled, commercial steel sheet, with minimum base metal thickness of 0.538-inch, 1/2-inch wide flange, complying with ASTM A366.
3. Cold-Rolled Channels: 0.0538-inch minimum base metal thickness, with minimum 1/2-inch wide flanges, 3/4-inch deep
4. Steel Studs: 2.5-inch deep, cold-rolled commercial quality steel channels, 0.0179-inch minimum base metal thickness, complying with ASTM A645.
5. Hat-shaped, Rigid Furring Channels: 7/8-inch deep, 0.0538-inch minimum base metal thickness, screw-type commercial quality steel sections, complying with ASTM C645.
6. Resilient Furring Channels: 1/2-inch deep, 0.0296-inch minimum base metal thickness, screw-type, hat-shaped, commercial quality steel sections, complying with ASTM C645.
 - a. Resilient Type: Where shown or indicated as, "resilient", provide manufacturer's special resilient furring channels designed to reduce sound transmission.
7. Hangers:
 - a. Angle Hangers: Two-inch by two-inch by 1/4-inch, base metal size, minimum; hot-dip galvanized in compliance with ASTM A153, Class B-1.
8. Hanger Anchorages:
 - a. Provide chemical anchors fabricated from corrosion-resistant materials with holes or loops for attaching hangers, capable of sustaining,

without failure, load equal to five times the load imposed by construction.

- b. Comply with ASTM E488 for concrete inserts, clips, bolts, screws and other devices applicable to indicated method of structural anchorage for hangers.

C. Interior Metal Stud System Materials:

1. Punched Steel Curtain Wall Studs: Rolled channels of 18-gage steel, with 1-3/8-inch flanges and depths as shown, ASTM A570/, Grade D steel, 40,000 psi.
2. Studs and Runners: ASTM C645, formed C-shaped steel channels of 0.0312-inch thick, base metal minimum, steel with 1.75-inch flange depth as shown, 40,000 psi steel complying with ASTM A653.
3. Slip-type Head Joints:
 - a. Single Long-Leg Runner System: ASTM C645 top runner with two-inch deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of top of studs to provide lateral bracing.
 - b. Double-Runner System: ASTM C645 top runners, inside runner with two-inch deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 - c. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - d. Product and Manufacturer: Provide one of the following:
 - 1) VertiClip SLD and VertiTrack Series by VTD Steel Network Inc.
 - 2) Superior Flex Track System (SFT) by Superior Metal Trim.
 - 3) Or Equal.
4. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Product and Manufacturer: Provide one of the following:
 - 1) Fire Trak with Fire Trak Slip Clip by Fire Trak Corporation.
 - 2) The System by Metal-Lite, Inc.
 - 3) Or Equal.
5. Stiffeners: 0.0538-inch minimum base metal thickness, 3/4-inch by 1/2-inch, cold-rolled channel. Provide rust-inhibitive paint finish.
6. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated 0.0312-inch minimum base metal thickness.
7. Cold-Rolled Channel Bridging: 0.0538-inch minimum base metal thickness, with minimum 1/2-inch- wide flanges, 1.5 inches deep.
 - a. Clip Angle: Not less than 1.5 by 1.5 inches, 0.068-inch, minimum base metal thickness, galvanized steel.

- D. Wall/Partition Metal Furring Materials:
1. Channel Furring: 0.0538-inch minimum base metal thickness, 3/4-inch by 1/2-inch, cold-rolled channel. Provide rust-inhibitive paint finish.
 2. Hat Shaped Rigid Furring Channels, ASTM C645: 0.0312-inches, minimum base metal thickness, 1.5-inches deep, screw-type hat-shaped section.
 3. Resilient Furring Channels, ASTM C645: 0.0312-inches, minimum base metal thickness, 1/2-inch deep, screw-type hat-shaped section.
 - a. Resilient-Type: Where shown or indicated as “resilient”, provide manufacturer’s special hat-shaped rigid furring channels designed to reduce sound transmission.
 4. Furring Brackets: 0.0312-inch minimum base metal thickness, serrated-arm type, adjustable from 1/4-inch to 2.25-inch wall clearance for channel furring.
 5. Tie Wire: ASTM A641, Class 1 zinc coating, soft temper, 0.0625-inch minimum base metal diameter wire, or double strand of 0.0475-inch minimum base metal diameter wire.
 6. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1.25-inches, wall attachment flange of 7/8-inch, minimum base metal thickness of 0.0179-inch, and depth required to fit insulation thickness indicated.
- E. Auxiliary Products and Trim:
1. General: Provide auxiliary materials that comply with installation requirements in the Contract Documents.
 - a. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
 2. Isolation Strip at Exterior Walls: Provide one of the following:
 - a. Asphalt-Saturated Organic Felt: ASTM D226, Type I No. 15 asphalt felt.
 - b. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch thick, in width to suit steel stud size.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine substrates and conditions under which non-structural metal framing Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Anchorages: Coordinate Work with structural ceiling Work to ensure that inserts and other structural anchorage provisions are installed to receive hangers.

- B. Maintain environmental conditions, including temperature, humidity, and ventilation, within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

3.3 INSTALLATION, GENERAL

- A. General: Comply with ASTM C754, except where framing sizes and spacing are indicated in the Contract Documents.
 - 1. Gypsum Plaster Assemblies: Comply with ASTM C841 relative to framing installation.
 - 2. Cement Plaster Assemblies: Comply with ASTM C1063 relative to framing installation.
 - 3. Gypsum Board Assemblies: Comply with ASTM C840 relative to framing installation.
- B. Allowable Tolerances:
 - 1. For flat surfaces, do not exceed 1/8-inch in twelve feet for bow, warp, plumb and level.
 - 2. For curved surfaces, do not exceed 1/8-inch in eight feet for bow, warp, plumb and level.
- C. Isolation: Where non-structural metal framing system abuts building structure horizontally, and where partitions abut overhead structure, isolate the Work from structural movement sufficiently to prevent transfer of loading into non-structural metal framing and support framing from the building structure. Install slip or cushion type joints to absorb deflections but maintain lateral support.
 - 1. Frame both sides of control and expansion joints independently, and do not bridge joints with non-structural metal framing or auxiliary system components.
 - 2. Locations: Provide control joints as shown or, if not shown or indicated, at the following locations:
 - a. Walls and Ceilings:
 - 1) Where framing and furred assemblies cross expansion joints in substrates.
- D. Fixture Support Framing: Install supplementary framing, blocking, and bracing where non-structural metal framing Work is shown or indicated, to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar Work requiring attachment and support.
- E. Wire Tying: Except as otherwise shown or indicated, tie interior furring with 16-gage or double 18-gage wire; tie interior lath with 18-gage wire and tie exterior furring with 14-gage or double 16-gage wire; and tie exterior lath with 16-gage wire.
- F. Splicing Members: Lap furring members eight inches and runner channels 12 inches, and wire-tie near each end of lap. Lap light-gage studs 12 inches and

install screws in both flanges near each end of lap. Splice plastering accessories by using concealed splines, anchored to prevent offsets.

3.4 SUSPENSION SYSTEMS

- A. Space runner channels as shown; if not shown space at four feet on centers.
- B. Install hangers supported only from building structural members. Locate hangers near each end and spaced four feet along each channel or direct-hung runners, unless otherwise shown or indicated.
- C. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system.
- D. Splay hangers only where required and, if allowed by Laws and Regulations and authorities having jurisdiction for fire-resistance-rated construction assemblies, to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
- E. Where width of ducts and other obstructions within ceiling plenum produces hanger spacing that interfere with location of hangers required to support standard suspension system members, provide supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established in reference standards and publications referred to in this Section, and designed by a professional engineer.
- F. Connect angle hangers directly to structural members, including additional framing members introduced for ceiling support, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in manner that will not cause hangers to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
- G. Do not connect or suspend steel framing from ducts, piping, or conduits.
- H. Sway-brace suspended steel framing with hangers used for support.
- I. Install suspended steel framing components in sizes and spacing shown, but not greater than required by steel framing and installation standards referenced in this Section.
 - 1. Carrying Channels: Four feet on centers.
 - 2. Hangers: Four feet on centers.
 - 3. Furring Channels: 16 inches on centers.
- J. Fire-resistive-Rated Assemblies: Wire tie furring channels to supports.

3.5 STUD SYSTEMS

- A. General: Comply with ASTM C645 and ASTM C754. Install steel studs with continuous runner tracks at top and bottom of each wall/partition area, and above and below each opening more than two feet wide. Anchor tracks to floor and overhead structure at each end and two feet on centers, maximum, unless otherwise shown.
- B. Extend partition stud system through suspended ceilings to structural support above, except where shown to terminate at ceiling. Cut studs short where abutting underside of structural support.
- C. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
- D. Space studs 16 inches on centers, including jack studs above and below openings, except as otherwise shown.
- E. Anchor exterior wall studs to bottom and top runner tracks, at both flanges. Install stud shoes or clips, or weld or screw-fasten to tracks.
- F. Anchor light-gage screw-type partition studs to runner tracks by friction fit, except screw end studs to both tracks at both flanges.
- g. Install minimum of three studs at partition corners and intersections, spaced as recommended by stud manufacturer for the application indicated.
- H. Install horizontal stud system stiffeners in continuous runs at the spacing indicated. Weld or wire-tie at each stud intersection.
 - 1. Space curtain wall stiffeners 4.5 feet on centers, and install double stiffeners, one each face, where unsupported wall height exceeds 18 feet.
 - 2. Space partition stiffeners 4.5 feet on centers in light-gage screw-type stud systems, which are to receive gypsum lath and plaster.
- I. Provide additional studs at each jamb of openings more than two feet wide, and secure jamb studs to frames of openings and to runner tracks above and below openings in manner indicated. Screw to frame anchors or directly to frames, or wire-tie or weld, if not otherwise indicated.
 - 1. Install two studs at each jamb, except as otherwise shown.
 - 2. Install stud system stiffeners not more than six inches above and six inches below each opening, and extend two regular stud spaces beyond opening both ways.
- J. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

1. Firestop Track: Where shown or indicated, provide to maintain continuity of fire-resistance-rated assembly indicated.
- K. Sound-Rated Partitions: Provide framing to comply with sound-rated assembly indicated.
- L. Direct Furring:
1. Screw to wood framing. Refer to Section 06 10 53, Miscellaneous Rough Carpentry, for wood framing requirements.
 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced two feet on centers.

3.6 METAL FURRING

- A. Space furring members: 16 inches on centers, unless otherwise shown or indicated.
- B. Where Z-Furring Members are noted:
1. Erect insulation, specified in Section 07 21 05, Building Insulation, vertically and hold in place with Z-furring members spaced two feet on centers.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced two feet on centers.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

3.7 AUXILIARY STEEL STUD SYSTEM COMPONENTS

- A. Anchor each flange of auxiliary non-structural metal framing system components to plaster base eight inches on centers.
- B. Miter or cope accessory corners, and install with tight joints accurately aligned.
- C. Install prefabricated control joints of one-piece design, where shown or indicated as control joint.
- D. Install prefabricated expansion joints of two-piece design, where shown or indicated as expansion joint, 1/4-inch joint width for interior Work, 3/8-inch for exterior Work.

3.8 FIELD QUALITY CONTROL

- A. Before installing non-structural metal framing ceilings, inspect deck accompanied by ENGINEER and prepare written report of deficiencies. Do not proceed with installation of non-structural metal framing until defective Work is corrected.
 - 1. Notify ENGINEER at least 14 days in advance of date and time when Work, or part of Work, will be ready for above ceiling observation.
 - 2. Before notifying ENGINEER, complete the following in areas to receive non-load-bearing steel framing ceilings:
 - a. Installation of insulation, and successful testing of piping conveying fluids and automatic fire suppression system.
 - b. Installation of ventilation duct system.
 - c. Installation of air distribution devices.
- B. Special Inspections: Coordinate with the Coordinating Special Inspector. Refer to Section 01 45 33.00, Code-Required Special Inspections, for detailed requirements.

3.9 ADJUSTING AND REPAIR

- A. Cut, repair, and align non-structural metal framing Work as required and as necessary to accommodate other work. Repair bent and dented members. Repair or replace the Work as necessary to comply with specified tolerances.

3.10 CLEANING

- A. Remove temporary covering and other provisions made to minimize debris on other work. Repair surfaces that have been stained, marred or otherwise damaged during non-structural metal framing Work. When Work is completed, remove unused materials, containers, and equipment and debris.

3.11 RELATED WORK

- A. Lath and Cement Plaster Installation: Refer to Section 09 24 00, Portland Cement Plastering.
- B. Gypsum Board Installation: Refer to Section 09 21 16, Gypsum Board Assemblies.

3.12 PROTECTION OF EXECUTED WORK

- A. Provide adequate precautions for protecting non-structural metal framing Work from deterioration and damage during remainder of construction.

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SECTION 09 24 00

PORTLAND CEMENT PLASTERING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install all cement plaster. The Work also includes:
 - a. Providing openings in cement plaster to accommodate the Work under this and other Sections, and building into cement plaster items such as sleeves, anchorage devices, inserts, and all other items to be embedded in cement plaster for which placement is not specifically provided under other Sections.
 - b. Providing openings in cement plaster to accommodate work under other contracts and assisting other contractors in building into cement plaster items such as sleeves, fasteners, inserts, and all other items to be embedded in cement plaster under other contracts.
2. Extent of cement plaster is shown.
3. Types of products required include the following:
 - a. Exterior portland cement plaster (stucco).
 - b. Metal lath.
 - c. Accessories.
 - d. Miscellaneous materials.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before cement plaster Work.
2. Coordinate furnishing and installing products for maintaining fire-resistance-rating of cement plaster at perimeters and penetrations where built-in and recessed items and transitions with other building components occur in the Work.
3. Notify other contractors in advance of constructing cement plaster to provide other contractors with sufficient time for installing items included in their contracts that will be installed with or before cement plaster Work.

C. Related Sections:

1. Section 06 10 53, Miscellaneous Rough Carpentry.
2. Section 07 92 00, Joint Sealants.
3. Section 09 22 16, Non-Structural Metal Framing.
4. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ACI 306.1, Specification for Cold Weather Concreting.
2. ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. ASTM C11, Terminology Relating to Cement and Related Building Materials and Systems.
5. ASTM C25, Test Methods for Chemical Analysis of Limestone, Quick-Lime and Hydrated Lime.
6. ASTM C91, Specification for Masonry Cement.
7. ASTM C150, Specification for Portland Cement.
8. ASTM C207, Specification for Hydrated Lime for Masonry Purposes.
9. ASTM C206, Specification for Finishing Hydrated Lime.
10. ASTM C595, Specification for Blended Hydraulic Cements.
11. ASTM C665, Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
12. ASTM C834, Specification for Latex Sealants.
13. ASTM C841, Specification for Installation of Interior Lathing and Furring.
14. ASTM C847, Specification for Metal Lath.
15. ASTM C897, Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters.
16. ASTM C919, Practice for Use of Sealants in Acoustical Applications.
17. ASTM C926, Specification for Application of Portland Cement-Based Plaster.
18. ASTM C932, Specification for Surface-Applied Bonding Compounds for Exterior Plastering.
19. ASTM C933, Specification for Welded Wire Lath.
20. ASTM C1032, Specification for Woven Wire Plaster Base.
21. ASTM C1063, Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement Based Plaster.
22. ASTM C1328, Specification for Plastic (Stucco) Cement
23. ASTM D226, Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
24. ASTM E90, Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
25. ASTM E119, Test Methods for Fire Tests of Building Construction and Materials.
26. FS UU-B-790, Building Paper, Vegetable FiberKraft, Waterproofed, Water Repellant and Fire Resistant)
27. ML/SFA 920, Specification for Metal Lathing and Furring.
28. PCA, Portland Cement Plaster/Stucco Manual.
29. UL, Fire Resistance Directory.

1.3 TERMINOLOGY

- A. Terminology used in this Section is in accordance with ASTM C11.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Provide cement plaster and auxiliary products and accessories manufactured by firms specializing in producing types of products specified, in compliance with the Contract Documents.
 - b. Provide cement plaster and auxiliary products and accessories manufactured by firms who are members of ML/SFA and AWCI, and participate in their certification programs.
2. Installer:
 - a. Engage a single installer regularly performing cement plaster installation, and with documented skill and successful experience in installing types of materials required; and who employs only tradesmen who are trained, skilled, and have successful experience in installing types of materials specified.
 - b. Submit name and qualifications with the following information for at least three successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for each project.
 - 2) Approximate contract cost of cement plastering.
 - 3) Quantity (area) installed.

B. Component Supply and Compatibility:

1. Provide cement plaster products from manufacturer who provides test certificates for published fire, sound, and structural data covering systems designed and constructed according to its published specifications.
2. Obtain all cement plaster products from single source and single manufacturer.

C. Regulatory Requirements:

1. Where fire resistance classification (four-hour, three-hour, and similar designations) is shown or scheduled which includes cement plaster, provide components complying with applicable requirements for materials and installation established by UL and authorities having jurisdiction.
2. Provide cement plaster having same aggregate as specified for similar non-rated Work, unless specified aggregate has not been tested and approved by UL for the required rating.
3. UL Compliance: Comply with UL Fire Resistance Directory for applicable fire-test-response characteristics. Use finish-coat plaster originally tested and rated with base-coat plaster.
4. Use finish-coat plaster originally tested and rated with base-coat plaster.
5. Structural Criteria: The Work shall conform to structural criteria requirements as indicated in contract Documents. Support system shall conform to Laws and Regulations, including building code referred to in Section 01 42 00, References. Refer to Section 01 45 33.00, Code-Required Special Inspections and Procedures.

6. Comply with 40 CFR 59, Subpart D, National Volatile Organic Compound Emission Standards for Architectural Coatings.

D. Mock-Ups:

1. Prior to installing cement plaster, but after ENGINEER's approval of Samples and submittals, construct four-foot square sample panel at the Site, of full thickness, and at location selected by ENGINEER, using approved materials, including non-load-bearing framing, furring, lath, and plaster, and workmanship required for the Work. Obtain ENGINEER's approval of color, texture, and tolerances before proceeding. Compliance with other requirements is responsibility of CONTRACTOR. Do not alter, move, or destroy mock-up panels until corresponding cement plaster Work is acceptably completed.
2. Approved mock-ups may become part of the completed Work if approved mock-ups are undamaged and undeteriorated at Substantial Completion.
3. Remove and replace with new material cement plaster Work that does not conform to standard of approved mock-up panels.
4. Provide mock-up for the following:
 - a. Each type of exposed exterior cement plaster.
 - b. Exposed aggregate applications.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:
 - a. Manufacturer's product data, specifications, and performance data for each item and each system specified.
 - b. Copies of test reports verifying compliance with physical properties, quality assurance performance requirements, and compatibility testing of primer specified in Section 09 91 00, Painting.
 - c. Include reports and other data as may be required to show compliance with the Contract Documents.
2. Samples: Sample submittals will be reviewed by ENGINEER for color, texture and pattern only. Compliance with all other requirements is the responsibility of CONTRACTOR. Submit the following:
 - a. Twelve-inch by 12-inch sections of metal lath.
 - b. Mock-up(s).

B. Informational Submittals: Submit the following:

1. Certificates.
 - a. Certificates stating that materials meet or exceed requirements of the Contract Documents and stating that materials have been provided as specified to meet fire-resistance-ratings, thickness requirements, and application requirements.
2. Supplier Instructions:
 - a. Manufacturer's mixing and installation instructions for each material specified.
3. Site Quality Control Submittals:

- a. Results of specified inspections and observations.
 - b. Refer to Section 01 45 33.00, Code-Required Special Inspections and Procedures for reporting requirements.
- 4. Qualifications Statements:
 - a. Manufacturer, when required by ENGINEER.
 - b. Installer.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Comply with applicable requirements of ASTM C926.
 - 2. Temporary Heat: Provide temporary heating and protection as required to protect each coat of cement plaster from freezing for not less than 24 hours after application.
 - a. Exterior Cement Plaster Work: Protect cement plaster against cold when ambient temperature is less than 40 degrees F. Heat materials and provide temporary protection and heating as required by ACI 306.1.
 - b. Interior Cement Plaster Work: Maintain not less than 50 degrees F temperature in areas to be plastered for not less than forty-eight hours before, during, and after application.
 - 3. Distribute heat uniformly in areas to be plastered and provide deflection or protective screens as required to prevent concentration of heat on cement plaster near heat source.
 - 4. Supplemental heat and power sources, as may be required should CONTRACTOR wish to continue cement plaster Work in cold weather, are not available at the Site. Provision of supplemental heat, including fuel, equipment, operating and maintenance personnel, and power sources, is responsibility of CONTRACTOR.
 - 5. Warm Weather Requirements: Protect cement plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure cement plaster as required by climatic and Site conditions to prevent dry-out during cure period. Provide suitable coverings, moist-curing, barriers to deflect sunlight and wind, or combinations of these, as required.

1.7 SEQUENCING

- A. In general, complete plastering prior to installing adjoining tile Work, marble, acoustical materials, and similar finishes.
- B. Finish Coat:
 - 1. Delay application of interior finish coat plastering until cementitious bases and similar adjoining Work is complete.
 - 2. Delay application of exterior finish coat plastering until adjoining Work is complete, where possible.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Performance Criteria:
 - 1. General:
 - a. Standards: Comply with ASTM C926 and PCA Portland Cement Plaster/Stucco Manual for all Work, except when more stringent requirements in the Contract Documents, or when more stringent measures are required by authorities having jurisdiction.

2.2 MANUFACTURERS

- A. Metal Lath Components: Provide products of one of the following:
 - 1. Dietrich Metal Framing, Inc.
 - 2. Marino\WARE, Division of Ware Industries, Inc.
 - 3. Or equal.
- B. Plastering Materials: Products and manufactures for each material are specified in this Section in the Articles on plastering materials:

2.3 METAL FRAMING AND FURRING MATERIALS

- A. Refer to Section 09 22 16, Non-Structural Metal Framing.

2.4 METAL LATH MATERIALS

- A. General: Unless otherwise specified, comply with ML/SFA 920 for selection of metal lath for each application specified.
 - 1. Product Standard: Comply with ASTM C847.
 - 2. Backing: Where lath is indicated to have backing, and where backing is required for machine application of plaster, provide lath with factory applied backing of moisture resistant paper or polyethylene film.
 - 3. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.
 - 4. Metal Lath Components: Hot-dipped galvanized finish; ASTM A653, G90, for 18-gage (0.0451-inch, minimum) and lighter formed metal products, ASTM A123, galvanized after fabrication, for 16-gage (0.0566-inches, minimum) and heavier products.
 - 5. Exterior Diamond Mesh Lath: 3.6 pounds per square yard large mesh openings (approximately 1-3/8 inch by 3-1/8 inch).
 - 6. Flat Rib Lath: 2.75 pounds per square yard, 1/8-inch rib depth.
 - 7. Paper Backing: FS UU-B-790, Type I, Grade A, 6.0 lb/100 sq. ft.
 - a. Provide paper-backed lath unless otherwise indicated.

2.5 METAL LATH ACCESSORIES

- A. General: Comply with ASTM C1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
- B. Plastering Accessories: Hot-dipped galvanized finish; ASTM A653, G60, for auxiliary components including perforated flange corner beads, casing beads, caps, screeds, moldings, single-vee perforated flange control joints, two-piece perforated flange expansion joints, and similar units as indicated or required for exterior use and for use in high humidity areas, except where fully concealed in plaster.
- C. Accessories:
 - 1. Cornerite: Fabricated from expanded-metal lath.
 - 2. Striplath: Fabricated from expanded-metal lath.
 - 3. Cornerbeads: Fabricated from galvanized steel.
 - a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.
 - b. Small nose cornerbead with perforated flanges; use on curved corners.
 - c. Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
 - d. Bull nose cornerbead, radius 3/4-inch minimum, with expanded flanges; use at locations indicated on Drawings.
 - 4. Casing Beads: Fabricated from galvanized steel: square-edged style: with expanded flanges.
 - 5. Control Joints: Fabricated from galvanized steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
 - 6. Expansion Joints: Fabricated from galvanized steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
 - 7. Two-Piece Expansion Joints: Fabricated from galvanized steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4- to 5/8-inch wide; with perforated flanges.

2.6 CEMENT PLASTERING MATERIALS

- A. General: Except as otherwise shown or indicated, provide standard products recommended by the manufacturers specified, for the application shown or indicated. Provide either neat or factory-mixed materials.
- B. Base-Coat Cement: Provide one of the following cements, or mixtures thereof, where recommended by cement manufacturer.
 - 1. Portland Cement:
 - a. ASTM C150, Type I.
 - b. Provide non-staining, Portland cement that will attain compressive strength of not less than 2,800 psi at three days and 4,000 psi at seven days.
- C. Base-Coat Lime:
 - 1. ASTM C206, Type S special hydrated lime for finishing purposes.

- D. Base Coat Aggregate: Sand, ASTM C897.
- E. Factory-Prepared Finish-Coat: Manufacturer's standard factory-packaged blend of Portland cement, ASTM C150, Type I or III; hydrated lime, Type S, ASTM C206 or ASTM C207; aggregate, ASTM C897; and compatible with cement plaster base-coat and finish texture, recommended by specified manufacturers for the application required, ready for mixing with water at time of application. Provide complete selection of manufacturer's standard and custom colors for final selection by ENGINEER.

2.7 MISCELANEOUS PLASTER MATERIALS

- A. Base-Coat Fiber: Alkaline-resistant glass polypropylene fibers, 1/2-inch long, free of contaminants and manufactured for use in portland cement plaster.
- B. Bonding Agent: ASTM C932.
- C. Acid-Etching Solution: Muriatic acid, ten percent solution of commercial hydrochloric acid, mixed one part to not less than six or more than ten parts of water.
- D. Dash Coat Material: Two parts cement to three parts fine sand, mixed with water to a paste consistency.
- E. Isolation Strip at Exterior Walls:
 - 1. Asphalt-saturated Organic Felt: ASTM D226, Type I (No. 15 asphalt felt) unperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.
- F. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant, with a VOC content of 50 g/L or less when calculated. According to 40 CFR 59, Subpart D (EPA Method 24),] complying with ASTM C834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
 - 1. Products and Manufacturers: provide one of the following:
 - a. AC-20 + Silicone by Pecora Corporation.
 - b. Tremflex 834 by Tremco, Inc.
 - c. Or Equal.
- G. Calking and Sealants: Refer to Section 07 92 00, Joint Sealants.
- H. Water: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

2.8 CEMENT PLASTER MIXES AND COMPOSITIONS

- A. General: Comply with ASTM C926 for base- and finish-coat mixes applicable to plaster bases, materials, and other requirements specified.
- B. Base-Coat Mixes and Compositions: Proportion materials for respective base-coats in parts by volume per sum of cementitious materials for aggregates to comply with requirements for each method of application and plaster base indicated. Adjust mix proportions within limits specified to attain workability.
- C. Fiber Content: Add fiber to mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's approved written instructions, but do not exceed one pound per cubic foot of cementitious materials. Reduce aggregate quantities accordingly to maintain workability.
- D. Three-Coat Cement Plaster Over Metal Lath: Provide base-coat proportions as follows:
 - 1. Scratch-Coat: One part portland cement, zero to 3/4 parts lime, 2.5 to four parts aggregate.
 - 2. Brown-Coat: One part portland cement, zero to 3/4 parts lime, three to five parts aggregate.
- E. Factory-Prepared Finish Coats: Add water only; comply with manufacturer's written instructions.
- F. Bonding Additive: Proportion and mix in accordance with additive manufacturer's instructions.

2.9 CEMENT PLASTER MIXING

- A. Mechanically mix cementitious and aggregate materials for cement plasters to comply with applicable referenced application standards and with approved recommendations of cement plaster manufacturer.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine surfaces to receive cement plaster, including grounds and other auxiliary system components that act as grounds or screeds, and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with cement plaster Work until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Clean cement plaster bases, and substrates for direct application of cement plaster, removing loose material and substances that may impair cement plaster system performance.
- B. Acid-etch concrete and masonry surfaces, specified or shown for direct cement plaster application. Scrub with acid-etch solution on previously wetted surface, and rinse thoroughly with clean water. Repeat the application, if necessary to obtain adequate suction and mechanical bond of cement plaster, where dash coat or bonding agent or additive is not used.
 - 1. Test substrate with litmus paper to verify that surface is chemically neutral or alkaline.
- C. Provide metal reinforcement on exterior substrates as specified, whether or not shown. Stretch and fasten to substrate in accordance with industry standards and manufacturer's approved instructions, using self-furring type fasteners.
 - 1. Except where paper-backed reinforcement is provided, provide one course of asphalt-saturated felt under metal reinforcement.
 - 2. Provide corner reinforcement at external corners of exterior Work, except where metal plastering beads or other metal accessories are shown.
- F. Provide temporary grounds and screeds as necessary to ensure accurate rodding of cement plaster to true surfaces; coordinate with scratch-coat Work.
 - 1. Refer to Section 06 10 53, Miscellaneous Rough Carpentry, for the installation of permanent wood grounds.

3.3 INSTALLATION, GENERAL

- A. Fire-Resistance-Rated Assemblies: Provide components according to requirements for design designations indicated in the Contract Documents from listing organization and UL Fire Resistance Directory.
- B. Sound Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.
- C. Acoustical Sealant: Where required, seal joints between edges of plasterwork and abutting construction with acoustical sealant.
- D. Allowable Tolerances:
 - 1. For flat surfaces, do not exceed 1/8-inch in ten feet from a true plane in finished plaster surfaces, as measured by ten-foot straightedge placed at any location on plastered surfaces.
 - 2. Where brown-coat plaster is specified to receive adhesively applied finish, comply with specified tolerances for finish-coat plastering.

3.4 INSTALLATION OF METAL FRAMING AND FURRING

- A. Refer to Section 09 22 16, Non-Structural Metal Framing.

3.5 INSTALLATION OF METAL LATH

A. General:

1. Comply with manufacturer's installation instructions and recommendations. If a discrepancy exists with the Contract Documents, request interpretation from ENGINEER.
2. Comply with ML/SFA 920 and ASTM C1063, except where otherwise shown or indicated.
3. Install metal lath by wire tying supports or substrate in the manner shown and in accordance with ASTM C841.
4. Install with long dimension of lath across the supports.
5. Lap sides of wire mesh not less than 1/2-inch. Lap ends not less than one-inch. Stagger end laps, wire ties, side laps at intervals not exceeding nine inches, lace end laps.
6. At external corners, cut and butt lath and provide continuous corner reinforcing.
7. Provide corner reinforcing at openings, at ends of arches, and at all other exposed corners.
8. Schedules: Comply with Table 09 24 00-A of this Section.

B. Installation of Auxiliary Metal Lath Components:

1. Comply with ASTM C1063, except where otherwise shown or indicated.
2. Anchor each flange of auxiliary metal lath system components to plaster base eight inches on centers.
3. Miter or cope accessory corners, and install with tight joints accurately aligned.
4. Provide metal corner beads at external corners.
5. Provide casing beads at terminations of plaster Work, except where plaster is shown to pass through other Work and be concealed by other materials, and except where special screeds, bases or frames act as casing beads including interior metal door frames.
 - a. For exterior Work, set casing beads 1/4-inch from abutting frames and other Work, for application of sealant.
 - b. Where plaster abuts concrete, set casing bead 1/4-inch from concrete.
 - c. Where interior plaster abuts exterior masonry, apply waterproof plastic adhesive tape on concealed face of bead.
 - d. Where interior plaster abuts exterior door frames and similar Work in exterior walls, provide resilient edged-casing beads.
 - e. At control joints and expansion joints set pair of casing beads back-to-back with metal strip behind anchored to only one side of joint. At expansion joints, space beads 1/4-inch apart for interior Work, 3/8-inch apart for exterior Work.
6. Provide prefabricated control joints of one-piece design, where shown as control joint.
7. Provide prefabricated expansion joints of two-piece design, where shown as expansion joint, 1/4-inch joint width for interior Work, 3/8-inch for exterior Work.

- C. Flashings: Refer to the Section 07 62 00, Sheet Metal Flashing and Trim, for installation of flashings associated with exterior plastering.
- D. Surface Conditioning: Immediately before plastering, dampen surfaces of concrete and concrete unit masonry that are specified or indicated for direct application of cement plaster, except where bonding agent has been applied. Provide moisture-cured application that will result in optimum degree of saturation and suction for cement plaster.

3.6 INSTALLATION, CONTROL AND EXPANSION JOINTS

- A. In accordance with ASTM C1063 located control joints as follows:
 - 1. Delineate plasterwork into areas (panels) of the following maximum sizes:
 - a. Vertical Surfaces: 144 square feet.
 - b. Horizontal and Other nonvertical Surfaces: 100 square feet.
 - c. At distances between control joints of not more than 18 feet on centers.
 - d. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2 1/2:1.
 - e. Where control joints occur in surface of construction directly behind plaster.
 - f. Where plastered ceiling framing or furring changes direction.
 - g. Where plasterwork areas change dimensions, to delineate rectangular shaped areas (panels) to relieve stress that occurs at corner formed by dimension change.

3.7 INSTALLATION OF CEMENT PLASTER

- A. General:
 - 1. Standards: Except as otherwise shown or indicated, comply with ASTM C926.
 - 2. Provide moisture-cure plaster base- and finish-coats to comply with ASTM C926, including Annex A2, Design Considerations, written instructions for time between coats and curing.
 - 3. Do not use materials that are frozen, caked, or lumpy, or that are dirty or contaminated by foreign materials.
 - 4. Use only potable water, free from impurities that might impair the cement plaster Work. Do not use water that has been used to clean tools.
 - 5. Do not use excessive water in mixing and applying cement plaster materials.
 - 6. Grout hollow metal frames, bases and similar Work occurring in plastered areas of interior Work, using base-coat materials. Where necessary for grouting access, grout prior to lathing.
 - a. Grout frames and bases solidly and continuously.
 - 7. Sequence plastering applications in accordance with Article 1.7 of this Section.
 - 8. Plaster flush with metal frames and other built-in metal items or accessories, that act as plaster ground, unless specifically shown otherwise. Where interior cement plaster is not terminated at metal by casing beads, cut base

coat free from metal before cement plaster sets and groove finish coat at junctures with metal.

9. Corners: Make internal corners and angles square; finish external corners flush with corner beads on interior Work, and square and true with stucco faces on exterior Work.
10. Schedules: Comply with Table 09 24 00-A of this Section.

B. Cement Plaster Applications:

1. Provide three-coat cement plaster over metal lathed and metal reinforced substrates (scratch, brown, and finish coats); and apply two-coat (base and finish coats) over direct-plastered concrete and concrete unit masonry substrates. Do not apply three-coat cement plaster on horizontal masonry substrates.
2. Cement Plaster Thicknesses: Provide base-coat 3/4-inches thick and finish-coat 1/8-inches thick, for total cement plaster thickness of 7/8-inches, except as follows:
 - a. Limit horizontal applications to maximum of 3/8-inches thick where applied directly to concrete without lath or metal reinforcement.
 - b. Limit vertical applications to maximum of 5/8-inches thick where applied directly to masonry or concrete without lath or metal reinforcement. Provide base-coats of minimum 3/8-inch thickness on masonry and minimum 1/4-inch on concrete.
 - c. On metal reinforcing, provide minimum scratch-coat thickness of 1/2-inch. On backings that are not solid, apply a minimum thickness of 3/8-inch.
 - d. Provide finish-coat cement plaster not less than 1/8-inch thick, and increase thickness as required to achieve required texture, pattern, and embedment of exposed aggregate or other finish requirements as specified.

C. Finish-Coat Texture/Pattern:

1. Sand-Float Plaster Finish: Float finish-coat application to uniform sand-float texture using sponge-type float. Match sample or mock-up, or, if none, provide standard sand-float texture.
2. Dash Plaster Finish: Where shown, dash finish-coat application in two-coats over base-coat by machine application, to an even and uniform dash finish matching mock-up or, if none, provide standard medium textured dash finish.
3. Trowel-Textured Finish: Provide finish-coat with hand-trowel-textured finish as established by approved Sample or as approved on mock-up.
4. Exposed Aggregate Cement Plaster Finish: Where shown or indicated, provide specially formulated bedding coat, including bonding additive, as finish-coat; level to tolerance specified and in thickness required to adequately embed aggregate. Embed aggregate in freshly applied finish-coat by machine dashing where size is No. 4 or smaller, passing 5/8-inch sieve, and by hand-placing where larger. Tamp lightly with resilient trowel or float. Match approved mock-up.
 - a. Finish-Coat Thickness: 3/8-inch for maximum No. 3 aggregate.

D. Curing Cement Plaster:

1. Protect each coat of cement plaster Work from dry-out for 20 to 24 hours after placement or until curing operation will not damage surface, and moisture-cure not less than 48 hours after time of placement. Moisture-cure by maintaining in moist condition, by frequent fog spraying with water and by protecting from fast dry-out with covering of polyethylene film or similar enclosure. Cure each coat to uniform moisture content before installing succeeding coat, and do not install finish-coat until base-coat has been cured at least five days.
2. Refer to Section 09 91 00, Painting, for application of paint finish and coatings on cement plaster.

3.8 FIELD QUALITY CONTROL

- A. Before installing cement plaster ceilings, inspect ceiling support framing accompanied by ENGINEER and submit written report of deficiencies. Do not proceed with installing cement plaster on ceiling support framing until deficiencies are corrected.
1. Notify ENGINEER 14 days in advance of the date and time when Work, or part of Work, will be ready for above ceiling observation.
 2. Before notifying ENGINEER, complete the following in areas to receive cement board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation of insulation, and successful testing of piping conveying fluids and automatic fire suppression system.
 - c. Installation of ventilation duct system.
 - d. Installation of air distribution devices.
 - e. Installation of ceiling support framing.

3.9 REPAIR

- A. Cut, patch, repair, and point-up cement plaster as required and as necessary to accommodate other Work. Repair cracks and indented surfaces. Point-up finish plaster surfaces around items built into or penetrating plaster surfaces. Repair or replace the Work to eliminate blisters, buckles, check cracking, dry-outs, efflorescence, excessive pinholes, and similar imperfections. Repair or replace defective Work as necessary to comply with specified tolerances and required visual effects.

3.10 CLEANING AND PROTECTION

- A. Remove temporary covering and other provisions made to minimize spattering of cement plaster on other work. Promptly remove cement plaster from door frames, windows, and other surfaces, that are not to be plastered. Repair surfaces that have been stained, marred, or otherwise damaged during cement plastering Work. When cement-plastering Work is complete, remove unused materials, containers, and equipment and cement plaster debris.
- B. Protect cement plaster from deterioration and damage during remainder of construction.

3.11 SCHEDULES

- A. The schedules listed below are part of this Section:
 - 1. Table 09 24 00-A: Furring and Plaster Systems

TABLE 09 24 00-A: FURRING AND PLASTER SYSTEMS

Location	Lath	Coats	Base Coat	Finish Coat	Finish	Thickness	Facility
Exterior Ceilings and Soffits	Flat rib ⁽¹⁾	Three	Ready-mixed	Ready-mixed	Sand Float	7/8-inch	(--1--)
Notes: (1) Stud spacing: 16 inches on centers.							

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SECTION 09 30 13

CERAMIC TILE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified and required to furnish and install all ceramic tile. The Work also includes:
 - a. Providing openings in ceramic tile to accommodate the Work under this and other Sections, and building into the ceramic tile all items to be embedded in or penetrate ceramic tile Work.
 - b. Providing openings in ceramic tile to accommodate work under other contracts and assisting other contractors in building into ceramic tile all items furnished under other contracts that will be embedded in or penetrate ceramic tile Work.
2. Extent of ceramic tile Work is shown or indicated.
3. Types of products required include:
 - a. Glazed ceramic wall tile.
 - b. Unglazed ceramic floor tile.
 - c. Recycled glass-content, ceramic unglazed floor tile.
 - d. Recycled glass-content, ceramic glazed wall tile.
 - e. Recycled porcelain glazed floor tile.
 - f. Portland cement slurry mortar bed bond coat.
 - g. Latex-portland cement setting bed mortar.
 - h. Latex-portland cement bond coat mortar.
 - i. Latex-portland cement sanded grout.
 - j. Custom marble thresholds.
 - k. Auxiliary materials, additives, accessories, and trim.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before ceramic tile Work.
2. Notify other contractors in advance of installing ceramic tile to provide other contractors with sufficient time for installing items included in their contracts that are to be installed with or before ceramic tile Work.
3. Comply with ANSI American National Standard Specifications for the Installation of Ceramic Tile for related trade coordination.
4. Coordinate substrate finishing and curing techniques for type of ceramic tile installation required.
5. Coordinate substrate finishing with other Sections and coordinate installation requirements of those Sections with the Work of this Section.

6. Coordinate final locations of structural expansion joints, control joints, cold joints, and saw-cut control joints so that such joints do not interrupt ceramic tile pattern shown.

C. Related Sections:

1. Section 07 92 00, Joint Sealants.
2. Section 09 21 16, Gypsum Board Assemblies.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI, American National Standard Specifications for the Installation of Ceramic Tile.
2. ANSI A10.20, Safety Requirements for Ceramic Tile, Terrazzo and Marble Work.
3. ANSI A108.1, Installation of Ceramic Tile.
4. ANSI A108.5, Ceramic Tile.
5. ANSI A108.10, Installation of Grout in Tilework.
6. ANSI A118.4, Latex-Portland Cement Mortar.
7. ANSI A118.7, Polymer Modified Cement Grouts for Tile Installation.
8. ANSI A137.1, American National Standards Specification for Ceramic Tile.
9. ASTM A82, Specification for Steel Wire, Plain, for Concrete Reinforcement.
10. ASTM A185, Specification for Steel Welded Wire Reinforcement, Plain for Concrete.
11. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).
12. ASTM C144, Specification for Aggregate for Masonry Mortar.
13. ASTM C150, Specification for Portland Cement.
14. ASTM C171, Specification for Sheet Materials for Curing Concrete.
15. ASTM C241, Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic.
16. ASTM C373, Test Method for Water Absorption, Bulk Density, Apparent Porosity and Apparent Specific Gravity of Fired Whiteware Products.
17. ASTM C424, Test Method for Craze Resistance of Fired Glazed Whitewares by Autoclave Treatment.
18. ASTM C482, Test Method for Bond Strength of Ceramic Tile to Portland Cement Paste.
19. ASTM C485, Test Method for Measuring Warpage of Ceramic Tile.
20. ASTM C499, Test Method for Facial Dimensions and Thickness of Flat, Rectangular Ceramic Wall and Floor Tile.
21. ASTM C501, Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.
22. ASTM C503, Specification for Marble Dimension Stone (Exterior).
23. ASTM C627, Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester.
24. ASTM C648, Test Method for Breaking Strength of Ceramic Tile.

25. ASTM C650, Test Method for Resistance of Ceramic Tile to Chemical Substances.
26. ASTM C847, Specification for Metal Lath.
27. ASTM C1026, Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling.
28. ASTM C1028, Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
29. ASTM C87, Test Method for Melting Point of Petroleum Wax (Cooling Curve).
30. ASTM D2240, Test Method for Rubber Property - Durometer Hardness.
31. TCNA, Handbook for Ceramic Tile Installation.

1.3 TERMINOLOGY

- A. Terminology used in this Section is in accordance with:
 1. Terminology, explanations, requirements, and notes in the Foreword to ANSI Standard Specifications for the Installation of Ceramic Tile.
 2. All terms in ANSI A137.1.
- B. The following words or terms are not defined but, when used in this Section, have the following meaning:
 1. "Ceramic tile" is a ceramic surfacing unit, usually relatively thin in relation to facial area, made from clay, or mixture of clay and other ceramic materials, called the body of the tile, having either a glazed or unglazed face and fired above red heat in the course of manufacture to temperature sufficiently high to produce specific physical properties and characteristic specified.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 1. Manufacturer:
 - a. Provide ceramic tile and auxiliary products and accessories manufactured by firms specializing in producing types of products specified, in compliance with reference standards used in this Section.
 - b. Provide ceramic tile and auxiliary products and accessories manufactured by firms that are members of TCNA and participate in TCNA certification programs.
 2. Installer:
 - a. Engage a single installer regularly performing ceramic tile installation, and with documented skill and successful experience installing types of materials required; and that employs only tradesmen who are trained, skilled, and have successful experience installing types of materials specified.
 - b. Submit installer name and qualifications, and the following information for at least three successful projects:

- 1) Names and telephone numbers of owners, architects or engineers responsible for projects.
- 2) Approximate contract cost of the ceramic tile.
- 3) Quantity (area) installed.

B. Component Supply and Compatibility:

1. Provide each type of ceramic tile from only one manufacturer.
2. Provide ceramic tile from source with adequate resources to provide ceramic tile of same color, grade, finish, type, and variety, and from same production run, and of consistent quality, appearance, and physical properties, for each contiguous area, without delaying the Work.
3. Provide modified cement mortars, bonding adhesives, and grouts of generic type specified, but of brand acceptable to, or recommended by, ceramic tile manufacturer.
4. Obtain all ceramic tile setting and grouting products from one manufacturer.

C. Regulatory Requirements:

1. Comply with Americans with Disabilities Act of 1990 (Public Law 101-336), Appendix A to 28 CFR 36 (Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities - ADAAG).

D. Mock-Ups:

1. Prior to installing ceramic tile and accessories, but after ENGINEER's approval of Samples and Action Submittals, provide four-foot square Sample of each type of ceramic tile floor and wall system in areas selected by ENGINEER to show representative installation of the Work.
2. Obtain ENGINEER's approval of colors, patterns, textures, and tolerances before starting ceramic tile Work. Retain and protect mock-ups during construction as a standard for judging completed ceramic tile Work. Do not alter, move, or destroy mock-up panels until corresponding ceramic tile Work is acceptably completed.
3. Approved mock-ups may become part of the Work if approved mock-ups remain undamaged and undeteriorated at Substantial Completion.
4. Remove and replace with new material ceramic tile Work that does not conform to the standard approved on mock-ups.
5. Do not commence ceramic tile installation without obtaining ENGINEER's approval of associated mock-up.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Completely dimensioned and detailed drawings for ceramic tile Work utilizing modular planning to minimize cutting. Show ceramic tile pattern and recommended location of control joints and expansion joints in finished ceramic tile Work.
 - b. Show all ceramic tiles including location of each type, color, and pattern. Show coordinated details for construction systems adjacent to

ceramic tile that may affect ceramic tile pattern. Submit large-scale details for interrelated thresholds, floor drains, coves, equipment pads, trench drains, shower bases, horizontal pipe chases, columns, and similar items that will interrupt or be coordinated with ceramic tile system, based on dimensions obtained through Site measurements.

2. Product Data:
 - a. Copies of manufacturer's specifications and literature for all required materials. Include manufacturer's published data, indicating that each material complies with the Contract Documents and is suitable for the application shown.
 - b. Test Reports: Submit certified laboratory test reports, for products identical to those to be provided for the Project, indicating conformance with the requirements specified.
 3. Samples: Sample submittals will be reviewed by ENGINEER for color, texture, and pattern only. Compliance with all other requirements is the responsibility of CONTRACTOR. Submit the following:
 - a. Ceramic tile mounted on 12-inch square hardwood boards showing color, type, and class of each ceramic tile required.
 - b. Manufacturer's full selection of standard and custom colored grout. Provide actual Samples of each grout material color, applied between metal or plastic flanges, for selection by ENGINEER.
 - c. Marble thresholds with color, profile, and finish specified, full width and 12 inches long.
 - d. Mock-up(s).
- B. Informational Submittals: Submit the following:
1. Certificates.
 - a. Master Grade Master Grade Certificate and Tile Contractor's Certificate signed by manufacturer and installer, for each type of ceramic tile in compliance with procedures established by ANSI A137.1 for ceramic tile.
 - b. Certificate stating that products licensed by the TCNA have been supplied, where applicable.
 - c. Certify that tiles from the same production run are available in sufficient quantity for the Work.
 - d. Installer certification.
 - e. Certify that setting bed mortars and grouts have been stored off the ground in factory-sealed containers and bags, and in areas maintained within humidity limitations recommended by product manufacturer.
 - f. Certify that setting bed mortar and grout materials were manufactured within 12 months of installation and have not and will not be subjected to freezing temperatures.
 2. Supplier Instructions:
 - a. Copies of TCNA Handbook for Ceramic Tile Installation showing proposed installation system, materials, and details for each area of the Work.
 3. Qualifications Statements:
 - a. Manufacturer, when required by ENGINEER.

- b. Installer.

C. Closeout Submittals:

1. Maintenance Data: Submit in accordance with 01 78 23, Operations and Maintenance Data, manufacturer's instructions for recommended maintenance practices for each type of ceramic tile, including the following:
 - a. Product name and number.
 - b. Name, address and telephone number of manufacturer and local distributor.
 - c. Detailed procedures for routine maintenance and cleaning.
 - d. Detailed procedures for light repairs such as dents, scratches, and staining.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of applicable reference standards used in this Section, Section 01 65 00, Product Delivery Requirements, Section 01 66 00, Product Storage and Handling Requirements, and the following.
1. Deliver ceramic tile bearing manufacturer's name with standard grade labels complying with ANSI A137.1.
 2. Tile shall be accompanied by certificate and shipping receipt from manufacturer stating grade of tile, number and kinds of containers and shipping identification.
 3. Include identification and formula numbers on containers of setting and grouting materials produced under TCNA license.
 4. Failure to comply with requirements of this Article shall be sufficient cause for ENGINEER'S rejection of the material in question. Remove unacceptable material from the Site and provide new material conforming to the Contract Documents.

1.7 PROJECT CONDITIONS

A. Environmental Requirements:

1. Supplemental Heat: Do not apply ceramic tile to surfaces that contain frost. Install ceramic tile only when substrate is at least 50 degrees F and rising. Maintain minimum temperature for curing period recommended under applicable ANSI reference standard for the substrate and setting bed specified.
 - a. Provide supplemental heat and protection as required to maintain ceramic tile at minimum of 50 degrees F during and after installation.
 - b. Supplemental heat and power sources, as may be required should ambient temperature fall below 50 degrees F, are not available at the Site. Provide supplemental heat, including fuel, equipment, operating and maintenance personnel and power sources.
 - c. Distribute heat uniformly and provide deflection or protective screens as required to prevent concentrating heat on ceramic tile near heat source.

2. Damp-cure latex-portland cement mortar setting bed under cover for minimum of 20 hours at temperatures of at least 70 degrees F and allow setting bed to dry before installing ceramic tile. Lower temperatures shall necessitate longer curing times. Comply with written recommendations of latex-portland cement mortar manufacturer.
 3. Warm Weather Requirements: Do not install ceramic tile when temperature of substrate is 100 degrees F or is expected to rise above 100 degrees F during curing period.
- B. Site Measurements:
1. Where field measurements cannot be taken at the Site without delaying the Work, establish dimensions and proceed with Shop Drawing preparation without Site-verified dimensions. Coordinate supports, adjacent construction, and equipment locations to ensure dimensions shown on Shop Drawings correspond to dimensions established for ceramic tile Work.

1.8 SCHEDULING

- A. Do not install ceramic tile until other Work to be embedded in ceramic tile systems has been acceptably installed.
- B. Sequence the Work so that other installers do not interfere with or need to Work in the ceramic tile installation areas until such time as ceramic tile Work can be adequately protected from potential damage from their work, or access requirements.
- C. Cooperatively schedule and assist in sequencing of work of other contracts so that other contractors do not interfere with or need to work in ceramic tile installation areas until ceramic tile is adequately protected from potential damage that may be caused by work of or access requirements of other contractors.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Performance Criteria:
1. Standards: Comply with applicable reference standards using this Section and recommendations of TCNA and ANSI, except to extent that more-stringent requirements are required in the Contract Documents.
 2. All requirements of ANSI American National Standard Specifications for the Installation of Ceramic Tile, including its General Requirements, Forwards, and Explanation and Notes, shall be part of this Section.
 3. Ceramic Tile Floor System Service Requirements, ASTM C627 and TCNA Performance-Level Requirement Guide and Selection Table:
 - a. Floors: F131.
 - b. Walls: W244C.
 - c. Shower: W211 with epoxy grout and waterproof membrane.

2.2 MATERIALS

A. Ceramic Tile, General:

1. Provide ceramic tile manufactured from shale and fire clays.
2. Comply with ANSI A137.1. Provide standard-grade ceramic tile. Seconds are unacceptable.
3. Where required to meet performance criteria specified, provide manufacturer's standard abrasive surfaced ceramic tile with fused aluminum oxide, uniformly impregnated on face of flat tile. Tiles showing an uneven distribution are unacceptable.
4. Provide ceramic tile with patterned backs. Dovetail backs are unacceptable.
5. Ceramic tile shall be precisely formed with uniform and straight edges, and facial surfaces.

B. Unglazed Ceramic Floor Tile:

1. Products and Manufacturers: Provide one of the following:
 - a. Subtle Strands Color Body Floor Tile by American Olean.
 - b. Color Collection by United States Ceramic Tile Company, the Roca Tile Group.
 - c. Or equal.
2. Provide unglazed floor tile with the following properties:
 - a. Percentage of Water Absorption, ASTM C373: 3.5 percent.
 - b. Frost Resistance, ASTM C424: Resistant.
 - c. Abrasive Wear Resistance, ASTM C501: 158.
 - d. Breaking Strength, ASTM C648: 300 psi, minimum.
 - e. Stain Resistance, ANSI Z124.6: Passed (except permanent inks).
 - f. Bond Strength, ASTM C482: 248 psi, minimum.
 - g. Warpage (diagonal), ASTM C485: plus-or-minus 0.05 percent.
 - h. Hardness, Mohs' Scale: 7.0 to 8.0, minimum.
 - i. Coefficient of Friction, ASTM C1028 and ADAAG: 0.50 minimum average of wet and dry leather for level floors; 0.60 minimum average of wet and dry leather for ramps.
3. Type: Single-fired, ceramic.
4. Size: 12" x 24" and 3" x 3" mosaic in shower on walls.
5. Thickness: 5/16"
6. Provide complete selection of special radiused cove base, bullnosed, stair tread and riser shapes, and other special trim shapes as shown and as required by ENGINEER for a complete installation. Provide same material, color, size, and finish as floor tile unless otherwise indicated in the Contract Documents.
7. Color: Dune SS36.

C. Ceramic Glazed Wall Tile:

1. Products and Manufacturers: Provide one of the following:
 - a. Color Story Wall Tile by American Olean Corporation.
 - b. United States Ceramic Tile Company, the Roca Tile Group.
 - c. Marazzi USA, Marazzi Group.

- d. Or equal.
 - 2. Provide glazed wall tile with the following properties:
 - a. Percentage of Water Absorption, ASTM C373: 20 percent.
 - b. Abrasive Wear Resistance, ASTM C501: 158.
 - c. Breaking Strength, ASTM C648: 100 psi, minimum.
 - d. Warpage (diagonal), ASTM C485: plus-or-minus 0.4 percent.
 - e. Hardness, Mohs' Scale: 4.0 to 6.0, minimum.
 - 3. Type: Single-fired, ceramic.
 - 4. Grind glazed wall tile on all four sides of tile after firing.
 - 5. Size: 6" x 6" running bond, Matte at base. Shower see floor tile.
 - 6. Thickness: 3/8"
 - 7. Provide complete selection of all special radiused cove base, bullnosed, stair tread, and riser shapes and other special trim shapes as shown, or as required for a complete installation. Provide same material, color, size, and finish as floor tile, unless otherwise indicated in the Contract Documents.
 - 8. Color: Calm, and Matte Shadow at base.
- D. Portland Cement: Comply with ASTM C150, Type 1, gray.
- E. Aggregate: Provide sand complying with ASTM C144. Provide clean, graded sand passing a 16-mesh screen.
- F. Mortar Setting Bed:
- 1. Provide thick/full bed setting bed for ceramic tiles. Provide epoxy version where performance level system indicates use of epoxy or furan grout
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Laticrete 3701 Fortified Mortar by Laticrete International, Inc.
 - b. Floor Mud and B-710 SBR Mortar Additive by ProSpec, a Sakrete Company.
 - c. Or equal.
 - 3. Latex-Portland Cement Mortar: Provide pre-blended, pre-sanded portland cement mortar with latex additives complying with ANSI A118.4.
 - 4. Physical Properties:
 - a. Compressive Strength, ASTM C109: 5,000 psi, minimum.
 - b. Hardness, ASTM D2240: 70 to 80 D-Scale; 72 hours.
 - c. Service Rating (TCNA), ASTM C627: Cycles 1 to 14 "extra heavy".
 - d. VOC Content:
 - 1) Mortar: 0.00 g/L.
 - 2) Admixture: 2.39 g/L.
- G. Thin-Set Mortar:
- 1. Provide high-performance, high-tack, non-flammable, non-toxic, water cleanable, ceramic tile mortar. Provide epoxy version where performance level system indicates use of epoxy or furan grout
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Laticrete 254 Platinum by Laticrete International, Inc.
 - b. ProSpec Superior Permaflex 600 by Bonsal American, Inc.
 - c. Or equal.

3. Latex-Portland Cement Bond Coat: Provide pre-blended, pre-sanded, portland cement mortar with latex additives complying with ANSI A118.4.
 4. Physical Properties: Provide the following:
 - a. Compressive Strength, ANSI A118.4: 2,500 psi, minimum.
 - b. Water Absorption, ANSI A118.7: Four percent, maximum.
 - c. Shear Bond, Porcelain Tile, Water Immersion, ANSI A118.4: 300 psi, minimum.
 - d. Service Rating (TCNA), ASTM C627: Cycles 1 to 14 “extra heavy”.
 - e. VOC Content: 0.00 grams per liter.
- H. Grout: Provide the following grout for areas receiving the Work of this Section:
1. Provide high-performance, premium sanded grout complying with ANSI A118.7 and recommended by grout manufacturer as acceptable for use in extra-heavy commercial and industrial applications. Provide epoxy version where performance level system indicates use of epoxy or furan grout.
 2. Products and Manufacturers: Provide one of the following:
 - a. Laticrete Permacolor Select by Laticrete International, Inc.
 - b. ProSpec Sanded Tile Grout (700) by, Bonsal American, Inc.
 - c. Or equal.
 3. Latex-Portland Cement Grout: Provide sanded cement grout consisting of blended mix of portland cement, graded aggregates, and color-fast pigments mixed with latex additive in place of water, complying with ANSI A118.7.
 4. Physical Properties:
 - a. Compressive Strength, ANSI A118.7: 3,500 psi, minimum.
 - b. Water Absorption, ANSI A118.7: Five percent, maximum.
 - c. Hardness, ASTM D2240: 60 to 70 D-Scale; 72 hours.
 - d. Linear Shrinkage, ANSI A118.7: 0.19 percent, seven-day maximum.
 - e. Service Rating (TCNA), ASTM C627: Cycles 1 to 14 “extra heavy”.
 - f. VOC Content: 0.00 g/L.
 5. Colors: Provide specified manufacturer’s complete selection of standard and custom colors for final selection by ENGINEER. ENGINEER will select maximum of four colors.
 5. Color: Walls - #90 Light Pewter and floor and shower - #889 Smoke Grey.
- I. Waterproof Liquid Rubber Membrane: Provide the following:
1. Heavy-duty membrane system acceptable for exposure to construction traffic and negative hydrostatic pressure.
 2. Products and Manufacturers: Provide one of the following:
 - a. Laticrete Hydroban of Laticrete International, Inc.
 - b. ProSpec B-6000 Waterproofing/Crack Isolation Membrane by Bonsal American, Inc.
 - c. Or equal.
- J. Tile Backer Panels:
1. Refer to Section 09 21 16, Gypsum Board Assemblies.

K. Auxiliary Materials:

1. Thresholds:
 - a. Provide sound Group “A” marble with an abrasive hardness of not less than 10.0 when tested in accordance with ASTM C241.
 - b. Provide beige colored, honed marble, complying with ASTM C503, for thresholds, where shown.
2. Metal Lath: ASTM C847, galvanized expanded metal lath, 3.4 pounds per square yard.
3. Burlap or Cheese Cloth: Provide to keep drainage layer free of mortar from mortar bed installation Work.
4. Expansion Joints: Provide expansion joint materials in accordance with TCNA Handbook for Ceramic Tile Installation and applicable ANSI installation standards. Provide expansion joint assemblies with neoprene filler between metal flanges.
5. Metal Edge Strip: Provide stainless steel metal edge strip with integral provisions for anchorage to substrate for transition between ceramic tile and other floor materials.
6. Temporary Protective Coating: Provide petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with melting point of 120 degrees F to 140 degrees F in compliance with ASTM C87, formulated to protect exposed ceramic tile surfaces against adherence of modified portland-cement mortars and grouts. Temporary protective coating shall be easily removable after grouting completion without damaging grout or tile.
7. Ceramic Tile Cleaner: Neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, and recommended for cleaning ceramic tile and modified portland-cement materials by the tile and grout manufacturers.
8. Sealants: Refer to Section 07 92 00, Joint Sealants.
9. Water: Clean and potable.

2.3 MIXES

A. Setting Bed Cement Mortar:

1. Provide latex-portland cement setting bed mortar mixed in accordance with ANSI A108.1 and manufacturer’s written specifications.
2. Machine-mix in mortar Supplier-approved mixer in which quantity of water is accurately and uniformly controlled.
3. Add only sufficient water to produce workable mix allowing for maximum compaction during tamping of mortar bed.

B. For mixing of bond coats, grouts, and similar materials, comply with manufacturer’s instructions and applicable ANSI reference standards using in this Section.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine the substrates to receive mortar bed and ceramic tile and conditions under which the ceramic tile Work will be performed. Notify ENGINEER in writing of unsatisfactory tolerances that exceed specified limits in other work adjoining the ceramic tile Work, and other conditions detrimental to proper and timely completion of the Work. Do not proceed with installing ceramic tile Work until unsatisfactory conditions have been corrected.
- B. Comply with recommendations for condition and inspection of surfaces, including tolerances, contained in the “Forward” and “General Requirements” of ANSI Specifications for the Installation of Ceramic Tile.

3.2 PREPARATION

- A. Prepare and cure substrates in accordance with ANSI A108.1, setting bed mortar manufacturer’s recommendations, TCNA recommendations, and installation methods in applicable ANSI reference standards used in this Section.
 - 1. Remove substances that are incompatible with ceramic tile setting materials by using terrazzo grinder, drum sander, or polishing machine equipped with heavy-duty wire brush.
- B. Provide structurally sound, dry substrate free of ridges and depressions and finished in accordance with installation method specified.
- C. Comply with ANSI suggestions for related trade preparations presented in the “Foreword” of ANSI American National Standard Specifications for the Installation of Ceramic Tile.
- D. Clean substrate of waxy and oily films and curing compounds.

3.3 INSTALLATION

- A. Install ceramic tiles in accordance with ANSI A108.1 and ANSI A10.20.
- B. Erection Tolerances:
 - 1. Limit out-of-plane variation of ceramic tile floor to 1/4-inch in 20 feet.
 - 2. Limit height offsets (lippage) between individual ceramic tiles to 1/32-inch.
 - 3. Limit joint width variation to plus-or-minus 1/16-inch in 20 feet.
- C. Ceramic Tile Tolerances:
 - 1. Comply with ASTM C499.
 - 2. Determine structural defects in flat tile and trim units in accordance with Appendix of ANSI A137.1.

- D. Install ceramic floor tile and thresholds in accordance with TCNA Handbook for Ceramic Tile Installation, as follows:
 - 1. Floor Tile: Handbook method F131, and in accordance with ANSI A108.6 and A118.3, except as otherwise specified.
 - 2. Base Cove Alternative: Flush.
 - 3. Thresholds: Install stone thresholds complying with TCNA, “Handbook for Ceramic Tile Installation” Method TR611-2K.
- E. Ceramic Wall Tile: Install ceramic wall tile complying with TCNA, Handbook for Ceramic Tile Installation, as follows:
 - 1. Wall Tile: Handbook method W224C and W211, and in accordance with ANSI A108.6 and A118.3, except as otherwise specified.
- F. Expansion Joints:
 - 1. Install ceramic tile associated with expansion joints, control joints, and cold-joints in accordance with TCNA Handbook for Ceramic Tile Installation, Method EJ171-2K.
 - 2. Provide expansion joints in locations and in manner recommended by TCNA and as shown.
 - 3. Locate openings for expansion joints directly over structural joints in horizontal surfaces, where backing materials change and where ceramic tile Work abuts restraining surfaces such as perimeter walls, curbs, columns, piping, and conduits.
 - 4. Width of openings for expansion joints over structural joints shall be at least as wide as corresponding structural joint.
 - 5. Provide interior expansion joints same width as grout joints with minimum size of 1/4-inch.
- G. Provide 95-percent mortar bond coat coverage for each ceramic tile back. Back butter each tile with bond coat or select a notched trowel sized to facilitate proper coverage, key mortar into substrate with flat side of trowel, and comb with notched side of trowel in one direction. Embed tile in mortar by beating-in, pushing in direction perpendicular to combed ridges, or other means to achieve 95 percent coverage. Corners and edges shall be fully supported by bonding mortar.
 - 1. Periodically remove and check ceramic tile in presence of ENGINEER to ensure that proper coverage is being attained.
- H. Extend ceramic tile Work into recesses and under equipment, fixtures, and permanent furniture such as laboratory metal casework, lockers, and shop equipment to form complete covering without interruptions, except as otherwise shown or indicated. Terminate ceramic tile Work neatly at obstructions, edges, and corners without disruption of pattern or joint alignment. Provide standard pre-manufactured trim components.
- I. Accurately form intersections and returns. Perform cutting and drilling of ceramic tile without marring visible surfaces.

- J. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight, aligned joints. Cut and ground edges shall be uniform and straight without marring tile faces. Extend ceramic tile half-way under door thresholds. Fit ceramic tile closely to electrical outlets, piping, conduit, and fixtures so that plates, collars, or covers overlap ceramic tile. Use bullnosed tile adjacent to carpet.
- K. Jointing Pattern: Unless otherwise shown or indicated, lay ceramic tile in grid pattern. Align joints when adjoining ceramic tile on floor, base, and trim are same size. Lay out ceramic tile Work and center tile fields both directions in each space. Adjust to minimize tile cutting. Provide uniform joint widths per tile manufacturer.
- L. Grout joints (except control and expansion joints) with specified grout, in accordance with ANSI A108.10.
 - 1. Dampen tile surfaces with water. Spread grout with a sharp, firm, rubber grout float. Work the grout paste into the joints until completely filled. Use diagonal strokes to pack the tile joints. Ensure that joints are filled and that grout is not bridging the joint.
 - 2. Provide full flush joints for ceramic floor tiles by sprinkling thin layer of dry grout powder over surface immediately after grouting. When grout darkens over joint, buff with burlap, carpet remnant, or cotton rag to pack joint and clean face of tile.
- M. Protect ceramic tile against damage from high performance grout by coating exposed faces of tile with wax coating to produce a thin, continuous film. Use wax that is compatible with grout and is removable by steaming method approved by tile and grout manufacturer. Apply wax in manner to avoid coating edges or backs, and handle coated tile to prevent waxed surfaces from contacting the backs or edges or other units.
- N. Cure ceramic tile Work using materials and techniques recommended by mortar and grout manufacturer and ANSI A108.5.
- O. Do not use chipped, cracked, or defaced ceramic tile.
- P. Provide divider strips and accent strips to same depth as finished ceramic tile floor and wall system, including setting bed.

3.4 ADJUSTMENT AND CLEANING

- A. Remove grout and mortar from ceramic tile faces and adjoining Work before grout or mortar hardens. Follow grout and mortar manufacturer's written recommendations for primary and secondary cleaning. Leave ceramic tile clean and free of foreign matter.
- B. Prohibit traffic from using ceramic tile floors for seven days after grouting is completed.

- C. Before traffic is allowed over finish ceramic tile floors, cover with heavy building paper.
- D. Lay board walkways on floors that are to be trucked-over. Provide continuous runways of required width installed over building paper.
- E. Remove protective wax surfacing in accordance with ceramic tile manufacturer's recommendations.
- F. Do not acid clean unglazed ceramic tile unless allowed by ceramic tile manufacturer's printed instructions and, if allowed, do so no earlier than 14 days after grouting. Mild acid cleaners that do not contain muriatic acid will be acceptable if recommended by ceramic tile manufacturer. Where acid cleaners are acceptable, comply with the following:
 - 1. Soak unglazed ceramic tile with water before cleaning with saturated solution of sulfuric acid in room temperature water.
 - 2. Protect metal and enamel surfaces, and cast iron and vitreous plumbing fixtures, from effects of acid cleaning by coating such items with petroleum jelly.
 - 3. Thoroughly flush ceramic tile with water before and after acid cleaning and restore protected surfaces to their original condition.
- G. Do not use acid or acid-based cleaners to clean glazed ceramic tile.
- H. Remove cracked, broken, unbounded, or damaged ceramic tile and replace with new material.
- I. Protection:
 - 1. Protect adjoining work from the Work of this Section.
 - 2. Where acid solutions are required to clean surfaces of finished Work, first cover exposed adjoining work to protect adjoining work from possible effect of acid or its fumes.
 - 3. Clean adjoining surfaces soiled by ceramic tile Work.
 - 4. Replace adjoining work damaged beyond repair by the Work of this Section.
- J. Immediately prior to inspection to determine Substantial Completion, remove protective coverings and wash ceramic tile floors and walls clean.

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SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install acoustical panel ceilings. The Work also includes:
 - a. Providing openings in acoustical panel ceilings to accommodate the Work under this and other Sections and building into the acoustical panel ceilings all items to be embedded in, or penetrate, acoustical panel ceilings.
 - b. Providing openings in acoustical panel ceilings to accommodate the work under other contracts and assisting other contractors in building into the acoustical panel ceilings all items furnished under other contracts that are required to be embedded in, or penetrate, acoustical panel ceilings.
2. Extent of acoustical panel ceilings is shown.
3. Types of products include the following:
 - a. Textured, ceramic/mineral fiber, acoustical ceiling panels.
 - b. Intermediate-duty, exposed, acoustical panel suspension system.
 - c. Acoustical sealants.
 - d. Miscellaneous fasteners, clips, hangers, tie-wire and other accessories.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the acoustical panel ceilings Work.
2. Coordinate furnishing and installing products for maintaining the fire-resistance-rating of ceiling construction at perimeters and penetrations where built-in and recessed items and transitions with other building components occur in the acoustical panel ceilings Work.
3. Notify other contractors in advance of the construction of the acoustical panel ceilings Work to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed with, or before, the acoustical panel ceilings Work.

C. Related Sections:

1. Section 07 92 00, Joint Sealants.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. ASTM A 153/A 153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM A 510, Specification for General Requirements for Wire Rods and Coarse Round Wire,
3. ASTM A 641/A 641M, Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
4. ASTM A 653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
5. ASTM B 221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
6. ASTM C 423, Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
7. ASTM C 635, Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
8. ASTM C 636, Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
9. ASTM C 834, Specification for Latex Sealants.
10. ASTM E 84, Test Method for Surface Burning Characteristics of Building Materials.
11. ASTM E 90, Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
12. ASTM E 119, Test Method for Fire Tests of Building Construction and Materials.
13. ASTM E 413, Classification for Rating Sound Insulation.
14. ASTM E 488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.
15. ASTM E 580, Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint.
16. ASTM E 795, Practice for Mounting Test Specimens During Sound Absorption Tests.
17. ASTM E 1264, Classification for Acoustical Ceiling Products.
18. ASTM E 1414, Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
19. ASTM E 1477, Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
20. ASTM F 593, Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
21. ASTM F 594, Specification for Stainless Steel Nuts.
22. AMP, 501, Finishes for Aluminum.
23. CISCA, Acoustical Ceilings: Use and Practice.
24. CISCA, Ceiling Systems Handbook.
25. NAAMM, Metal Finishes Manual.
26. UL, Fire Resistance Directory.
Design, Reference Guide, For New Construction and Major Renovation,
LEED-NC, Version 2.2.

1.3 DEFINITIONS

- A. Articulation Class (AC): A measure for rating the speech privacy performance of a ceiling in an open plan environment where sound is reflected off the ceiling between two adjacent spaces divided by partial-height furniture panels.
- B. Ceiling Attenuation Class (CAC): It is the measure of the blocking of sound through one ceiling plane, into the plenum above, and back through the other ceiling plane to an adjacent space.
- C. Light Reflectance coefficient (LR): It is a measure of the percentage of light which is reflected off of a given panel surface. Typically, the whiter and smoother the panel, the higher the LR value.
- D. Noise Reduction Coefficient (NRC): It is a measure of how much sound is absorbed by a given material. It is listed as a decimal and relates to percentage sound absorbed.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Provide all components of acoustical panel ceilings and auxiliary products produced by a single manufacturer, where possible, including recommended primers, adhesives, and edging strips, as required.
 - 2. Provide products from manufacturer who participates in ISO certification programs and who manufacture acoustical panel ceilings and auxiliary products conforming to the requirements of those programs.
- B. Installer's Qualifications:
 - 1. Engage a single installer regularly performing installation of acoustical panel ceilings with documented skill and successful experience in the installation of the types of materials required; and who agrees to employ only tradesmen who are trained, skilled and have successful experience in installing the types of materials specified.
 - 2. Submit name and qualifications to ENGINEER along with the following information on a minimum of three successful projects:
 - a. Names and telephone numbers of owners, architects or engineers responsible for projects.
 - b. Approximate contract cost of the acoustical panel ceilings.
 - c. Amount of area installed.
- C. Component Supply and Compatibility:
 - 1. Furnish all components of each acoustical panel ceiling system from a single manufacturer and from a single supplier with adequate resources to provide products of consistent performance characteristics, physical properties, and appearance, without delaying the Work.
- D. Regulatory Requirements:
 - 1. Codes: Comply with applicable requirements of the governing codes.

2. Wherever a fire-resistance-rated construction assembly classification is shown or scheduled that includes acoustical panel ceiling assemblies (2-hour, 1-hour and similar designations), provide components complying with the applicable requirements for materials and installation established by UL, and other governing authorities having jurisdiction at the Site.
3. UL Compliance: Comply with UL's "Fire Resistance Directory", for applicable fire-resistant construction systems.
4. Size anchorage devices for ceiling hangers for three times supported load, except size direct-pull concrete inserts for five times supported load, for structural classification specified, complying with ASTM C 635, Table 1, Direct Hung, unless more stringent requirements are specified by governing authorities having jurisdiction at the Site and in compliance with ASTM E 488.
5. Attachment Devices: Size internal attachment devices within suspended ceiling system for five times the design load indicated in ASTM C 635, Table 1, Direct Hung.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Reflected ceiling plans of suspension systems, showing hanger, anchor and acoustical panel locations, drawn to a scale of 1/4-inch equal to 1 foot-0 inch, and details of all transitions of acoustical panels with other items such as light fixtures, air diffusers, and perimeter walls and all supporting and suspension system details, including method of attachment of suspension system hangers to building structure, drawn to a scale of 3/4-inches equal to 1 foot-0 inches.
 - 1) Show and coordinate locations of ceiling-mounted items, automatic fire suppression system sprinkler heads, speakers, and penetrations for other items of Work that are to be coordinated with the ceiling, and show framing and support details for Work supported by the suspension system.
 - 2) Complete information on all anchors and supports indicating maximum resistance to tension, in compliance with performance criteria specified.
 2. Product Data:
 - a. Copies of manufacturer's product specifications and installation instructions for each acoustical ceiling material required, and for each suspension system. Include certified laboratory test reports and other data as required to show compliance with these Specifications.
 - b. Include manufacturer's recommendations for cleaning and refinishing acoustical units, including precautions against materials and methods, which may be detrimental to finishes and acoustical performances.
 3. Samples:
 - a. Full size samples for each acoustical panel specified. Samples shall show the full range of exposed color and texture to be expected in the completed Work.

- b. 12-inch long samples of each exposed runner and molding.
 - c. ENGINEER'S review will be for color and texture only. Compliance with other requirements is the responsibility of CONTRACTOR.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Product certificates signed by the manufacturer certifying materials comply with the specified performance characteristics and criteria, and physical requirements.
 - b. Certified Installer.
 - 2. Test Reports:
 - a. Certify compliance with ASTM C 635 and other specified requirements, and indicate structural classification of each type of suspension system.
 - b. Evidence of acoustical panel ceiling system's compliance with requirements of governing authorities having jurisdiction at the Site.
 - 3. Site Quality Control Submittals:
 - a. Special Inspections Reports: Coordinate with the Coordinating Special Inspector. Refer to Section 01 45 33.00CAOH, Code-Required Special Inspections and Procedures for detailed report requirements.
 - 4. Qualifications Statements:
 - a. Installer.
 - b. Testing laboratory.
- C. Closeout Submittals: Submit the following:
 - 1. Operations and Maintenance Data: Furnish five copies of manufacturer's instructions for recommended maintenance practices for each type of acoustical panel ceiling systems, including the following:
 - a. Product name and number.
 - b. Name, address and telephone number of manufacturer and local distributor.
 - c. Detailed procedures for routine maintenance and cleaning.
 - d. Detailed procedures for light repairs such as dents, scratches, and staining

1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with applicable requirements of referenced standards, Section 01 65 00, Product Delivery Requirements and Section 01 66 00, Product Storage Handling Requirements.

1.7 JOB CONDITIONS

- A. Existing Conditions:
 - 1. Existing Conditions: Review the existing conditions effecting the surface preparation and installation of acoustical panel ceilings and submit a report to the ENGINEER before installation. Existing facilities must meet all the

requirements listed in 1.6.B. below. All deficiencies must be corrected before beginning installation.

B. Environmental Requirements:

1. Before installing acoustical panels permit them to reach room temperature and a stabilized moisture content.
2. Do not install interior acoustical panel ceilings until the space has been enclosed and is weathertight, and until installation of moisture-bearing material in the space has been completed and the space is nominally dry, and until ambient conditions of temperature and humidity are continuously maintained at levels indicated for final occupancy.

1.8 SEQUENCING

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 SCHEDULING

- A. Do not begin installation of acoustical panel ceilings until all Work above ceilings has been completed and accepted by ENGINEER.
- B. Furnish cast-in-place, and built-in-place anchors and their locations, to other trades for installation well in advance of time needed for coordinating locations of acoustical panel ceiling supports with other Work that must share plenum area above acoustical panel ceilings.

1.10 WARRANTY

- A. General Warranty: The special warranties specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents.
- B. Special Warranties:
1. Sag, Warp or Rot Warranty: Provide written warranty, signed by CONTRACTOR and manufacturer and running to benefit of OWNER, agreeing to replace, for a period of 30 years from the date of Substantial Completion, acoustical panel ceiling systems that sag, warp or rot, as specified.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Performance Criteria:

1. General:
 - a. Standards: Provide manufacturer's standard acoustical panel ceiling systems that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light deflections.
 - b. References: In general, the recommendations of CISCA, "Acoustical Ceilings: Use and Practice" shall be considered part of this Section, unless otherwise specified.
 - c. Standards for Terminology and Performance: Applicable publications by the Ceiling and Interior Systems Construction Association (CISCA), including "Ceiling Systems Handbook" and ASTM C 635.
2. Noise Reduction Coefficient (NRC): The average of sound absorption coefficients when tested in accordance with ASTM C 423 for a specification range of ten points, for middle frequencies of 250, 500, 1000, and 2000 Hertz with face of test specimen mounted in compliance with ASTM C 795 for Mounting Type E-400 (400-millimeter air space) standard mounting according to ASTM E 1264. Provide not less than the following:
 - a. NRC Rating: Range of 0.50, except as otherwise specified.
3. Ceiling Attenuation Class: Provide acoustical panel ceilings that have been tested for sound transmission loss through the acoustical tile ceiling, determined in accordance with ASTM E 1414 and ASTM E 413. Provide not less than the following:
 - a. CAC Class: 40, for Mounting Type E-400.

2.2 CEILING PANELS

- A. General: Unless otherwise specified, provide standard lay-in panels of the type selected by ENGINEER. Provide sizes shown on reflected ceiling plans or, if not otherwise shown, 24-inch by 24-inch grid-size panels.
- B. Ceramic/Mineral Fiber Acoustical Panels:
 1. Environmental Profile:
 - a. Acoustical panels shall contain man-made fibers.
 - b. Provide units that do not require the use of additives to resist the growth of bacteria or fungus and that are unaffected by water or high humidity.
 - c. 100 percent recyclable.
 - d. 35 percent recycle content.
 2. Acoustical Panels: Provide units manufactured from ceramic and mineral fiber composition, not less than 5/8-inch thick, weighing 1.48 pounds per square foot. Provide a light non-directional texture, fine line edge; chalk white color integral throughout; ASTM E 1264, Type XX.
 3. Fire-Test-Response Characteristics of Acoustical Panels: Provide acoustical panels with surface-burning characteristics complying with ASTM E 1264 for Class A materials on face side; as determined by testing identical products in compliance with ASTM E 84.
 4. Physical Properties: Provide the following:
 - a. Flame Spread, ASTM E 84: 25.
 - b. Smoke Development, ASTM E 84: 50.

5. Complete selection of manufacturer's standard panel face profiles, patterns, and textures for final selection by ENGINEER.
6. Light Reflectance Ratings: Except as otherwise shown or specified, provide factory-finished acoustical panels that have been tested in compliance with ASTM E 1477 by a recognized testing laboratory, to show a light reflectance rating of not less than the following:
 - a. Light Reflectance: Not less than 0.80.
7. Products and Manufacturers: Provide one of the following:
 - a. Ceramaguard with HumiGuard Max by Armstrong World Industries.
 - b. RADAR Ceramic with ClimaPlus by USG Interiors Incorporated.
 - c. Or equal.

2.3 CEILING SUSPENSION SYSTEMS

- A. General: Comply with ASTM C 635, as applicable to the type of suspension system required for the type of acoustical panel ceiling units specified.
 1. Structural Class, Intermediate-Duty System (Direct Hung): 12.0 minimum to 15.9 maximum, pounds per linear foot of main runners.
 - a. Main Runners: 0.015-inch-thick metal, minimum.
 - b. Cross Tees: 0.015-inch-thick metal, minimum.
 2. Seismic Category: E, F, G.
 3. Seismic Zones: 0 to 4.
- B. Exposed Suspension System: Manufacturer's standard, 15/16-inch wide by 1-1/2-inch high exposed runners, cross-runners and accessories, with exposed cross runners stepped to lay flush with main runners; manufactured from hot-dipped galvanized G90, commercial steel CS Type B, complying with ASTM A 653; double-webbed construction with stainless steel clip end tap feature interlocking with cross tee slots to prevent lateral pull-out.
 1. Finish of Exposed Members: Provide uniform factory-applied finish on exposed surfaces of ceiling suspension system including moldings, trim and accessories.
 - a. Finish: Manufacturer's standard baked enamel finish, white, unless otherwise selected by ENGINEER.

2.4 MISCELLANEOUS MATERIALS

- A. Hangers:
 1. Wire Hangers: Galvanized, soft-temper steel wire complying with ASTM A 641/A 641M, Class C zinc coating, pre-stretched; bare steel diameter of 8-gauge (0.162-inch).
 2. Rod Hangers: Commercial steel complying with ASTM A 510, mild carbon steel; 1/4-inch bare steel rod diameter; hot-dip galvanized in compliance with ASTM A 153/A 153M, Class B-1.
 3. Flat Hangers: Commercial steel sheet complying with ASTM A 366/A 366M; bare steel size of 1-inch by 3/16-inches, minimum, and of lengths shown; hot-dip galvanized in compliance with ASTM A 153/A 153M, Class B-1.

4. Angle Hangers: 2-inch by 2-inch by 1/4-inch, bare steel size, minimum; hot-dip galvanized in compliance with ASTM A 153/A 153M, Class B-1.
 5. Anchors:
 - a. Provide stainless steel components complying with ASTM F 593 and ASTM F 594, Group 1, alloy Type 316 for bolts, and anchors with holes or loops for attaching hangers.
 - b. Comply with ASTM E 488 for concrete inserts, clips, bolts, screws and other devices applicable to the indicated method of structural anchorage for acoustical panel ceiling hangers.
- B. Sheet Metal Edge Molding and Trim: Type and profile shown, or if not shown, manufacturer's standard metal channel molding for edges and penetrations that fit acoustical panel edge details and suspension systems specified; formed from commercial grade sheet steel of same material, color and finish as used for exposed flanges of suspension system members.
1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 2. For circular penetrations in ceiling, provide shop-fabricated edge moldings fabricated to diameter required to fit penetrations exactly.
- C. Acoustical Sealant for Exposed and Concealed Joints: Provide a modified acrylic-latex, non-sag, paintable, non-staining, sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints in building construction as demonstrated by testing representative assemblies according to ASTM E 90 and acceptable for use with UL Design Designations specified.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the conditions under which the acoustical panel ceiling Work is to be performed and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

- A. Concrete Inserts: Provide inserts for incorporation into formwork. Furnish layouts for cast-in-place ceiling support anchors whose installation is specified in other Sections.
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid the use of less-than-half width panels at borders, and comply with accepted Shop Drawing layout.

3.3 INSTALLATION

A. General:

1. As a minimum standard, unless otherwise shown, specified, required by accepted Shop Drawings, or governing authorities having jurisdiction at the Site, install acoustical panel ceilings to comply with CISCA's "Ceiling System Handbook."
2. Where acoustical panel ceilings must resist lateral forces, comply with requirements of governing authorities having jurisdiction at the Site and ASTM E 580.

B. Install suspension systems to comply with ASTM C 636, with hangers supported only from building structural members. Locate hangers near each end and spaced four feet along each carrying channel or direct-hung runners, unless otherwise shown.

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system.
2. Where width of ducts and other obstructions within ceiling plenum produces hanger spacing that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by Reference Standards and publications.
3. Secure wire hangers to ceiling suspension members by looping or wire-tying with a minimum of three tight turns, either directly to structure or to inserts, eye screws, clips or other anchorage devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Connect rod hangers directly to structural members, including additional framing members introduced for ceiling support, by attaching to inserts, eye-screws, or other devices and fasteners that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause hangers to deteriorate or otherwise fail due to age, corrosion or elevated temperatures.
9. Do not connect or suspend steel framing from ducts, pipes or conduit.
10. Sway-brace suspended steel framing with hangers used for support.
11. Space hangers not more than 4 foot-0 inches on centers along each member, supported directly from hangers and provide hangers not more than 8-inches from ends of each member.
12. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from structural members as required for hangers, without attaching top permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.

13. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- D. Arrange acoustical panels and orient directionally-patterned panels in the manner shown on accepted Shop Drawings.
 1. Install acoustical panels in coordination with suspension system, with edges concealed by support of suspension members.
 2. Install acoustical panels with pattern running in one direction.
 3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 4. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings.
 5. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
- E. Install edge moldings and trim of the type shown at edges of each acoustical ceiling area, and at locations where edge of units would otherwise be exposed after completion of the Work.
 1. Sealant Bed: Apply acoustical sealant in a continuous ribbon, concealed on back of vertical legs of molding before fastening to vertical surface.
 2. Secure moldings to building construction by fastening with screw-anchors into the substrate, through holes drilled in vertical leg. Space holes not more than 3- inches from each end and not more than 16-inches on centers along each molding, leveling with ceiling suspension system to tolerances specified.
 3. Miter corners of moldings accurately to provide hair-line joints, securely connected to prevent dislocation.
 4. Do not use exposed fasteners, including blind rivets, on molding or trim.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency:
 1. CONTRACTOR shall engage a qualified independent testing agency, accepted by ENGINEER, to perform quality control testing.
 2. Perform all specified testing in compliance with the requirements of ASTM E 488.
 3. Extent and Testing Frequency: Testing shall take place in successive stages in areas described below. Proceed with installation of acoustical panel ceilings only after results for previously installed hangers comply with requirements.
 4. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion, but no acoustical panels have been installed, perform the following tests:
 - a. Within each test area testing agency will, select one of every ten anchors used to attach hangers to concrete and will test them for 1,140 pounds of tension. It will also select one of every two post-installed

anchors used to attach bracing wires to concrete and will test them for 1,620 pounds of tension.

- b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until twenty consecutively pass and then will resume initial testing frequency.
5. Testing agency shall report test results promptly and in writing to ENGINEER.
6. Where fasteners and anchors are removed and replaced, additional testing shall be performed to determine compliance with specified requirements.

B. Allowable Tolerances:

1. Surfaces to Receive Acoustical Treatment: Free from irregularities and level to within 1/4-inch in 12 feet.
2. Deflection:
 - a. Suspension System Components, Hangers, and Fastening Devices Supporting Light Fixtures, Ceiling Grilles, and Acoustical Units: Maximum deflection 1/360 of the span.
 - b. Deflection Test: ASTM C 635.
3. Allowable Tolerance of Finished Acoustical Ceiling System: Level within 1/8-inch in 12 feet-0 inches.
4. Accessibility Percentage: 100.

3.5 ADJUSTMENT AND CLEANING

- A. Do not proceed with installation of acoustical panels until testing is completed and non-complying fasteners and anchors have been replaced with new material complying with the requirements of these Specifications.
- B. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings and suspension system members. Comply with 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.
- C. Installer shall advise CONTRACTOR and ENGINEER of required protection for the acoustical panel ceilings, including manufacturer's recommended temperature and humidity limitations and dust control, so that the Work will be without damage and deterioration at the time of acceptance by OWNER. CONTRACTOR shall provide required protection.

+ + END OF SECTION + +

SECTION 09 61 53

CONCRETE HARDENER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all concrete hardener Work.
2. The extent of the concrete hardener includes all interior concrete floors not shown or scheduled to be finished with another material.
3. The types of concrete hardener Work required include, but are not necessarily limited to, silicate penetrant.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the concrete hardener Work.
2. Notify other contractors in advance of the installation of the concrete hardener Work to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the concrete hardener Work.

C. Related Sections:

1. Section 03 00 05, Concrete.

1.2 QUALITY ASSURANCE

- A. Installer's Qualifications: Engage a single installer regularly engaged in the installation of concrete hardeners with five years experience in the application of the types of materials required, and who agrees to employ only tradesmen with specific skills and experience in this type of Work. Installer shall meet the requirements of the concrete hardener manufacturer for providing guarantee coverage. Submit name and qualifications to ENGINEER.
- B. Source Quality Control: Obtain all material from only one manufacturer who will send a qualified technical representative to the Site for the purpose of advising the installer of proper procedures and precautions for the use of the material, at no additional cost to the OWNER.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

- a. Copies of manufacturer's specifications, recommendations and installation instructions. Include manufacturer's published data, indicating the material complies with the requirements and is intended for the application shown.
 - b. Submit installer's qualifications in accordance with Article 1.2, above.
- B. Informational Submittals: Submit the following:
 - 1. Certificates: Submit a certificate of coverage signed by a duly authorized representative of the manufacturer.
- C. Closeout Submittals: Submit the following:
 - 1. Maintenance Data: Upon completion of the Work, furnish five copies of detailed maintenance manual including the following information:
 - a. Product name and number.
 - b. Name, address and telephone number of manufacturer and local distributor.
 - c. Detailed procedures for routine maintenance and cleaning.
 - d. Detailed procedure for light repair such as scratches and staining.
 - 2. Guarantee Documentation:
 - a. Submit for approval written guarantee agreeing to replace the concrete hardener should it fail to perform as specified in Article 1.6, below.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded, in ample time to prevent delay of that Work.
 - 2. Deliver materials in concrete hardener manufacturer's original unopened containers.
 - 3. Include the following information on the label:
 - a. Name of material and supplier.
 - b. Formula or specification number, lot number and date of manufacturer.
 - c. Mixing instructions, shelf life and curing time when applicable.
 - 4. Failure to comply with these requirements shall be sufficient cause for the rejection of the material in question, by ENGINEER, and requiring its removal from the Site. In such a case, supply new material conforming to the specified requirements, at no additional cost to OWNER.
 - 5. Handle materials carefully to prevent inclusion of foreign materials.
 - 6. Do not open containers or mix components until all necessary preparatory Work has been completed.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports.

Protect steel members and packaged materials from corrosion and deterioration.

2. Store materials so as to preclude the inclusion of foreign material.
3. Protect material from freezing.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.5 JOB CONDITIONS

A. Environmental Conditions:

1. Do not apply concrete hardener to uncured concrete. Comply with manufacturer's written instructions for minimum ten days of curing time.
2. Apply hardener only when temperature of concrete is 50°F or above.

B. Protection:

1. Do not allow concrete hardener to overflow or spill onto adjoining surfaces.
2. Remove concrete hardener that is splashed on surfaces not designated to receive concrete hardener immediately by flushing with water.

C. Sequencing:

1. Coordinate the Work so that the concrete hardener is installed when best results will be obtained, as recommended by the manufacturer's technical representative.

1.6 GUARANTEE

- A. Provide a five year written guarantee, signed by CONTRACTOR and installer, stating that should concrete floors show signs of dusting because of wear and abrasion they will be re-installed, in the manner specified herein, at no additional cost to OWNER, from the date of Final Acceptance of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete Hardener: Provide a clear, colorless, aqueous solution of chemically active, magnesium, silicates and fluosilicates plus a wetting and penetrating agent, that reacts with the free lime and calcium carbonates to bind soft, loose particles together and form a hard dense vitreous surface which is resistant to chemical attack and the growth of mildew, fungi and other organisms. Use potable water only.

2.2 MANUFACTURERS

- A. Products and Manufacturers: Provide one of the following:
 - 1. MasterKure HD 300WB by Master Builders Solutions Construction Systems US, LLC.
 - 2. Armortop by Anti-Hydro Waterproofing Company.
 - 3. Or equal.

2.3 MIXES

- A. Follow manufacturer's written instructions for the proper mixing, dilution and coverage of each coat.

2.4 FINISH

- A. The finished installation of the concrete hardener shall have a smooth, uniform even finish without discontinuities or discolorations.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the substrates and the conditions under which the concrete hardener Work is to be performed and notify ENGINEER, in writing, of any conditions detrimental to the proper and timely completion of the Work and performance of the concrete hardener. Do not proceed with the concrete hardener Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 SUBSTRATE PREPARATION

- A. Steel trowel concrete in strict accordance with printed directions supplied by the concrete hardener manufacturer.
- B. Provide concrete free of all honeycombing and fins.
- C. Do not use sealers, curing or parting compounds on the concrete.
- D. Provide wet curing only.
- E. Surfaces to receive concrete hardener shall be clean, dry and free of all loose dirt, oil, wax and other foreign matter.

3.3 INSTALLATION

- A. Provide the services of a manufacturer's technical representative for the purpose of advising the installer of proper procedures and precautions for the use of the material prior and during the installation of the concrete hardener.
- B. Apply concrete hardener using the coverage recommended by the manufacturer per coat.
- C. Apply a minimum of three separate coats.
- D. Apply a fourth coat using undiluted material should the manufacturer's technical representative recommend this procedure, based on field conditions, and as directed by ENGINEER.
- E. Apply each coat by spray.
- F. Mop up excess solution or puddles.
- G. After each of the first and second applications, allow the floor to dry until no longer visibly wet.
- H. To avoid the development of crystals, when applying the third coat, flush the surface liberally with clean, hot water. At the same time, brush the floor rapidly with a stiff-bristle broom. Mop up excess water.
- I. Follow manufacturer's written instructions should white crystals develop after the first or second coat. Consult manufacturer's technical representative.

3.4 ADJUSTMENT AND CLEANING

- A. Clean adjacent surfaces of concrete hardener resulting from the Work. Use solvent or cleaning agent recommended by the concrete hardener manufacturer. Leave all finished Work in a clean neat appearance.
- B. Protect the concrete hardener until fully cured.

+ + END OF SECTION + +

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SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and apply paint systems.
 - a. CONTRACTOR is responsible for surface preparation and painting of all new and existing interior and exterior items and surfaces throughout the Project areas included in the general contract and other contracts described in this Section.
2. Extent of painting includes the Work specified below. Painting shown in schedules may not provide CONTRACTOR with complete indication of all painting Work. Refer to Article 2.2 of this Section where all surfaces of generic types specified are specified for preparation and painting according to their status, intended function, and location, using the painting system for that surface, function, and location as specified, unless specifically identified on the Drawings as a surface not to receive specified painting system.
 - a. All new and specifically identified existing surfaces and items except where natural finish of material is specified as a corrosion-resistant material not requiring paint; or is specifically shown as indicated by written note, or specified as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint them the same as adjacent similar materials or areas.
 - b. Surface preparation and painting of all new and specifically identified existing items, both interior and exterior, and other surfaces, including items furnished by OWNER, are included in the Work, except as otherwise shown or specified.
 - c. Removal of all substances, top coats, primers and all intermediate coats of paint and other protective or decorative coatings on those items and surfaces to remain that are identified to receive a painting system under this Section, to provide surfaces acceptable for application of painting specified.

B. Coordination:

1. Review installation, removal, and demolition procedures under other Sections and coordinate them with the Work specified in this Section.
2. Coordinate painting of areas that will become inaccessible once equipment and similar fixed items have been installed.
3. Furnish information to ENGINEER on characteristics of finish materials proposed for use and ensure compatibility with prime coats used. Provide

barrier coats over incompatible primers or remove and repaint as required. Notify ENGINEER in writing of anticipated problems using specified painting systems with surfaces primed by others. Reprime equipment primed in factory and other factory-primed items that are damaged or scratched.

C. Related Sections:

1. Section 07 92 00, Joint Sealants.

D. Work Not Included: The following Work is not included as painting Work, or are included under other Sections or in other contracts:

1. Shop Priming: Shop priming of structural metal, miscellaneous metal fabrications, other metal items and fabricated components such as shop-fabricated or factory-painted process equipment, plumbing equipment, heating and ventilating equipment, electrical equipment, and accessories shall conform to applicable requirements of this Section but are included under other Sections or in other contracts.
2. Pre-finished Items:
 - a. Items furnished with such finishes as baked-on enamel, porcelain, and polyvinylidene fluoride shall only be touched up at Site by CONTRACTOR using manufacturer's recommended compatible field-applied touchup paint.
 - b. Items furnished with finishes such as chrome plating or anodizing.
3. Concealed Surfaces: Non-metallic wall or ceiling surfaces in areas not exposed to view, and generally inaccessible areas, such as furred spaces, pipe chases, duct shafts, and elevator shafts.
4. Face brick, glazed structural tile, and prefaced, ground-faced or split-faced concrete unit masonry.
5. Exterior face of architectural precast concrete.
6. Corrosion-Resistant Metal Surfaces: Where the natural oxide of item forms a barrier to corrosion, whether factory- or Site-formed, including such materials as copper, bronze, muntz metal, terne metal, and stainless steel.
7. Operating Parts and Labels:
 - a. Do not paint moving parts of operating units, mechanical and electrical parts such as valve and damper operators, linkages, sensing devices, interior of motors, and fan shafts.
 - b. Do not paint over labels required by governing authorities having jurisdiction at Site, or equipment identification, performance rating, nameplates, and nomenclature plates.
 - c. Cover moving parts and labels during the painting with protective masking. Remove all protective masking upon completion of Work. Remove all paint, coatings, and splatter that comes in contact with such labels.
8. Structural and miscellaneous metals covered with concrete need not receive primers, intermediate, or finish coats of paint.

E. Description of Colors and Finishes:

1. Color Selection:
 - a. ENGINEER reserves the right to select non-standard colors for paint systems specified within ability of paint manufacturer to produce such non-standard colors. Provide such colors at no additional expense to OWNER.
2. Color Coding of Pipelines, Valves, Equipment, and Ducts:
 - a. Color-coding of pipelines, valves, equipment and ducts shall comply with applicable standards of ANSI A13.1, ANSI Z535.1, CFR 1910.144, Recommended Standards for Water Works, and Recommended Standards for Wastewater Facilities. For piping and equipment not covered by the above standards, conform to OWNER's color standards.
 - b. For equipment located on roofs and equipment that is exposed-to-view, color will be selected by ENGINEER.

1.2 REFERENCES

A. Referenced Standards: Standards referenced in this Section are:

1. ANSI A13.1, Scheme for Identification of Piping Systems.
2. ANSI Z535.1, Safety Color Code.
3. ASTM D16, Terminology for Paint, Related Coatings, Materials and Applications.
4. ASTM D2200, Pictorial Surface Preparation Standards for Painting Steel Surfaces.
5. ASTM D4262, Testing Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
6. ASTM D4263, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
7. ASTM D4541, Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion-Testers.
8. ASTM E329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
9. Great Lakes Upper Mississippi River Board of Public Health and Environmental Managers (GLUMRB) Recommended Standards for Water Works.
10. GLUMRB, Recommended Standards for Wastewater Facilities.
11. Ozone Transport Commission, (OTC), OTC Model Rule for Architectural and Industrial Maintenance Coatings.
12. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
13. SSPC VIS 1, Visual Standard for Abrasive Blast Cleaned Steel.
14. SSPC VIS 2, Method of Evaluating Degree of Rusting/Painted Steel Surfaces.
15. SSPC Volume 2, Systems and Specifications.

1.3 DEFINITIONS

A. Coating terms defined in ASTM D16 apply to this Section.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications:
 - 1. Engage a single applicator regularly performing installation of painting systems, with documented skill and successful experience in installing types of products required and agrees to employ only tradesmen trained, skilled, and with successful experience in installing types of products specified.
- B. Testing Agency Qualifications: Provide independent testing agency with experience and capability to satisfactorily conduct testing specified in accordance with ASTM E329. Testing agency shall be selected by OWNER and paid for by CONTRACTOR.
- C. Source Quality Control:
 - 1. Obtain products from manufacturers that will provide services of a qualified manufacturer's representative at Site at commencement of painting Work to advise on products, mock-ups, installation, and finishing techniques, at completion of the Work to advise ENGINEER on acceptability of completed Work, and during course of Work as requested by ENGINEER.
 - 2. Submit "or equal" products, when proposed, with direct comparison to products specified, including information on durability, adhesion, color and gloss retention, percent solids, VOC's grams per liter, and recoatability after curing.
 - 3. "Or equal" manufacturers shall furnish same color selection as manufacturers specified, including intense chroma and custom pigmented colors in painting systems.
 - 4. Color Pigments: Provide pure, non-fading, applicable types to suit surfaces and services indicated. Comply with the following:
 - a. Lead and Chromate: Lead and chromate content shall not exceed amount allowed by authorities having jurisdiction.
 - b. Through CONTRACTOR, paint manufacturer shall notify ENGINEER of colors that are not suitable for long-term color retention in areas subject to hydrogen sulfide fume exposure.
 - c. Manufacturer shall identify colors that meet requirements of authorities having jurisdiction at Site for use in locations subject to contact with potable water or water that will be treated to become potable.
 - d. Comply with paint manufacturers' recommendations on preventing coating contact with levels of carbon dioxide and carbon monoxide that may cause yellowing during application and initial stages of curing of paint coatings.
- D. Regulatory Requirements:
 - 1. Comply with VOC content limits of Ozone Transport Commission (OTC), Model Rule for Architectural and Industrial Maintenance Coatings.

- E. Pre-Painting Conference:
1. Conduct a pre-painting conference at the Site to review specified requirements. Meeting attendees shall include painting applicator and its foreman, paint manufacturer's technical representative, installers of other work in and around painting that must follow painting Work, ENGINEER, and other representatives directly concerned with performance of painting Work.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Product Data:
 - a. Copies of manufacturer's technical data sheets, including surface preparation, number of coats, dry film thickness, test performance data including paint analysis, VOC and chemical component content in comparison to maximum allowed by the Contract Documents, and application instructions for each product proposed for use
 - b. Submit proof of acceptability of proposed application techniques by paint manufacturer selected.
 - c. Copies of CONTRACTOR's proposed protection procedures in each area of the Work explaining methods of protecting adjacent surfaces from splatter, for confining application procedures in a manner that allows other work adjacent to surface preparation and painting Work to proceed safely and without interruption, and for maintaining acceptable application, curing, and environmental conditions during and after painting systems application.
 - d. List each material and cross-reference to the specific painting system and application, including a list of site-specific surfaces to which painting system will be applied. Identify by manufacturer's catalog number and general classification. State number of gallons of each product being purchased for delivery to Site and square foot area calculated to be covered by each painting system specified based on theoretical loss of 20 percent. Where actual area to be covered by paint system exceeds area submitted to ENGINEER for that system, proof of additional material purchase shall be provided to ENGINEER. Calculated coverage shall be as specified for each component of each painting system specified. This requirement does not take precedence over CONTRACTOR's responsibility to provide dry film thickness required for each component of each painting system.
 - e. Identify maximum exposure times allowable for each paint system component before next coat of paint can be applied. Submit proposed methods for preparing surfaces for subsequent coats if maximum exposure times are exceeded.
 - f. Information on curing times and environmental conditions that affect curing time of each paint system component and proposed methods for accommodating variations in curing time. Identify this information for each painting system in the Work.

- g. Specification for spray equipment with cross-reference to paint manufacturer's recommended equipment requirements.
 - 2. Samples:
 - a. Copies of manufacturer's complete color charts for each coating system.
- B. Informational Submittals: Submit the following:
- 1. Certificates:
 - a. Certificate from paint manufacturer stating that materials meet or exceed Contract Documents requirements.
 - b. CONTRACTOR shall provide notarized statement verifying that all painting systems are compatible with surfaces specified. All painting systems components shall be reviewed by an authorized technical representative of paint manufacturer for use as a compatible system. Verify that all painting systems are acceptable for exposures specified and that paint manufacturer is in agreement that selected systems are proper, compatible, and are not in conflict with paint manufacturer's recommended specifications. Show by copy of transmittal form that a copy of letter has been transmitted to paint applicator.
 - 2. Test Reports:
 - a. Certified laboratory test reports for required performance and analysis testing in compliance with ASTM E329.
 - b. Adhesion testing plan and procedures.
 - c. Results of adhesion testing on existing surfaces containing paints or other coatings to be topcoated with paint systems specified. Prior to adhesion testing, submit a testing plan establishing methods, procedures and number of tests in each area where existing coatings are to remain and become substrate for painting Work. Based on results of adhesion testing, recommend methods, procedures, and painting system modifications, if necessary, for proceeding with Work.
 - d. Locations of and test methods for soil sampling before beginning Work and after Substantial Completion.
 - e. Proposed methods for testing, handling, and disposal of waste generated during Work.
 - f. Results of alkalinity and moisture content tests performed per ASTM D4262 and ASTM D4263.
 - g. Results of film thickness, holidays, and imperfections tests.
 - 3. Manufacturer's Instructions: Provide paint manufacturer's storage, handling, and application instructions prior to commencing painting Work at Site.
 - 4. Manufacturer's Site Reports: Provide report of paint manufacturer's representative for each visit to Site by paint manufacturer's representative.
 - 5. Special Procedure Submittals:
 - a. Proposed protection procedures for each area of Work, explaining methods of protecting adjacent surfaces from splatter, for confining application procedures in a manner that allows other work adjacent to surface preparation and painting Work to proceed safely and without interruption.
 - b. Site-specific health and safety plan.

- c. Procedures for maintaining acceptable application, curing and environmental conditions during and after painting systems application.
 - d. Procedures for providing adequate lighting, ventilation, and personal protection equipment relative to painting Work.
 - 6. Qualifications:
 - a. Applicator.
 - b. Testing laboratory
- C. Closeout Submittals: Submit the following:
- 1. Operations and Maintenance Data: Upon completion of the painting Work, furnish ENGINEER five copies of detailed maintenance manual including the following information:
 - a. Complete and updated product catalog of paint manufacturer's currently available products including complete technical information on each product. Identify product names and numbers of each product used in the painting Work.
 - b. Name, address, e-mail address and telephone number of manufacturer, local distributor, applicator and technical representative.
 - c. Detailed procedures for routine maintenance and cleaning.
 - d. Detailed procedures for light repairs such as dents, scratches and staining.
 - 2. Record Documentaion: Statement of Application: Upon completion of the painting Work, submit a notarized statement to ENGINEER signed by CONTRACTOR and painting applicator stating that Work complies with requirements of the Contract Documents and that application methods, equipment, and environmental conditions were proper and adequate for conditions of installation and use.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Product Delivery Requirements: Deliver products to Site in original, new, and unopened packages and containers, accurately and legibly and accurately labeled with the following:
 - 1. Container contents, including name and generic description of product.
 - 2. Manufacturer's stock number and date of manufacture.
 - 3. Manufacturer's name.
 - 4. Contents by volume, for major pigment and vehicle constituents.
 - 5. Grams per liter of volatile organic compounds.
 - 6. Thinning instructions, where recommended.
 - 7. Application instructions.
 - 8. Color name and number.
- B. Product Storage Requirements:
 - 1. Store acceptable materials at Site.
 - 2. Store in an environmentally controlled location as recommended in paint manufacturer's written product information. Keep area clean and accessible. Prevent freezing of products.

3. Store products that are not in actual use in tightly covered containers.
 4. Comply with health and fire regulations of authorities having jurisdiction at Site.
- C. Product Handling Requirements:
1. Handle products in a manner that minimizes the potential for contamination, or incorrect product catalyzation.
 2. Do not open containers or mix components until necessary preparatory work has been completed and approved by ENGINEER and painting Work will start immediately.
 3. Maintain containers used in storing, mixing, and applying paint in a clean condition, free of foreign materials and residue.

1.7 SITE CONDITIONS

- A. Site Facilities:
1. Supplemental heat sources, as required to maintain both ambient and surface temperatures within range recommended by paint manufacturer for paint system applications, are not available at the Site.
 2. Provision of supplemental heat energy sources, power, equipment, and operating, maintenance, and temperature-monitoring personnel is CONTRACTOR's responsibility.
 3. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas being painted. Properly locate and vent heat sources to exterior so that paint systems and personnel are unaffected by exhaust products.
- B. Existing Conditions:
1. Existing surfaces to receive painting Work shall have their surfaces prepared to meet requirements of painting systems specified. Prior to initiating painting Work, perform adhesion tests on existing surfaces to be painted. Perform testing per ASTM D4541 or other method acceptable to ENGINEER. Number and location of tests shall be sufficient to determine the condition of existing coatings and suitability of existing coatings to remain to provide an acceptable substrate for new coatings. Submit testing plan prior to testing and provide ENGINEER the adhesion test results.
 2. Provide abrasive blasting, scraping, or other abrading or surface film removal, or preparatory techniques accepted by ENGINEER.
 3. Before commencing painting in an area, surfaces to be painted and floors shall be cleaned of dust using commercial vacuum cleaning equipment equipped with high-efficiency particulate air (HEPA) filters and dust containment systems.
- C. Environmental Requirements:
1. Comply with manufacturer's published requirements.
- D. Protection:
1. Cover or otherwise protect finished Work of other trades and those surfaces not being painted concurrently and not to be painted.

2. During surface preparation and painting, facility shall remain in operation. Use procedures that prevent contamination of process or cause or require facility shutdown.
3. Coordinate and schedule surface preparation and painting to avoid exposing personnel to hazards associated with painting Work. Provide required personnel safety equipment per requirements of authorities having jurisdiction at Site.
4. Submit protection procedures to be employed. Do not begin surface preparation and painting Work until ENGINEER accepts protection techniques proposed by CONTRACTOR.
5. When working with flammable materials, provide fire extinguishers and post temporary signs warning against smoking and open flame.

PART 2 - PRODUCTS

2.1 PAINTING SYSTEM MANUFACTURERS

- A. Products and Manufacturers: Where referenced under painting systems, provide painting systems manufactured by the following:
 1. Tnemec Company, Incorporated (TCI).
 2. The Carboline Company, part of StonCor Group, an RMP Company (TCC).
 3. Or equal.

2.2 PAINTING SYSTEMS

- A. New and Existing Surfaces: OTC Compliant; Interior and Exterior:
 1. Surface Preparation: Comply with manufacturer's published recommendations for material and surface condition.
 2. Filler, Surfacer and Patching Compound:
 - a. Products: Provide one of the following:
 - 1) Epoxy-based products, number of coats, and dry film thickness recommended in manufacturer's published data sheets for finish coats and surfaces specified.
 3. Primer/Intermediate:
 - a. Products: Provide one of the following:
 - 1) Epoxy-based products, number of coats, and dry film thickness recommended in manufacturer's published data sheets for finish coats and surfaces specified.
 4. Finish for All Surfaces Except Gypsum Board and Wood; Semi-gloss:
 - a. Generic Components:
 - 1) Minimum 62-percent volume solids, high-build, two-component, polyamide-catalyzed epoxy or polyamido-amine epoxy; 250 grams per gallon VOC, maximum.
 - b. Products and Manufacturers: Provide products of one of the following:
 - 1) Series V69 Hi-Build Epoxoline (TCI); Carboguard 890 Series (TCC, 3.0 to 6.0 dry mils per coat, 107 to 201 square feet per gallon.

5. Wood Finish; Semi-gloss:
 - a. Generic Components:
 - 1) Minimum 36-percent solids, acrylic polymer, 215 grams per liter VOC, maximum.
 - b. Product and Manufacturer: Provide products of one of the following:
 - 1) Series 28/29 Tufcryl (TCI); Carbocrylic 3359 (TCC: Two coats, 2.0 to 3.0 dry mils per coat.
- B. New and Existing Surfaces; Non-Submerged, OTC Compliant; Exterior:
1. Surface Preparation: Comply with manufacturer's published recommendations for material and surface condition.
 2. Shop Primer:
 - a. Products: Provide one of the following:
 - 1) Epoxy-based products, number of coats and dry film thickness recommended in manufacturer's published data sheets for finish coats and surfaces specified.
 3. Intermediate:
 - a. Products: Provide one of the following:
 - 1) Epoxy-based products, number of coats and dry film thickness recommended in manufacturer's published data sheets for finish coats and surfaces specified.
 4. Finish, Metals: Semi-Gloss:
 - a. Generic Components:
 - 1) Minimum 71-percent solids, aliphatic acrylic polyurethane; 220 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide products of one of the following:
 - 1) Series V73 Endura-Shield (TCI); Carbothane 133 LH (TCC); Hi-Solids Polyurethane (SWC): Two coats, 4.0 dry mils per coat.
 5. Finish for All Surfaces Other Than Metals; Semi-Gloss:
 - a. Generic Components:
 - 1) Minimum 40-percent volume solids, waterborne acrylic coating that can fill and bridge minor hairline cracks; 94 grams per liter VOC, maximum.
 - b. Product and Manufacturer: Provide products of one of the following:
 - 1) Series 1029 Enduratone (TCI); Flexxide Elastomer (TCC: One coat, 6.0 dry mils.
- C. New and Existing Surfaces; OTC Compliant; Floor:
1. Surface Preparation: Comply with manufacturer's published recommendations for material and surface condition.
 2. Shop Primer:
 - a. Products: Provide one of the following:
 - 1) Epoxy-based products, number of coats and dry film thickness recommended in manufacturer's published data sheets for finish coats and surfaces specified.
 3. Intermediate:
 - a. Products: Provide one of the following:

- 1) Epoxy-based products, number of coats and dry film thickness recommended in manufacturer's published data sheets for finish coats and surfaces specified.
 - b. Products and Manufacturers: Provide products of one of the following:
 - 1) Series 237 Power-Tread (Double Broadcast), 1/8" DFT or equal.
- 4. Finish:
 - a. Generic Components:
 - 1) Minimum 62-percent volume solids, high-build, two-component, polyamide-catalyzed epoxy or polyamido-amine epoxy; 250 grams per gallon VOC, maximum.
 - b. Products and Manufacturers: Provide products of one of the following:
 - 1) Series 280 Tneme-Glaze (TCI), 10.0 dry mils or equal.

2.3 CALKING AND SEALANTS

- A. Refer to Section 07 92 00, Joint Sealants.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which painting Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.
- B. Do not paint over existing paint where there is no assurance that existing paint will provide an acceptable surface for long-term adherence and durability of painting systems specified, or where paint manufacturer requires removal of all existing paint to recommend use of specified painting system.

3.2 SURFACE PREPARATION

- A. General:
 - 1. Comply with paint manufacturer's published recommendations for products, surface condition, and surface preparation.

3.3 PROTECTION OF PROPERTY AND STRUCTURES

- A. Protect property and structures adjacent to the Work from waste residues resulting from cleaning, surface preparation, and painting Work.
- B. Use shrouding, vacuum blasting, or other acceptable methods for cleaning and surface preparation of exterior surfaces.
- C. During blast cleaning and surface preparation of interior and exterior surfaces, control exhausting of dust and grit using shrouding, negative-pressure

containment/dust collection systems, or other means to protect adjacent property and structures and prevent dust and grit from escaping. Similarly, control removal and temporarily store residues to protect adjacent property and structures.

- D. For painting of exterior surfaces, use rollers, shrouding, or other acceptable methods as required to protect adjacent property and structures from wind-blown paint residues.
- E. Submit proposed procedures for cleaning, surface preparation, and paint application that describe in detail methods to be used to protect adjacent property and structures from residues. Do not proceed with cleaning, surface preparation, or painting until proposed procedures are accepted by ENGINEER.

3.4 MATERIALS PREPARATION

- A. General: Mix and prepare painting products in strict accordance with paint manufacturer's product data sheets.

3.5 APPLICATION

- A. General:
 - 1. Apply paint systems by brush, roller, or airless spray per paint manufacturer's recommendations and in compliance with Paint Application Specifications No. 1 in SSPC Volume 2, where applicable, and in strict accordance with paint manufacturer's product data sheets.
 - 2. Surfaces of items not normally exposed-to-view do not require same color as other components of system of which they are a part, but require same painting system specified for exposed surfaces of system.
 - 3. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint before final installation of registers or grilles.
 - 4. Paint backs of access panels and removable or hinged covers to match exposed surfaces.
 - 5. Omit field-applied primer on metal surfaces that have been primed in the shop. Touch-up paint to shop-primed coats and pre-finished items only when approved by ENGINEER using compatible primers and paint manufacturer's recommended compatible field-applied finishes.
 - 6. Welds shall be stripe-coated with intermediate or finish coat of paint after application of prime coat.
- B. Minimum/Maximum Paint Film Thickness: Comply with manufacturer's published recommendations for coating type and surface.
- C. Scheduling Surface Preparation and Painting: Comply with manufacturer's published recommendations for coating type and surface.

- D. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to result in a finish coat with no burn-through or other defects caused by insufficient sealing.
- E. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.
- F. Brush Application:
 - 1. Brush-out and work all brush coats onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections are unacceptable. Neatly draw all glass and color break lines.
 - 2. Brush-apply all primer or first coats, unless otherwise allowed to use mechanical applicators.
- G. Mechanical Applicators:
 - 1. Use mechanical methods for applying paint when allowed by applicable ordinances, paint manufacturer, and approved by ENGINEER.
 - 2. Limit roller applications, if approved by ENGINEER, to interior wall finishes for second and third coats. Apply each roller coat to provide equivalent hiding as brush-applied coats.
 - 3. Where spray application is used, apply each coat to provide equivalent hiding of brush-applied coats. Do not double back with spray equipment for purpose of building up film thickness of two coats in one pass.
- H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint Work not in compliance with specified requirements as required by ENGINEER.

3.6 FIELD QUALITY CONTROL

- A. ENGINEER reserves right to invoke the following product testing procedure at any time, to a maximum of five times, during field painting Work:
 - 1. CONTRACTOR shall engage service of an independent testing laboratory to sample paints used. Samples of materials delivered to Site shall be taken, identified, and sealed, and certified as to being the material actually applied to surfaces in each area, in presence of CONTRACTOR.
 - 2. A testing laboratory selected by OWNER and paid by CONTRACTOR at no extra cost to OWNER will perform appropriate tests for any or all of the following characteristics:
 - a. Abrasion resistance.
 - b. Apparent reflectivity.
 - c. Flexibility.
 - d. Washability.
 - e. Absorption.
 - f. Accelerated weathering.
 - g. Dry opacity.
 - h. Accelerated yellowness.

- i. Recoating.
 - j. Skinning.
 - k. Color retention.
 - l. Alkali resistance.
 - m. Quantitative materials analysis.
 - 3. If test results show that product being used does not comply with specified requirements, CONTRACTOR may be directed to stop painting and remove non-complying paint; and prepare and repaint surfaces painted with rejected paint with products complying with the Contract Documents.
- B. Notify ENGINEER after completing each coat of paint. After inspection and checking of film thickness, holidays, and imperfections by CONTRACTOR, and after acceptance by ENGINEER, proceed with succeeding coat.
- 1. ENGINEER will witness all testing and shall be notified of scheduled testing at least twenty-four hours in advance.
 - 2. Apply additional coats, if required, to produce specified film thickness and to correct holidays and to completely fill all surface air holes.
- C. For magnetic substrates, measure thickness of dry film nonmagnetic coatings following recommendations of SSPC PA-2. These procedures supplement manufacturers' approved instructions for manual operation of measurement gauges and do not replace such instructions.
- D. Record time, location, number of coats, dry film thickness, holidays, and other imperfections and submit testing results to ENGINEER.

3.7 SCHEDULE

- A. All new and existing exposed surfaces, not prefinished, shall be painted.
- 1. Floors – Refer to 2.2 C.
 - 2. Gypsum Board and Plaster – Refer to 2.2 A.
 - 3. Interior CMU and Concrete – Refer to 2.2 A.
 - 4. Exterior Stucco – Provide concrete stain and sealer.
 - 5. Exterior Concrete – no paint finish.
 - 6. Steel – Refer to 2.2 B.
 - 7. Piping and insulated piping: No paint finish, provide pipe markers.
 - 8. Electrical conduits and miscellaneous fitting: Paint the same color as adjacent wall paint system. Provide paint system compatible with material.
- B. Provide paint system as recommended by paint manufacturer, unless otherwise noted.

3.8 PROTECTION OF NEW FINISHES

- A. Provide "Wet Paint" signs as required to protect newly painted finishes. After completing painting Work, remove temporary protective wrappings provided for protection of the Work and work of other contractors.

3.9 ADJUSTING AND CLEANING

- A. Correct damage to work of other trades by cleaning, repairing or replacing, and repainting, as acceptable to ENGINEER.
- B. During progress of the Work, remove from Site all discarded paint products, rubbish, cans, and rags at end of each workday.
- C. Upon completion of painting, clean paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- D. At completion of Work of other trades, touch-up and restore all damaged or defaced painted surfaces as determined by ENGINEER.

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SECTION 10 14 00

SIGNAGE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install signage.
 - a. Under this Section, each prime contractor shall provide signage for their own Contract, in accordance with the Contract Documents.
2. Extent of signage is shown and specified.
3. Types of products required include the following:
 - a. Room identification, information, entry and directional signs.
 - b. Health, safety, warning, floor loading and fire extinguisher location signs.
 - c. Pipe markers, tags, and equipment nameplates.
 - d. Site entry, directional and information signs.
 - e. Stainless steel fasteners, supports, very-high-bond high-performance mounting tape, primers and other accessories.

B. Coordination:

1. Coordinate adhesives and fasteners with mounting surfaces. Review other Sections to ensure compatibility of signage mounting accessories with various surfaces on which signage will be installed.
2. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before signage Work.
3. Notify other contractors in advance of installing signage to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before signage Work.

C. Related Sections:

1. Section 03 00 05, Concrete.
2. Section 09 91 00, Painting.
3. Section 31 23 05, Excavation and Fill.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AA DSA-45, Designation System for Aluminum Finishes.
2. ASME A13.1 Scheme for the Identification of Piping Systems.
3. ANSI/ICC A117.1, Accessible and Usable Buildings and Facilities.
4. ANSI Z535.1, Marking Physical Hazards Safety Color Code.
5. ANSI Z535.2, Environmental and Facility Safety Signs.
6. ANSI Z535.3, Criteria for Safety Symbols.
7. ASTM B26/B26M, Specification for Aluminum-Alloy Sand Castings.

8. ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.
9. ASTM E527, Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS).
10. CDA, Properties of Cast Copper Alloys.
11. NFPA 704, System for the Identification of the Hazards of Materials for Emergency Response.
12. UL 924, Safety of Emergency Lighting and Power Equipment.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 1. Signage Manufacturers:
 - a. Engage firms specializing in producing types of products specified, in compliance with the Contract Documents, with documented record of successful in-service performance, and that possess sufficient production capacity to avoid delaying the Work.
 - b. Submit to ENGINEER name and experience record of manufacturers.
- B. Component Supply and Compatibility:
 1. Obtain each separate type of signage from a single Supplier and from a single manufacturer.
- C. Regulatory Requirements: Comply with applicable requirements of the following:
 1. OSHA, 29 CFR Part 1910.1200, Hazard Communication Standard.
 2. OSHA, 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances.
 3. OSHA, 29 CFR Part 1910.144, Safety Color Code for Marking Physical Hazards.
 4. OSHA, 29 CFR Part 1910. 145, Specification for Accident Prevention Signs and Tags.
 5. United States Access Board, Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines.
 6. Americans with Disabilities Act (ADA), Public Law 101-36, 28 CFR Part 36, Appendix A, Accessibility Guidelines for Buildings and Facilities (ADAAG), relative to characters and symbols contrast only.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Schedule of all signage required for the Work, indicating signage type location, and other information to demonstrate compliance with the Contract Documents.
 - b. Fabrication and erection information for each type of signage
 - c. Valve schedule for small-diameter valves, in accordance with this Section.

- d. Complete, camera-ready, color graphic layouts of custom- designed signs based on specified requirements and manufacturer recommendations.
- e. Complete selection of each specified manufacturer's standard and custom graphic layouts and pictograms, colors, and alphabetic/text styles.
- f. Full-size graphic layout drawings for plaques, individual dimensional letters and numbers, and other items where final graphic appearance is necessary prior to signage fabrication, incorporating all required graphic features specified or shown.
- g. Mounting and Installation Data:
 - 1) Drawings of and information on anchorages and accessory items.
 - 2) Submit location template drawings for items supported or anchored to permanent construction.
 - 3) Coordinate mounting position, method, and proposed mounting accessories and fasteners with actual Project conditions. Indicate required mounting accessories on plan drawings showing locations of required exit signs based on measurements taken at the Site. Show final location and identify type of mounting surface for each exit sign. Coordinate location of exit signs for non-interference with other Work and as required by authorities having jurisdiction.
- 2. Product Data:
 - a. Copies of manufacturer's technical data, including catalog information and specifications, for each product specified.
- 3. Samples:
 - a. Each color and finish of exposed materials and accessories required for signage.
 - b. Sample Signage:
 - 1) Full-size Sample of each type of permanent room and space identification sign, and informational and directional sign incorporating all features specified.
 - 2) Full-sized Sample of each type (such as snap-on, strap-on, and adhesive) of pipe marker proposed for use with mounting accessories.
 - 3) Full-sized Sample equipment nameplate, valve tag, pipe tag, and accessories. Stamp valve tag with information shown on valve schedules. When not indicated in the Contract Documents, information on the type of coding system will be furnished to CONTRACTOR by ENGINEER.
 - 4) Full-sized Sample right-to-know signs, labels and tags.
- B. Informational Submittals: Submit the following:
 - 1. Manufacturer's Instructions:
 - a. Templates for anchorages to be installed in concrete or masonry.
 - b. Manufacturer's instructions and recommendations for support and foundations of signs installed outdoors.

- C. Closeout Submittals: Submit the following:
 - 1. Warranty Documentation:
 - a. General and special warranties required under this Section.

1.5 WARRANTY

- A. General Warranty: The special warranty specified for each type of sign in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents. The obligations of CONTRACTOR under the Contract Documents shall not be limited in any way by the provisions of the specified special warranty.
- B. Special Warranty on Products:
 - 1. Provide each signage manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct, or at option of OWNER, remove or replace materials specified in this Section found to be defective during a period of five years after the date of Substantial Completion.
 - 2. Special warranty shall cover defective Work that includes, but is not limited to, the following:
 - a. Deterioration of metal and polymer finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image colors and sign lamination.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. General:
 - 1. Details shown or indicated for signage, such as alpha-numeric and text type representation, letter spacing, designs of borders, and other graphic features, are generic and intended only to establish text, general positions, and symbols.
 - 2. Colors shall be brilliant, distinctive shades, matching the safety colors specified in ANSI Z535.1 and OSHA 1910.144.
 - 3. Permanent rooms and spaces, and directional and informational signage where specified as accessible to people with disabilities, shall comply with ANSI/ICC A117.1 and ADA-ABA Accessibility Guidelines.
 - 4. Accident prevention signs and tags shall comply with OSHA 1910.145.
 - 5. Health, safety, and warning signs shall comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, OSHA 1910.144, and 1910.145, unless otherwise shown or indicated. Colors shall be as indicated in Table 1 of ANSI Z535.1. In addition to text, safety symbol pictograms shall be incorporated into each sign.

2.2 PANEL SIGNS – ROOM IDENTIFICATION, INFORMATION, ENTRY, AND DIRECTIONAL

- A. Products and Manufacturers: Provide one of the following:
 - 1. Graphic Blast MP and FG ADA System and Custom Design ADA Series, by Best Sign Systems, Inc.
 - 2. Blast Etched Fiberglass and Blast Etched Melamine Signs, by Visigraph Corporation.
 - 3. Or equal.
- B. Panel Signs – Room Identification, Information, Entry, and Directional:
 - 1. Product Description: Provide unframed signs, surface-etched, 1/32-inch raised tactile lettering and pictograms, sandblasted on an opaque sheet.
 - 2. Materials:
 - a. Interior Signs: Three-ply, self-extinguishing melamine plastic.
 - b. Exterior Signs: One-piece fiberglass.
 - 3. Size and Thickness: 0.125-inch thick; eight inches by eight inches with 1/2-inch radiused corners.
 - 4. Graphics and Text: White, Standard Helvetica Medium characters and matching arrow type-face; upper and lower case letters, one-inch high capitals and, in addition, Grade 2 Braille alphabet for room designation, directional, entry, and information signs.
 - 5. Colors and Contrast: Background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast by at least 70 percent with their background as determined by ADA formula in ADAAG Appendix A4.30.5.

2.3 PANEL SIGNS – HEALTH, SAFETY, WARNING, FLOOR LOADING, AND FIRE EXTINGUISHER LOCATION

- A. Product Description: Provide rigid fiberglass reinforced plastic signs with fade-resistant embedded graphics.
- B. Products and Manufacturers: Provide one of the following:
 - 1. Graphic Blast Word and Picture Series, by Best Sign Systems, Inc.
 - 2. Blast Etched Fiberglass Signs, by Visigraph Corporation.
 - 3. Or equal.
- C. General:
 - 1. Size and Thickness: 0.125-inch thick; 10 inches by 14 inches, unless otherwise shown or indicated.
 - 2. Graphics and Text: Standard Helvetica Medium characters and matching arrow type-face; upper and lower case, one-inch high capitals and, in addition, Grade 2 Braille alphabet message designations and other text.
 - 3. Exposure: As recommended by sign manufacturer for both indoor and outdoor use and with an upper service temperature limit of 190degrees F. Average durability for outdoor use shall be 15 years.

- D. Safety Instruction Signs: Standard color of sign background shall be white; panel shall be green with white letters and numbers. Letters and numbers used against white background shall be black.
- E. Caution Signs: Standard color of sign background shall be yellow; panel shall be black with yellow letters and numbers.
- F. Danger Signs: Standard color of sign background shall be white; panel shall be black with red insert with white letters and numbers. Letters and numbers used against white background shall be black.
- G. Warning Signs: Standard color of sign background shall be orange; panel shall be black with orange insert with black letters and numbers. Letters and numbers used against orange background shall be black.
- H. No Smoking Signs: Standard color of sign background shall be white. Letters and numbers used against white background shall be red.
- I. Biohazard Signs: Standard color of sign background shall be white; panel shall be black with white letters. Sign shall include red international biohazard pictogram on white background.
- J. Floor Loading Signs: Standard color of sign background shall be white; panel shall be blue with white letters and numbers. Letters and numbers used against white background shall be black.
- K. Fire Extinguisher Location Signs (surface-mounted units only): Standard color of sign background shall be red with white letters and numbers. Each sign shall include international fire extinguisher pictogram and directional arrow indicating location of fire extinguisher.
- L. Auxiliary Products:
 - 1. Mounting Brackets: Provide sign manufacturer's standard mounting brackets for installing projected or double-sided signs.

2.4 PIPE MARKERS

- A. Description:
 - 1. Provide pipe markers for each pipeline provided under the Contract, and for other piping indicated to receive pipe markers.
- B. Products and Manufacturers: Provide one of the following:
 - 1. Custom High Performance Pipe Markers (B-689), and SnapOn and StrapOn Pipe Markers (B-915), by Brady Worldwide, Inc., Signmark Division.
 - 2. Custom Ultra-Mark High Performance Pipe Markers, by Seton Identification Products, a Tricor Direct Company.
 - 3. Or equal.

C. Pipe Markers:

1. Lettering of Titles/Legend and Color Field Size:

- a. Letter size and color field length shall be as indicated in Table 10 14 00-A of this Section:

**TABLE 10 14 00-A, PIPE MARKERS:
SIZE OF TEXT AND COLOR FIELD**

Outside Diameter of Pipeline or Covering* (inches)	Size of Text (Legend Characters)	Minimum Length of Color Field**
3/4 to 1.25	1/2-inch	8 inches
1.5 to 1-7/8	3/4-inch	8 inches
2 to 5-7/8	1.25-inch	12 inches
6 to 9-7/8	2.5-inch	24 inches
10 and Larger	3.5-inch	32 inches
*Outside diameter includes pipe diameter plus insulation and jacketing. **Length of sign and color field shall be as required to accommodate required legend, and shall not be less than minimum length indicated unless required otherwise by space constraints.		

- b. Text and symbols shall be Standard Helvetica Medium, all upper case. Pipe markers shall include text with separate arrow signs indicating direction of flow of pipeline contents. Pipe markers with arrows shall be located as specified in Part 3 of this Section.
- c. Pipe markers indicating pipeline contents shall identify pipeline contents by complete name, as indicated in Table 10 14 00-B of this Section. Obtain from ENGINEER interpretation of required pipe marker text for pipelines provided under the Project that are not listed in Table 10 14 00-B of this Section.

2. Pipe Marker Materials:

- a. General: The following are applicable to all types of pipe markers furnished under this Section:
- 1) Provide pipe markers with ultraviolet light-resistant, sealed, subsurface color graphics, recommended by sign manufacturer, suitable for both indoor and outdoor use.
 - 2) Pipe markers shall be resistant to abrasion, chemical reagents, and physical agitation such as washdowns and wind.
 - 3) Provide manufacturer's full selection of standard and custom sizes and graphics.
 - 4) Where manufacturer has established minimum order quantities for custom units provide minimum order quantities at no additional cost to OWNER.
- b. Materials: Provide the following at CONTRACTOR's option, suitable for outside diameter of the associated pipe and pipe covering:
- 1) Adhesive, Wrap-Around Pipe Markers: Adhesive pipe markers shall be coiled construction, 0.006-inch total thickness, PVF over laminated polyester, with peel-off backing. Suitable for service temperature ranging from -40 degrees F to 230 degrees F.

- 2) Snap-on Pipe Markers: Snap-on pipe markers shall be cylindrically coiled, printed plastic sheets. Pipe marker total thickness for pipe and pipe covering from 3/4-inch to 2-3/8-inch outside diameter shall be not less than 0.020-inch. Pipe marker total thickness for pipe and pipe covering from 2.5-inch through six-inch outside diameter shall be not less than 0.030-inch. Suitable for service temperature ranging from -40 degrees F to 180 degrees F.
 - 3) Strap-on Pipe Markers: Provide strap-on pipe markers where pipe diameter is large enough to preclude overlap of pipe marker material around the circumference of the pipe. Strap-on pipe markers shall be flat, printed plastic sheets, not less than 0.020-inch total thickness, constructed to be attached to the pipe with bands. Suitable for service temperature ranging from -40 degrees F to 180 degrees F. Provide each pipe marker with two 1/4-inch wide band straps of nylon, plastic, or stainless steel, lengths as required by circumference of pipe and pipe covering. Provide manufacturer's recommended banding tools for banding.
3. Pipe marker colors shall comply with ASME A13.1, unless otherwise indicated.

2.5 EQUIPMENT NAMEPLATES

A. Description:

1. Provide equipment nameplate for each equipment item furnished under the Contract, and for other equipment items indicated to receive nameplates. Equipment nameplates specified in this Article are in addition to equipment manufacturer's standard nameplate with manufacturer name, model number, serial number, and similar information.
2. Install equipment nameplates as indicated in Part 3 of this Section. Mechanically fasten equipment nameplates to the associated equipment item.

B. Products and Manufacturers: Provide one of the following:

1. Brady-Etch Stainless Steel ID Tags (B-748) custom engraved, by Brady Worldwide, Inc.,
2. Custom Screenprinted Nameplates – Stainless Steel, by Seton Identification Products, a Tricor Direct Company
3. Or equal.

C. Equipment Nameplates:

1. Material: Type 304 or Type 316 stainless steel with 0.0015-inch thick black enamel background or black screenprinted background, 26-gage thick with rounded corners. Provide nameplates with screenprinted background installed outdoors with acrylic overcoat. Suitable for temperatures ranging from -40 to 89 degrees C.
2. Provide each equipment nameplate with not less than two holes, each approximately 3/16-inch diameter, for mechanically fastening nameplate to the associated equipment. Provide appropriate stainless steel fasteners.

3. Nameplate Size:
 - a. Size shall be as required for required text, and shall be not less than one-inch by four inches.
4. Text Engraved on Nameplates:
 - a. Text Size: Equipment nameplate titles shall have text as large as possible to fit on nameplate; text shall be not less than 1/2-inch high. All text on a given nameplate shall be one size.
 - b. Text and symbols shall be Standard Helvetica Medium, all upper-case.
 - c. Left-justify multiple lines of text
 - d. Where more than one item of the same type of equipment is furnished, consecutively number each associated equipment nameplates as shown or indicated; for example "Pump No. 1", "Pump No. 2", "Pump No. 3", and so on.
5. Provide nameplates for all mechanical, HVAC and plumbing equipment.

2.6 VALVE TAGS

- A. Products and Manufacturers: Provide one of the following:
 1. Custom Engraved Stainless Steel Valve Tags, by Brady Worldwide, Inc.
 2. Custom Stainless Steel Valve Tags, by Seton Identification Products, a Tricor Direct Company
 3. Or equal.
- B. Metal Tags:
 1. For each valve and for pipelines smaller than 3/4-inch outside diameter, provide permanently-legible, round metal tags, each two-inch diameter, Type 304 or Type 316 stainless steel, with engraved lettering filled with black enamel. Provide tags with 3/16-inch diameter hole located that does not interfere with legend.
 2. Legend for Valve Tags:
 - a. Based on information provided on the Drawings, submit to ENGINEER not less than (--1--) days before system startup, a valve schedule indicating all required valves.
 - b. For each valve, the valve schedule shall indicate: location, valve type, valve number, words to identify valve's function, type of operator, and normal operating position.
 - c. Information presented in the valve schedules shall be coded on tags in a system provided by or acceptable to OWNER. Each valve shall be coded and identified by ENGINEER utilizing a combination of up to twelve letters and numbers.
 3. Legend for Small Pipeline Tags: Comply with requirements for pipe markers relative to legend. Where legend is not indicated, obtain interpretation from ENGINEER.
 4. Miscellaneous Valve and Small Pipeline Tag Accessories:
 - a. Stainless Steel Wire: Nylon-coated; 0.048-inch outside diameter.
 - b. Clamps: Brass.
 - c. Lead Seals: Monel; four ply, 0.014-inch by 10 inches long; for attaching tags.

- d. Hand Sealing Press: As recommended by tag manufacturer for crimping lead seals.

2.7 PANEL SIGNS – RIGHT-TO-KNOW LABELS, SIGNS, AND TAGS

- A. Products and Manufacturers: Provide one of the following:
 - 1. Custom B-302 Pressure Sensitive Polyester Right-To-Know Labels, B-120 Fiberglass Chemical Tank Signs, Front No. 1/Back No. 1 B-851 Right-To-Know Accident Prevention Tags and Right-To-Know Pictograms, by Brady Worldwide, Inc.
 - 2. Right-to-Know & HazCom Signs, Labels, and Tags, by Seton Identification Products, a Tricor Direct Company.
 - 3. Or equal.
- B. General:
 - 1. Right-to-know signs, labels, and tags shall use NFPA 704 “diamond” hazard identification systems and shall comply with OSHA 1910.1200 and OSHA Subpart Z.

2.8 PANEL SIGNS – SITE ENTRY, DIRECTIONAL, AND INFORMATION

- A. Products and Manufactures: Provide one of the following:
 - 1. Series 820 Post and Panel Signs, by ASI Sign Systems, Inc.
 - 2. Custom Post and Panel Signs, by Andco Industries Corporation.
 - 3. Or equal.
- B. Fiberglass sheets, not less than 1/8-inch thick, bonded to extruded aluminum internal structure, to form a seamless monolithic sign panel. Provide the following:
 - 1. Posts: Four-inch diameter, 6063-T52 alloy extruded aluminum posts, notched to receive sign panel. Provide posts to height of six feet above finished grade and extending below ground to extent shown or indicated.
 - 2. Finish: Two coats of colored polyurethane and one coat of clear polyurethane; factory-applied to posts and sign panels. Provide complete selection of manufacturer's standard and custom colors.
 - 3. Graphics: Subsurface, photo-mechanically incorporated utilizing an integral graphic process.
 - 4. Color: ENGINEER will select maximum of three colors, in addition to white and black. All colors and OWNER logo, in addition to white and black, will appear on each sign.

2.9 AUXILIARY MATERIALS

- A. Very-High-Bond High-Performance Bonding Tape:
 - 1. Provide all surface-mounted signage with very-high-bond foam tape backing except where specified as requiring mechanical fasteners.
 - 2. Products and Manufacturers: Provide one of the following:

- a. Scotch Brand (Very-High-Bond) 4942 VHB Double Coated Acrylic Foam Tape and No. 94 Acrylic Primer, by 3M Industrial Tape and Specialties Division.
 - b. Or equal.
- 3. Provide a very-high-bonding pressure sensitive joining system consisting of double-coated conformable acrylic foam tape and release liners.
- 4. Thickness: 0.045-inch.
- 5. Tape Width: 1.5 inches.
- 6. Color: Dark gray.
- 7. Bonding Adhesive: Acrylic; very-high-bond, solvent and shear resistance.
- 8. Primer: High-performance tape manufacturers recommended acrylic primer.
- B. Fasteners: Provide fasteners of non-magnetic stainless steel of size and type required and recommended by the associated individual signage manufacturer.
- C. Anchors and Inserts: Provide nonferrous metal or hot-dipped galvanized anchors and inserts. Provide toothed stainless steel or lead expansion bolts for drilled-in-place anchors.
- D. Mounting Brackets:
 - 1. Provide manufacturer's standard mounting brackets for each of the following sign types: hanging, projected, double-sided.
 - 2. Provide inserts, and mechanical and adhesive anchoring devices as specified in this Article for installation of signage.

2.10 FABRICATION

- A. Shop Assembly:
 - 1. Fabricate and preassemble items in the shop to the greatest extent possible.
 - 2. Disassemble units only to extent necessary for shipping and handling limitations.
 - 3. Clearly mark units for reassembly and coordinated installation.

2.11 SOURCE QUALITY CONTROL

- A. Fabrication Tolerances:
 - 1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within tolerance of plus or minus 1/16-inch measured diagonally across each sign.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine substrates and conditions under which signage will be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely

completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:

1. Location:
 - a. Install signage and appurtenances at the locations shown or indicated. When locations are not shown or indicated, install signage at locations directed by ENGINEER.
 - b. Provide exit signs at locations shown or indicated. Surface-mount signs above each point of egress, unless otherwise shown or indicated.
 - c. Lightly mark and locate position of each sign. Obtain ENGINEER's acceptance of marked locations before mounting.
2. Installation – General:
 - a. Install signs level, plumb, and at proper height.
 - b. Signage shall be securely mounted with concealed, very-high-bond acrylic foam tape, specified adhesives, or mechanical fasteners where specified. Attach signs to surfaces in accordance with sign manufacturer's instructions, unless otherwise shown or indicated.
 - c. Provide very-high-bond acrylic foam tape on back of signage using a full perimeter of specified tape. Leave no gaps in tape perimeter at back of signage; peel off second release liner and press onto surfaces.
3. Repair or replace damaged units.

B. Panel Signs – Room Identification, Directional, and Information Signs:

1. Where permanent identification is provided for rooms and spaces, install signs on the wall adjacent to the latch side of the door.
2. Where there is no wall space on the latch side of the door, including at double leaf doors, install signs on the nearest adjacent wall.
3. Mounting height shall be in accordance with ADA-ABA Accessibility Guidelines in areas accessible to disabled people. For other areas install signs with five feet from the finished floor to centerline of sign. Mount such signage so that a person may approach within three inches of the sign without encountering protruding objects or, when reading sign, be forced to stand within the swing of a door.

C. Pipe Markers, Equipment Nameplates, and Valve Tags:

1. Location of Pipe Markers and Pipe Tags:
 - a. Provide pipe markers with text (pipeline contents or service) and adjacent arrow indicating the direction of flow of pipeline contents on each piping system provided under the Project and other piping systems shown or indicated as to receive pipe markers.
 - b. Locations: Provide pipe markers at each of the following locations:
 - 1) At intervals of not more than 30 linear feet apart
 - 2) Directly adjacent to each side of each penetration by the pipeline of the following: wall, floor, ceiling, roof.
 - 3) Adjacent to each change in flow direction.

- 4) On each branch where pipes connect together including but not limited to tees, wyes, and crosses.
 - 5) Adjacent to each side of each valve (including but not limited to check valves, isolation valves, control valves, and other valves), strainer cleanouts, and each equipment item along the pipeline.
 - 6) Comply with ASME A13.1.
 - c. Provide flow-direction arrows at intervals not greater than 15 linear feet. Where flow may be bi-directional, provide arrows adjacent to each other to indicate both directions.
 - d. Pipe marker locations will be determined by ENGINEER, but in general place pipe markers where personnel view of label is unobstructed. When pipeline is overhead, install label on the two lower quarters of the pipe or pipe covering. Pipe markers shall be clearly visible from personnel operating positions, especially operating positions adjacent to valves and equipment.
 - e. Provide pipe tags, where specified, at locations as specified for pipe markers.
 - 2. Location of Valve Tags and Valve Nameplates:
 - a. Valve nameplates and valve signs for large valves shall be located on or adjacent to the valve.
 - b. For smaller valves, attach tags to valve bonnet or valve flange bolts.
 - c. For valves to receive equipment nameplates, as specified in this Section, install nameplate as required for other equipment nameplates.
 - d. Do not attach tags, nameplates, or signs to valve handwheels or other valve actuators.
 - 3. Equipment Nameplates:
 - a. Locate nameplates on equipment bases and on structures at readily-visible elevation in such positions relative to the equipment and structures as to prevent damage to nameplate.
 - b. Position nameplate for ease of reading by operations and maintenance personnel.
- D. Panel Signs – Right-To-Know Signs, Labels, and Tags:
- 1. Locate tags at intervals of not more than 20 feet center-to-center along chemical pipelines and fill pipelines and on each side of locations where pipelines emerge from penetrations with other materials.
 - 2. Install tank signs on each tank shown or indicated to receive signage at quarter-points on tank circumference, five feet above finished floor.
- E. Panel Signs – Site Entry, Directional, and Information Signs:
- 1. Install posts to concrete footings in accordance with sign manufacturer's written instructions. Refer to Sections 03 00 05, Concrete, and Section 31 23 05, Excavation and Fill.
 - 2. Attach sign panels to posts in accordance with sign manufacturer's written instructions.

3.3 SCHEDULE

- A. Provide the following signage:
 - 1. Room sign at each door entering a room.
 - 2. Room sign on boths of communicating or pass through room.
 - 3. Identifaction sign are each fire extinguisher and eye wash and shower statons.
 - 4. First Aid Kit location sign at entry to facility.
 - 5. Handicap entry graphic with arrow at exterior entry indicating locationof HC entry.
 - 6. Graphic restroom signs on restroom / toilet doors.
 - 7. No smoking sign at entry / exit to facility.
 - 8. NFPA chemical hazard signage as recommended and requied by NFPA.
- B. Provide additional signage with text and graphics as directed by Owner or Engineer.
 - 1. Cautious Signage: 5 signs.
 - 2. Danger Signage: 5 signs.
 - 3. Notice Signage: 5 signs.
 - 4. Warning Signage: 5 signs.

3.4 PROTECTION AND CLEANING

- A. After installation, clean soiled signage surfaces in accordance with manufacturer's written instructions.
- B. Clean existing plaques and cut leetrer at entry to facility. Use low voc, non-toxic cleaners. Remove tarnish and stains. Provide clear sealer as recommended for material.
- B. Protect signage from damage until completion of the Work.

+ + END OF SECTION + +

SECTION 10 28 05

TOILET AND BATH ACCESSORIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install toilet and bath accessories Work.
2. Extent of toilet and bath accessories is shown and specified.
3. Types of products required include the following:
 - a. Paper towel dispensers.
 - b. Paper towels.
 - c. Waste receptacles.
 - d. Sanitary napkin disposal units.
 - e. Sanitary napkin tampon dispenser/disposal units.
 - f. Toilet tissue dispensers.
 - g. Toilet seat tissue dispensers.
 - hi. Mirrors.
 - i. Grab bars.
 - j. Soap dispensers.
 - k. Combination shelf with utility hook and mop strips.
 - l. Pail hooks.
 - m. Towel and robe hooks.
 - n. Shower stall seats.
 - o. Shower curtain rods and hooks.
 - p. Soap dishes.
 - q. Miscellaneous fasteners, accessories and trim as required for a complete and functioning installation.

B. Coordination:

1. Furnish inserts and anchoring devices to be set in concrete or built into masonry and recycled gypsum wallboard for installation of toilet and bath accessories. Refer to concrete and masonry Specifications for installation of inserts and anchorage devices.
2. Coordinate toilet and bath accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of toilet and bath accessories
3. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before toilet and bath accessories Work.

4. Notify other contractors in advance of installing toilet and bath accessories to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before toilet and bath accessories Work.
- C. Related Sections:
1. Section 03 00 05, Concrete
 2. Section 04 05 05, Unit Masonry Construction.
 3. Section 08 71 00, Door Hardware.
 4. Section 09 26 16, Gypsum Wallboard Assemblies
 5. Section 09 30 13, Ceramic Tiling.

1.2 REFERENCES

- A. Standards referenced in this Section are:
1. ANSI/ICC A117.1, Accessible and Usable Buildings and Facilities.
 2. NFPA 70, National Electric Code.

1.3 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
1. Provide products of the same manufacturer for each type of bath accessory unit and for units exposed in the same areas.
- B. Regulatory Requirements:
1. Comply with the following:
 - a. Building code specified in Section 01 42 00, References.
 - b. Requirements of authorities having jurisdiction.
 - c. ANSI/ICC A117.1.
 - d. Americans with Disabilities Act of 1990 (Public Law 101-336), Appendix A, to 28 CFR Part 36 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Schedule of toilet and bath accessories indicating proposed location for each item.
 2. Product Data:
 - a. manufacturer's published literature, technical data, and specifications for each toilet and bath accessory item.
 3. Samples:
 - a. Standard and custom color charts for color selection by ENGINEER. Submit for each item under this Section where color or finish is not specified.
- B. Informational Submittals: Submit the following:
1. Manufacturer's Instructions:

- a. Setting drawings, templates, instructions, and directions for installing anchorage devices in other work.
- b. Instructions for storing and installing materials furnished, including printed statement of costs for each recycled material.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. General:
 1. Components and materials shall be suitable for their intended use and environment.
 2. Stamped names or labels on exposed faces of units are unacceptable.
 3. Provide locks with the same keying for each type of toilet and bath accessory units in the Project, where possible. Furnish two keys for each lock.
 4. Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SURFACE-MOUNTED PAPER TOWEL DISPENSER

- A. Products and Manufacturers: Provide one of the following:
 1. No. 0210, by American Specialties, Inc.
 2. B-262, by Bobrick Washroom Equipment, Inc.
 3. Or equal.
- B. Requirements:
 1. Size to dispense not less than 400 c-fold towels with interchangeable paper drop.
 2. Construction: Cabinet and door not less than 22-gage stainless steel, No. 4 satin finish, all-welded construction, without mitered corners. Hang door with concealed, full-length stainless steel piano hinge
 3. Provide with tumbler-lockset.

2.3 SURFACE-MOUNTED WASTE RECEPTACLE

- A. Products and Manufacturers: Provide one of the following:
 1. No. 0826, by American Specialties, Inc.
 2. B-275, by Bobrick Washroom Equipment, Inc.
 3. Or equal.
- B. Construction: Fabricated from not less than 22-gage stainless steel, No. 4 satin finish, all-welded construction, without mitered corners. Top and bottom hemmed, interior liner hooks, 12-gallon capacity.

2.4 SURFACE-MOUNTED SANITARY NAPKIN DISPOSAL UNIT

- A. Products and Manufacturers: Provide one of the following:
 - 1. No. 0473-A by American Specialties, Inc.
 - 2. No. B-254 by Bobrick Washroom Equipment, Inc.
 - 3. Model 4722-15 by Bradley Corporation.
 - 4. Or equal.
- B. Requirements:
 - 1. Fabricate disposal units from not less than 22-gage stainless steel, with flange of one-piece seamless construction without metered corners.
 - 2. Provide self-closing upper door equipped with full-length stainless steel piano hinge and lift handles on each end.
 - 3. Trap door shall have hidden stainless steel spring tensioned self-catching lock and be hinged on front face. Provide fold-down stainless steel purse shelf of 22-gage stainless steel.

2.5 TOILET TISSUE DISPENSERS

- A. General: Provide toilet tissue dispensers at each water closet.
- B. Products and Manufacturers: Provide one of the following:
 - 1. No. 0697-GAL, by American Specialties, Inc.
 - 2. B-2840, by Bobrick Washroom Equipment, Inc.
 - 3. Model 5263, by Bradley Corporation.
 - 4. Or equal.
- C. Multi-roll Toilet Tissue Dispenser: Fabricate shelf of not less than 18-gage stainless steel, to store and dispense not less than two 4.5-inch by 4.5-inch core tissue rolls. Fabricate flange from a single piece, with seamless construction.

2.6 TOILET SEAT TISSUE DISPENSERS

- A. General: Provide surface-mounted toilet seat tissue dispenser at each water closet.
- B. Products and Manufacturers: Provide one of the following:
 - 1. No. 0477-SM, by American Specialties, Inc.
 - 2. B-221, by Bobrick Washroom Equipment, Inc.
 - 3. Model 583, by Bradley Corporation.
 - 4. Or equal.
- C. Surface-mounted Toilet Seat Tissue Dispenser: Satin-finish stainless steel. Dispenses 250 single- or half-fold toilet seat covers.

2.7 MIRRORS

- A. Accessible Tilt Mirrors:
 - 1. General: Provide accessible tilt mirror above each accessible lavatory.

2. Products and Manufacturers: Provide one of the following:
 - a. No. 0535-B, by American Specialties, Inc.
 - b. B-293, by Bobrick Washroom Equipment, Inc.
 - c. Model 740-1836, by Bradley Corporation.
 - d. Or equal.
3. Stainless Steel Frame: Fabricate frame from 20-gage, Type 304L stainless steel, welded and ground smooth, no shelf. Mirrors shall be 1.5 feet by three feet size, with tilting frame tapered from 1.5 inches at bottom to 4.5 inches at top.

2.8 GRAB BARS

- A. General: Provide grab bars where shown. Provide custom specials where required or specified.
- B. Products and Manufacturers: Provide one of the following:
 1. 3200 P Series custom Type 56 with 54-inch leg and 36-inch leg, by American Specialties, Inc.
 2. B-68137.99, by Bobrick Washroom Equipment, Inc.
 3. Model 812-2, Type 059 by Bradley Corporation.
 4. Or equal.

2.9 SURFACE-MOUNTED HORIZONTAL LIQUID SOAP DISPENSER

- A. General: Provide surface-mounted liquid soap dispensers, one per lavatory.
- B. Products and Manufacturers: Provide one of the following:
 1. No. 0318, by American Specialties, Inc.
 2. 818615, by Bobrick Washroom Equipment, Inc.
 3. Model 661, 1 by Bradley Corporation.
 4. Or equal.
- C. Liquid Soap Dispenser:
 1. Units shall be 20 inches long by 2.5 inches high by 4-5/10 inches wide, with one liquid soap dispensing valve
 2. Capacity: 80 fluid ounces.
 3. Fabricate units of 20-gage stainless steel, with pin-type tumbler locking device. Dispense liquid soap in measured quantity by pump action with stainless steel internal springs, ABS piston, stainless steel push button and internal parts. Cabinet shall have no exposed fastening devices.
 4. Locking: Pin-type tumbler lock.

2.10 MISCELLANEOUS ITEMS

- A. Combination Shelf with Utility Hook and Mop Strip:
 1. Products and Manufacturers: Provide one of the following:
 - a. No. 1304-A, by American Specialties, Inc.

- b. B-239x34, by Bobrick Washroom Equipment, Inc.
 - c. Model 9934, by Bradley Corporation.
 - d. Or equal.
 - 2. Provide 18-gage stainless steel shelf with 3/4-inch lip, five 18-gage stainless steel hook strips, and four mop holders. Shelf shall be 34 inches wide and eight inches deep.
- B. Pail Hooks:
- 1. Products and Manufacturers: Provide one of the following:
 - a. No. 1307-3, by American Specialties, Inc.
 - b. B-232X24, by Bobrick Washroom Equipment, Inc.
 - c. Model 9943, by Bradley Corporation.
 - d. Or equal.
 - 2. One-piece channel strip fabricated from 20-gage stainless steel. Provide heavy-duty hooks fabricated from 11-gage stainless steel. Shelf shall be 26 inches long with three hooks.
- C. Towel and Robe Hooks:
- 1. For each indicated, provide two double concealed-mounting hooks. Cast brass with polished chrome finish.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. 0751, by American Specialties, Inc.
 - b. B-2116, by Bobrick Washroom Equipment, Inc.
 - c. Model 9119 by Bradley Corporation.
 - d. Or equal.
- D. Shower Stall Seats:
- 1. Provide folding handicapped shower stall seat constructed of one-inch diameter stainless steel tubing with 1/2-inch thick solid, white phenolic seat.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. 8206-L or R Folded Seat, by American Specialties, Inc.
 - b. B-5181, by Bobrick Washroom Equipment, Inc.
 - c. Model 9569-000000, by Bradley Corporation.
 - d. Or equal.
- E. Shower Curtain Rods and Hooks:
- 1. Provide for each shower one shower curtain rod and required number of hooks.
 - 2. Products and Manufacturers: Provide one the following:
 - a. No. 1204 Extra Heavy-Duty Shower Curtain Rods with No. 1200-SHU Shower Curtain Hooks, by American Specialties, Inc.
 - b. B-6047 with 204-1 Hooks, by Bobrick Washroom Equipment, Inc.
 - c. Model 9531 with 9540 Curtain Hooks, by Bradley Corporation.
 - d. Or equal.
 - 3. Provide stainless steel, 1.25-inch diameter extra-heavy-duty, 18-gage shower curtain rods with satin finish and with three-inch diameter, stainless steel rod flanges; two per rod.
 - 4. Provide chrome finished shower curtain snap hooks; one for each shower curtain grommet.

F. Shower Curtains:

1. Provide shower curtain for each shower.
2. Products and Manufacturers: Provide one of the following:
 - a. No. 1200-V Vinyl Shower Curtains, by American Specialties, Inc.
 - b. No. 204-2, by Bobrick Washroom Equipment, Inc.
 - c. Model 9537, by Bradley Corporation.
 - d. Or equal.
3. Flame-resistant, anti-bacterial, eight-gage vinyl fabric with rustproof nylon reinforced chrome-plated grommets.
4. Height: Seven feet.
5. Width: Provide curtain six inches wider than shower stall openings.
6. Color: Full selection of manufacturer's standard and custom colors.

H. Surface-Mounted Soap Dishes:

1. Products and Manufacturers: Provide one of the following:
 - a. No. 7320, by American Specialties, Inc.
 - b. B-7680, by Bobrick Washroom Equipment, Inc.
 - c. Model 9014-63, by Bradley Corporation.
 - d. Or equal.
2. Material: Drawn, one-piece stainless steel.

I. Undersink Guards:

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
2. Product and Manufacturer: Provide one of the following:
 - a. HANDY SHIELD-MAXX, by Plumberex Specialty Products, Inc.
 - b. Truebro Lav Guard 2, by IPS Corporation.
 - c. Or Equal.
3. Material and Finish: Anti-microbial, molded plastic, white.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine the areas and conditions under which toilet and bath accessories will be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install items required to meet accessibility codes in accordance with Laws and Regulations, and ANSI/ICC A117.1.

- B. Determine that substrates are completed and ready to accept surface-mounted or recessed accessories. Refer to Section 03 00 05, Concrete; Section 04 05 05, Unit Masonry Construction; Section 09 26 16, Gypsum Wallboard Assemblies; and Section 09 30 13, Ceramic Tiling, for substrate requirements.
- C. Use concealed fastenings where possible.
- D. Provide anchorage devices, fasteners, and other necessary anchorages, and attach accessories securely to walls, floors, and partitions in locations as shown and as required.
- E. Install concealed mounting devices and fasteners fabricated of the same material as the accessories as recommended by manufacturer.
- F. Install exposed mounting devices and fasteners finished to match the accessories.
- G. Provide theft-resistant fasteners for all mountings.
- H. Secure and install toilet and bath accessories in accordance with the manufacturer's instructions for each item and each type of substrate construction.
- I. Lock grab bars to concealed mounting plate installed in wall.
- J. Toilet Accessory Schedule:
 - 1. Provide the listed toilet accessories in each identified space, unless otherwise noted.
 - 2. Mechanical Room adjacent to slop or mop sink:
 - a. Combination Shelf with Utility Hook and Mop Strip.
 - b. Pail Hooks.
 - 3. Each Unisex Toilet or Restroom:
 - a. Accessible Tilt Mirrors, one per lavatory.
 - b. Liquid Soap Dispenser, one per lavatory.
 - c. Paper Towel Dispenser
 - d. Waste Receptacle.
 - e. Multi-roll Toilet Tissue Dispenser, one per water closet.
 - f. Surface-mounted Toilet Seat Tissue Dispenser, one per water closet.
 - g. Grab Bars, one set per accessible water closet.
 - h. Sanitary Napkin (Bio-Hazard) disposal Unit, one per water closet.
 - i. Lavatory Under Sink Guards.
 - 2. Shower compartment:
 - a. Shower Curtains.
 - b. Shower Curtain Rods and Hooks.
 - c. Surface-Mounted Soap Dishes.
 - d. (1) Towel and (2) Robe Hooks.
 - e. Shower Stall Seats.

3.3 ADJUSTMENT AND CLEANING

- A. Adjust toilet and bath accessories for proper operation.
- B. After completion of installation, clean and polish all exposed surfaces.
- C. Deliver keys and instruction sheets to OWNER in accordance with Section 08 71 00, Door Hardware.

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SECTION 10 43 16

FIRST AID CABINETS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all first aid equipment Work.
2. Extent of the first aid equipment is specified.
3. Types of products required include the following:
 - a. First aid station.
 - b. Emergency burn relief station.
 - c. Miscellaneous mounting brackets, accessories, fasteners.

1.2 REFERENCES

A. Standards referenced in this Section are.

1. ANSI.

1.3 QUALITY ASSURANCE

A. Quality Source Control:

1. Furnish as complete first aid equipment produced by one manufacturer, including hardware, accessory items, mounting brackets, and fastenings.
2. Furnish all equipment by one manufacturer unless otherwise accepted by ENGINEER.

B. Reference Standards: Comply with applicable provisions and recommendations unless otherwise shown or specified:

1. Occupational Safety and Health Act of 1970.
2. ANSI.

1.4 SUBMITTALS

- ###### A. Shop Drawings: Submit for approval manufacturer's detailed technical data sheets, and certification of OSHA and ANSI.

1.5 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:

1. Protect finished surfaces from soiling and damage during handling, storage, and installation.
2. Protect steel and packaged materials from corrosion and deterioration.
3. Keep equipment covered with polyethylene film or other protective covering.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Industrial First Aid Kit: Provide the following:

1. Quantity: 1 unit.
2. Description: Each unit shall consist of a balanced assortment of first aid supplies adequate to administer first aid for up to 50 people. Provide 24 gage steel, weatherproof, dustproof, rust resistant case with rounded corners with carrying handle and wall brackets.
3. Product and Manufacturer: Provide the following:
 - a. Industrial First Aid Kit Number 50 by Johnson & Johnson Incorporated.
 - b. 36 Unit by Figgie International Incorporated, Fire Protection/Safety Group, Scott Aviation Division.
 - c. #50 Person Original Safety, First Aid Kit by Northern Safety Company, Incorporated.

B. Emergency Burn Relief Kit: Provide the following:

1. Quantity: 1 unit.
2. Description: Each unit shall consist of 6 yards of 4-inch gauze bandage; 24-inch by 72-inch gauze compress and 4-ounce aerosol can of benzocaine. Provide all items contained within a 24-gauge steel, waterproof, dustproof, rust-resistant case with rounded corners and hanger brackets for wall mounting.
3. Product and Manufacturer: Provide the following:
 - a. P/N 70495-00 by Figgie International Incorporated, Fire Protection/Safety Group, Scott Aviation Division.
 - b. Or Equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the substrates and conditions under which the first aid equipment Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

- A. When exact locations of first aid kits or cabinets are not shown on Drawings, locate as directed by ENGINEER.
- B. Securely fasten products to structure, square and plumb, per Supplier's instructions. Mounting heights shall be 4.0 feet above finished floor.

- C. Identification Devices: Provide signs level and plumb directly above first aid kit or cabinet, securely mounted, attached to substrate per sign manufacturer's instructions. Signage shall be per Section 10 14 00, Signage

3.3 FIRST AID CABINET SCHEDULE

- A. Provide one portable first aid kit and burn relief kit in administrative area of Control Building. Install as directed by ONWER or ENGINEER.

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SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all fire protection specialties Work.
 - 2. Extent of fire protection specialties Work is shown and specified.
 - 3. Types of fire protection specialties Work required includes:
 - a. Dry chemical extinguishers.
 - b. Carbon dioxide extinguishers.
 - c. Mounting accessories and miscellaneous fasteners.
- B. Coordination:
 - 1. Review installation procedures under other Sections and coordinate installation of items that must be installed with or before fire protection specialties.
- C. Related Sections:
 - 1. Section 10 14 00, Signage.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ASTM E814, Test Method for Fire Tests of Penetration Firestop Systems.
 - 2. FM Global, FM Approval Guide.
 - 3. NFPA 10, Portable Fire Extinguishers.
 - 4. UL Fire Classification Rating.
 - 5. U.S. Architectural & Transportation Barriers Compliance Board's Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities.

1.3 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Provide fire protection specialties products from one manufacturer.
- B. Certifications: Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.
 - 2. Provide fire extinguishers approved, listed, and labeled to comply with ASTM E814.

- C. Regulatory Requirements:
 - 1. Provide fire protection specialties approved and labeled by UL.
 - 2. Provide fire protection specialties conforming to NFPA 10 requirements.
 - 3. Provide fire protection specialties conforming to ADA-ABA Accessibility Guidelines.

1.4 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Submit the following:
 - a. Manufacturer's technical data, certification of UL rating, and installation instructions for fire protection specialties.
 - b. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
 - c. Product Schedule: For fire extinguishers and fire protection cabinets. Coordinate final fire extinguisher and fire protection cabinet schedule to ensure proper fit and function.
- B. Closeout Submittals: Submit the following:
 - 1. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.
 - 2. Warranty: Sample of special warranty.

1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. General: Provide manufacturer's standard mounting brackets for portable fire extinguishers size as specified.

- B. Multi-Purpose Dry Chemical Fire Extinguishers:
 - 1. Ten-pound capacity, enameled steel container with pressure-indicating gauge, for Class A, Class B, Class C fires, UL rating 4A-60 B:C.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Cosmic Model 10E by J.L. Industries, a division of Activar Construction Products Group.
 - b. MP 10 Series by Larsen's Manufacturing Company.
 - c. Or equal.
- C. Carbon Dioxide Fire Extinguishers:
 - 1. Ten-pound enameled steel container capacity UL rating 10 B:C.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sentinel Model 10 by J.L. Industries, a division of Activar Construction Products Group.
 - b. CD 10 Series by Larsen's Manufacturing Company.
 - c. Or equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine substrates and conditions under which fire protection specialties will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to ENGINEER.

3.2 INSTALLATION OF FIRE EXTINGUISHERS

- A. When exact locations of fire protection specialties are not shown on Drawings, locate as directed by ENGINEER.
- B. Securely fasten products to structure, square and plumb, per Supplier's instructions. Mounting heights shall be:
 - 1. Install fire extinguishers to meet ADA/ABA requirements.
 - 2. Install fire extinguishers with gross weight greater than 40 pounds with top of fire extinguisher no more than 3.5 feet above finished floor.
 - 3. Install fire extinguishers with gross weight less than 40 pounds with top of fire extinguisher no more than 4.0 feet above finished floor.
 - 4. Clearance between bottom of fire extinguisher and finished floor shall be at least four inches.
- C. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semi-recessed fire protection cabinets.
 - 2. Provide inside latch and lock for break-glass panels.

- 3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
- D. Identification Devices: Refer to Section 10 14 00, Signage.
- E. Recharge fire extinguishers provided under this Contract so that most recent inspection date coincides as nearly as possible with date of Substantial Completion. Inform OWNER in writing of next required inspection and recharging date.

3.3 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

+ + END OF SECTION + +

SECTION 10 51 00

LOCKERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all locker Work.
2. Extent of lockers is shown.
3. Types of products required include the following:
 - a. All welded, factory-assembled, heavy-duty single-tier metal lockers.
 - b. Miscellaneous accessories, closures, identification labels and other components, trim and fasteners.

B. Coordination:

1. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 00 05, Concrete.
2. Coordinate size and location of masonry bases.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. ASTM A 666-1, Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.
2. ASTM A 879, Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
3. ASTM A 1008/A 1008M, Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
4. U.S. Architectural and Transportation Barriers Compliance Board. Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG). Continual Revisions.

1.3 QUALITY ASSURANCE

A. Provide metal lockers as complete units produced by a single manufacturer, including necessary mounting accessories, fittings, and fastenings.

B. Color:

1. Provide locker units in color selected by ENGINEER from manufacturer's standard and custom colors. Minimum order requirements of the manufacturer shall not be acceptable cause by CONTRACTOR for rejection of ENGINEER'S color selection.

2. Unless otherwise shown, non-exposed surfaces may be manufacturer's standard neutral color as selected by ENGINEER.
 3. Manufacturer's of "or equal" products shall be able to supply exactly the same construction and color selections as the manufacturer's specified.
- C. Regulatory Requirements: Where metal lockers are indicated to comply with accessibility requirements, comply with Accessibility Guidelines for Buildings and Facilities (ADAAG) and the NYS Building Code.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Shop Drawings for metal lockers, verifying dimensions affecting installations. Show lockers in detail, method of installation, fillers, trim, base and accessories. Include locker numbering sequence information.
 2. Product Data:
 - a. Copies of manufacturer's technical data, color charts, and installation instructions for the metal locker units.
 3. Samples: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
 - a. For the following products, in manufacturer's standard sizes, showing the full range of color, texture, and pattern variations expected. Prepare Samples from the same material to be used for the Work.
 - 1) Lockers.
 - 2) Locker benches.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver metal lockers until building is enclosed and ready for their installation. Protect from damage during delivery, handling, storage, and installation.
- B. Deliver master keys, control keys, and combination control charts to OWNER.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify the following by field measurements before fabrication and indicate measurement on Shop Drawings:
1. Concealed framing, blocking and reinforcements that support metal lockers before they are enclosed.
 2. Recessed openings.

1.7 WARRANTY

- A. Provide manufacturer's ten year warranty against defects in materials and workmanship.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, matte finish, suitable for exposed applications, and stretcher leveled or roller leveled to stretcher-leveled flatness.
- B. Galvanized Steel Sheet: ASTM A 879, commercial quality, G60 (Z180) coating designation; mill phosphatized; suitable for exposed applications, and stretcher leveled or roller leveled to stretcher-leveled flatness.
- C. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, commercial quality, coating Class C; mill phosphatized; suitable for exposed applications; and stretcher leveled or roller leveled to stretcher-leveled flatness.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness. Roller-apply texture to doors in manufacturer's standard pattern.
- E. Maple: Laminated.
- F. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.

2.2 HEAVY DUTY LOCKER CONSTRUCTION

- A. Frames: Minimum 16 gage channels or 12 gage angles, with corners electrically welded to form a rigid one-piece structure. Form door stop at vertical members.
- B. Backs and Sides: Minimum 18 gage steel for backs; 16 gage steel for sides. Flange backs on vertical edges, and sides where they intermember with backs, making double-flanged rear corners.
 - 1. Exposed ends of non-recessed lockers; minimum 16 gage steel.
- C. Tops, Bottoms and Shelves: Minimum 16 gage steel, flanged edges.
- D. Double Panel Doors: One-piece, formed solid doors with louvers top and bottom minimum 14 gage cold-rolled sheet steel with double bends on both sides and single bends on top and bottom and an 18 gage formed inner panel welded to outer door to form a reinforcing channel. Construct doors to prevent springing when opening or closing. Fabricate doors to swing 180 degrees.
 - 1. Provide stamped louvered vents in door faces, as follows:
 - a. For single-tier lockers, not less than six louver openings top and bottom.
- E. Door Hinges: Heavy-duty, not less than 16 gage steel, full-loop, continuous full length piano hinges. Weld hinges to inside of frame and secure to door with not less than two factory-installed fasteners, completely concealed and tamperproof when locker door is closed.

- F. Center Partition: Provide center partition in each 24-inch wide locker.
- G. Latching: Positive, automatic, pre-locking, pry-resistant latch and fully recessed latch with rubber bumpers riveted to door stops and heavy-duty, rigid non-moving 11 gage hasp containing strike and hole for padlock.
 - 1. Provide stainless steel pan recessed into door containing no moving parts for through-the-door padlock.
 - 2. Provide single point latch welded to door frame.
- H. Sizes:
 - 1. Work Clothes Lockers: 24-inches wide by 18-inches deep by 72-inches high with closed base and legs.
- I. Products and Manufacturers: Provide one of the following:
 - 1. Stadium Framed Gear Welded Lockers by Penco Products, Incorporated.
 - 2. All weld Deluxe Collegiate Lockers by Lyon Workplace Products.
 - 3. Or equal.

2.4 FINISH

- A. Chemically pretreat metal with degreasing and phosphatizing process. Electrostatically spray powder coat finish to all surfaces, exposed and concealed, except plates and non-ferrous metal. Provide manufacturer's full selection of standard colors.

2.5 LOCKER ACCESSORIES

- A. Locking: Fabricate lockers to receive padlocks which shall be provided by OWNER.
- B. Equipment: Furnish each locker with the following accessories:
 - 1. Single-Tier Units: Clothing rod, 7/8-inch diameter heavy chrome plated steel, three single-prong wall hooks, and shelf.
- C. Number Plates: Manufacturer's standard etched, embossed, or stamped, non-ferrous metal number plates with numerals not less than 3/8-inch high. Number the lockers in sequence as directed by ENGINEER. Attach plates to each locker door, near top, centered, with at least two stainless steel fasteners of the same finish as number plate.
- D. Continuous Closed Base: Minimum 16 gage cold-rolled steel, 6-inches high, fabricated to enclose base of lockers without additional fastening devices. Flange bottoms inward 3/4-inch for stiffening. Welded to locker bottom and factory-finished to match lockers.
- F. Trim: Provide fill-in-panels, solid end panels and recessed trim consisting of 16 gage minimum cold-rolled steel, as necessary, to provide complete and finished installation. Factory-finish trim to match lockers. Secure trim to lockers with concealed fastening clips. Provide recessing trim on all top and sides as required for a complete and finished installation.

2.6 FABRICATION

- A. Construction: Provide all seams and joints including sides, back, top and bottom and hinges and shelves of welded construction. Bolts, screws or pop rivets are not approved. Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make all exposed metal edges and welds safe to the touch.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and his installer must examine the areas and conditions under which locker Work is to be installed and notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

- A. Install lockers required to meet accessibility codes in accordance with ANSI 117.1 and the NYS Building Code.
- B. Install metal lockers at the locations shown in accordance with the manufacturer's instructions for a plumb, level, rigid, and flush installation.
- C. Space fastenings about 48-inch on centers and apply through back-up reinforcing plates where necessary to prevent metal distortion. Conceal all fasteners.
- D. Install trim, to provide a flush, hairline joint against adjacent surfaces. Install with concealed fasteners.
- E. Touch-up marred finishes, or replace if not acceptable to ENGINEER. Use only materials and finishes as recommended or furnished by the locker manufacturer.
- F. Adjust doors and latches to operate easily without bind. Verify satisfactory operation of integral locking devices.

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SECTION 11 53 00

LABORATORY EQUIPMENT

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all laboratory equipment Work.
2. Extent of laboratory equipment is shown and scheduled.
3. Types of products required include:
 - a. Undercounter Refrigerator.
 - b. Undercounter Ice Maker.
 - c. Furnace.
 - d. pH Meter.
 - e. Imhoff Cone.
 - f. Air Flow Monitor.
 - g. Analytical Balance.
 - h. Settrometer.
 - i. Centrifuge.
 - j. Miscellaneous attachments, miscellaneous fittings, service outlets, brackets, supports, fasteners, and other accessories as required for complete and finished installation.

B. Coordination:

1. Coordinate delivery of laboratory equipment with laboratory casework and furniture.
2. Review installation procedures under this and other Sections and coordinate them with the Work of this Section.
3. Notify other contractors in advance of installing laboratory equipment to provide other contractors with sufficient time for installing items included in their contracts that will be installed with or before laboratory equipment Work.

C. OWNER-Furnished Equipment: OWNER will furnish the following equipment for installation by CONTRACTOR:

1. See contract drawing for list.

D. Related Sections:

1. Section 12 35 53, Laboratory Casework.

1.2 QUALITY ASSURANCE

A. Component Supply and Compatibility:

1. Obtain each type of product specified in this Section from a single laboratory equipment manufacturer.

- B. Regulatory Requirements: Comply with the following:
 - 1. OSHA, 1910, Subparagraph H, Hazardous Materials.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Drawings showing plans, elevations, ends, cross-sections, service run spaces, and location and type of service fixtures with utility lines thereto.
 - b. Include layout of units with relation to surrounding walls, doors, windows, laboratory casework, and other building components.
 - c. Show details and location of anchorages and fitting to floors, walls, and base, as required.
 - 2. Product Data:
 - a. Manufacturer's literature, including catalog information and specifications, for each type of laboratory product and equipment.
 - 3. Samples:
 - a. Manufacturer's standard color selections.
- B. Informational Submittals: Submit the following:
 - 1. Certifications:
 - a. Explosion-proof certification of laboratory equipment: UL, NFPA, and OSHA.
 - 2. Manufacturer's Instructions:
 - a. Instructions for handling, storing, protecting, and installing laboratory equipment Work.
- C. Closeout Submittals: Submit the following:
 - 1. Operations and Maintenance Data: Provide detailed maintenance manual for equipment specified in this Section, in accordance with Section 01 78 23, Operation and Maintenance Data.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage and Protection:
 - 1. Protect finished surfaces from soiling and damage during handling, storage, and installation.
 - 2. Protect steel and packaged materials from corrosion and deterioration.
 - 3. Keep equipment covered with polyethylene film or other protective covering.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND APPLIANCES

- A. See Contract drawing for equipment list and manufacturers.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which laboratory equipment Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. General:
 - 1. Install equipment plumb, level, true, and straight with no distortions.
 - 2. Shim using concealed shims, as required.
 - 3. Where laboratory equipment abuts other finished work, scribe and apply filler strips for accurate fit with all fasteners concealed where practicable.
 - 4. Coordinate the installation of laboratory equipment with installation of laboratory casework in Section 12 35 53, Laboratory Casework.
- B. Equipment and Appliances:
 - 1. Install in accordance with manufacturer's written instructions.
 - 2. Verify mechanical, plumbing, and electrical connections and proper functioning of equipment.
- C. Accessories:
 - 1. Install in accordance with manufacturer's written instructions. Turn screws to flat seat; do not drive screws. Adjust moving parts to operate freely without excessive bind.

3.3 CLEANING AND PROTECTION

- A. Clean shop-finished surfaces, touch-up as required, and remove or refinish damaged or soiled areas, as recommended by manufacturer's and acceptable to ENGINEER.
- B. Protect laboratory equipment Work from damage until Substantial Completion. Take precautions and provide protective measures as recommended by manufacturer's, and coordinate protective practices with work of other trades.

3.4 FIELD QUALITY CONTROL

- A. Field Quality Control:
 - 1. After installation and completion of connections, verify in presence of ENGINEER that equipment is installed correctly and functions properly. Correct deficiencies until all Work functions properly.

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SECTION 12 21 00

WINDOW BLINDS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all window blind Work.
2. Extent of window blind units is shown.
3. Types of products required include the following:
 - a. Manually-operated horizontal window blinds.
 - b. Miscellaneous accessories and materials.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate with the Work of this Section.
2. Notify other contractors in advance of installing window blinds to provide other contractors with sufficient time for installing items included in their contracts that will be installed with or before window blinds Work.
3. Provide inserts and anchoring devices to be set in concrete or built into masonry and gypsum wallboard for installation of window blinds. Coordinate delivery with other work to avoid delay.
4. Refer to concrete and masonry Sections of the Specifications for installation of inserts and anchorage devices. Refer to Section 04 05 05, Unit Masonry Construction; and Section 09 21 16, Gypsum Wallboard Assemblies.

C. Related Sections:

1. Section 04 05 05, Unit Masonry Construction.
2. Section 09 21 16, Gypsum Wallboard Assemblies.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. GANA, Glazing Manual.
2. NFPA 701, Methods of Fire Tests for Flame Propagation of Textiles and Films.
3. WCMA A100.1, American National Standard for Safety of Corded Window Covering Products.

1.3 QUALITY ASSURANCE

A. Component Supply and Compatibility:

1. Provide all window blinds of each type of blinds required as complete units produced by one manufacturer, including hardware, accessory items, mounting brackets, and fastenings.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Shop Drawings for special window blind components THAT are not fully dimensioned or detailed on manufacturer's product data. Include elevation layout indicating proposed division between window blind units and meeting edges at corners.
 - b. Coordinated drawings showing required clearances to window obstructions and other obstructions that would interfere with window blind operation. Coordinate pocket size and mounting with manufacturer's proposed products and show details and all dimensions on Shop Drawings.
 - c. Data sheets for window blinds proposed for use.
 - 2. Product Data:
 - a. Manufacturer's published literature, catalog sheets, and specifications for each type of window blind proposed for use.
 - 3. Samples:
 - a. Submit six-inch Samples of window blinds in all standard colors for selection by ENGINEER.
 - b. ENGINEER's review of Samples will be for color and texture only. Compliance with other requirements of the Contract Documents is CONTRACTOR's responsibility.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Manufacturer's certification of compliance with specified requirements for recycled louver material.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 - 1. Deliver window blinds in factory packaging, marked with manufacturer, product name, and installation location using same designations indicated on the Drawings.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install window blinds until construction and wet and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for the Project when occupied for its intended use.
- B. Field Measurements: Where window blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Advise ENGINEER in writing of installation conditions that vary from those required in the Contract Documents.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Horizontal Window Blinds:

1. Products and Manufacturers: Provide one of the following:
 - a. Riviera 1/2-inch Mini-Blinds, by Levolor Window Fashions, a Newell Rubbermaid Company.
 - b. Décor 1/2-inch Solids Mini-Blinds, by Hunter Douglas Contract, Hunter Douglas, Inc.
 - c. Or equal.
2. Head Channel: 0.025-inch thick tomized steel, U-shaped one-inch high by 1-9/16-inch wide with flanged edges at top, and coated with a baked-on finish. All hardware shall be enclosed in the metal head.
3. Tilter: 0.042-inch tomized steel with automatically disengaging worm and gear mechanism to eliminate overdrive and prevent strain or damage to window blinds.
4. Tilt Wand: Transparent with hexagonal cross section of 5/16-inch across flats.
5. Drum and Cradle: One for each window blind ladder as follows:
 - a. Drum shall be 0.031-inch tomized steel having two holes with rolled edges to anchor barbs on both ladder ends.
 - b. Cradles shall be 0.042-inch thick tomized steel, having two holes with rolled edges to guide cords through bottom of head channel without abrasion.
6. Tilt Rod: U-shaped with a circular radius of approximately 1/8-inch designed to achieve minimum torsional deflection. For window blinds greater than five feet wide and less than 6.67 feet long, or greater than 4.583 feet wide and greater than 6.67 feet long tilt rod shall be a solid D-shaped rod with an average cross section of 1/4-inch designed to achieve minimum torsional deflection.
7. End Braces: 0.037-inch thick tomized steel with reinforcing ribs and field adjustable tabs.
8. Installation Brackets: Provide brackets with a rivet-hinged safety locking front cover not less than 0.048-inch thick tomized steel with baked-on finish matching head channel.
9. Intermediate Brackets: 0.050-inch tomized steel installed with window blinds greater than five feet wide and less than 6.67 feet long, or greater than 4.583 feet wide and greater than 6.67 feet long.
10. Ladders (slat supports): Braided polyester yarn designed from maximum strength and flexibility combined with minimum stretch. Rungs shall consist of not less than two crossed cables interbraided with the vertical components. Ladders shall support the slats without visible distortion. Distance between ladders shall not exceed two feet for window blinds up to 6.67 feet long. For window blinds over 6.67 feet long, distance between ladders shall be not greater than 22 inches.

11. Slats: Virgin high magnesium aluminum, alloyed for maximum strength and corrosion resistance. Slats shall be nominally eight-gage, 1/2-inch wide with an elliptical crown formed after coating and curing. Slat ladder support distances shall prevent visible sag or bow after continued use indoors. Slats shall be unperforated.
12. Bottom Rail: 0.031-inch tomized steel formed after coating provided with color-compatible molded plastic ladder and end caps.
13. Lift Cord: Braided of high-strength flexible polyester fiber cord with minimum stretch and maximum abrasion resistance characteristics. Cord shall be of sufficient length, equalized to properly control raising and lowering of window blinds and spaced not more than 3.83 feet between cords.
14. Colors: Complete selection of manufacturer's standard colors. ENGINEER will select a maximum of three colors for the Work.
15. Accessories: Provide the following:
 - a. Pocket installation brackets.
 - b. Projection brackets to clear window hardware.
 - c. Two-tone slats with neutral white on outside face.

2.2 FABRICATION AND OPERATION

- A. Product Safety Standard: Fabricate vertical louver blinds to comply with WCMA A100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.
- B. Prior to fabrication, verify actual opening dimensions by accurate Site measurements. Adjust dimensions for proper fit at all openings.
- C. Fabricate components of window blinds from non-corrosive, non-staining, non-fading materials which are compatible with each other, and which do not require lubrication during normal expected life. Use dissimilar metals or plastics for contact surfaces which slide against each other in operation of window blinds.
- D. Fabricate window blind units to completely fill the openings as shown, from head-to-sill and jamb-to-jamb. For continuous window wall installations, fabricate window blinds so that ends occur only at mullions or other defined vertical separations, unless otherwise shown.
- E. Gear all operating equipment for reduction of the ratio of hand-movement to window blind-movement, so that window blinds operate easily and can be set accurately and smoothly.
- F. Concealed Components:
 1. Noncorrodible or corrosion-resistant-coated materials.
 2. Rotation-and-Traverse Mechanisms: With permanently lubricated moving parts.

- G. Installation Brackets: Constructed for easy removal and reinstallation of blind, for supporting headrail and operating hardware and for bracket positions and blind mounting method indicated.
- H. Installation Fasteners: Not less than two fasteners per bracket, fabricated from metal noncorrosive to brackets and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
- I. Color-Coated Finish: For metal components exposed to view unless anodized or plated finish is indicated. Apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine the substrates and conditions under which the window blinds Work will be installed and notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. General:
 - 1. Install window blinds where shown and in accordance with manufacturer's instructions. Position units plumb and true, securely anchored in place with proper clips, brackets, and bolts for the type of mounting required.
 - 2. Locate so exterior vane edges are not closer than two inches from interior faces of glass and not closer than 1.5 inches from interior faces of glazing frames through full operating ranges of blinds, in accordance with GANA Glazing Manual.
 - 3. Install mounting and intermediate brackets to prevent deflection of headrails.
 - 4. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.
- B. Divisions between window blinds are allowed only at mullions of continuous windows or openings where more than one window blind for one opening occurs.

3.3 ADJUSTING

- A. Adjust window blinds to operate free of binding and malfunction through full operating ranges.

3.4 CLEANING AND PROTECTION

- A. Prior to Substantial Completion, clean window blind surfaces in accordance with manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and that ensures that window blinds are without damage or deterioration at Substantial Completion.
- C. Prior to Substantial Completion, replace damaged window blinds that cannot be acceptably repaired.

+ + END OF SECTION + +

SECTION 12 35 53

LABORATORY CASEWORK

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all laboratory casework Work.
2. Extent of laboratory casework is shown and scheduled.
3. Types of products required include:
 - a. Fixed metal casework with base cabinets, wall cabinets, storage cabinets, and cabinet understructure.
 - b. Accessible casework and fume hoods.
 - c. Utility-space framing at backs of base cabinets and between backs of base cabinets.
 - d. Filler and closure panels.
 - e. Countertops.
 - f. Sinks and troughs.
 - g. Shelves.
 - h. Fume hoods.
 - i. Fittings and service accessories.
 - j. OWNER-furnished casework and fume hoods.
 - k. Miscellaneous infill and closure panels, attachments, miscellaneous fittings, service outlets, brackets, supports, fasteners, and other accessories as required for complete and finished installation.
 - l. Piping and wiring within fume hoods for service fittings, light fittings, fan switches, and other electrical devices included with fume hoods.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate them with the Work of this Section.
2. Notify other contractors in advance of installation of laboratory casework to provide them with sufficient time for installing items included in their contracts that must be installed with or before laboratory casework Work.

C. Related Sections:

1. Section 06 10 53, Miscellaneous Rough Carpentry.
2. Section 11 53 00, Laboratory Equipment.
3. Section 12 50 00, Furniture.
4. Section 22 10 53, Installation of Plumbing Piping.
5. Section 22 13 16, Sanitary Waste and Vent Piping.
6. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
7. Section 23 09 00, Instrumentation and Control for HVAC.

8. Section 23 31 13, Metal Ductwork.
9. Section 23 34 05, Metallic HVAC Fans.
10. Section 23 34 06, Non-Metallic HVAC Fans.
10. Section 26 05 33.13, Rigid Conduits.
11. Section 26 05 33.16, Flexible Conduits.
12. Section 26 05 33.36, Outlet Boxes.

1.2 REFERENCES

- A. Standards referenced in this Section are:
1. Americans with Disabilities Act of 1990 (ADA).
 2. ASHRA 110, Laboratory Fume Hood Performance Testing.
 3. ASTM A366/A366M, Specification for Commercial Steel (CS) Sheet, Carbon, (0.15 Maximum Percent) Cold-Rolled.
 4. ASTM A1008A/A1008M, Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 5. ASTM C1048, Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass.
 6. ASTM C 1186, Standard Specification for Flat Fiber-Cement Sheets.
 7. ASTM D 570, Test Method for Water Absorption of Plastics.
 8. ASTM D 695, Test Method for Compressive Properties of Rigid Plastics.
 9. ASTM D785, Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
 10. ASTM D790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 11. ASTM E 329, Specification for Agencies Engaged in Construction Inspection and/or Testing.
 12. BMHA 156.9, Cabinet Hardware.
 13. 16 CFR 1201, Safety Standard for Architectural Glazing Materials.
 14. FM Approval Guide.
 15. NFPA 30, Flammable and Combustible Liquids Code
 16. NFPA 70, National Electric Code.
 17. NFPA 268, Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source.
 18. NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.
 19. SEFA 1, Laboratory Fume Hoods - Recommended Practices.
 20. SEFA 2.3, Installation of Scientific Laboratory Furniture and Equipment Hoods - Recommended Practices.
 21. SEFA 3, Work Surfaces- Recommended Practices.
 22. SEFA 7, Laboratory and Hospital Fittings - Recommended Practices.
 23. SEFA 8, Laboratory Furniture.
 24. SEI/ASCE 7, Minimum Design Loads for Buildings and Other Structures.
 25. UL 1805, Laboratory Hoods and Cabinets.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Shall be experienced in producing casework of types required for the Project
 - b. Manufacturer shall have successfully passed test for compliance with SEFA 1 and SEFA 8
 - c. Manufacturer shall be a member of SEFA and shall comply with SEFA's recommended practices.
 - d. When requested by ENGINEER submit qualifications statement.
2. Installer:
 - a. Engage a single installer regularly performing installation of laboratory casework and fume hoods with documented skill and successful experience in the installation of the types of casework required; and who agrees to employ workers for this Project who are trained or certified by manufacturer for installation techniques required for the types of materials specified.
 - b. An experienced installer who complies with the requirements of SEFA 2.3, Installation of Scientific Laboratory Furniture and Equipment Hoods - Recommended Practices.
 - c. Submit name and qualifications to ENGINEER along with the following information on a minimum of three successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for projects.
 - 2) Approximate contract cost of the laboratory casework and fume hoods Work.
 - 3) Lineal footage of area installed.
3. Testing Agency:
 - a. Independent testing agency shall demonstrate to ENGINEER'S satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work in accordance with ASTM E 329, without delaying the Work.

B. Component Supply and Compatibility:

1. Provide laboratory casework and fume hood products manufactured or furnished by the same laboratory furniture and fume hood manufacturer for single responsibility.
2. No reduction of special production capabilities is acceptable for the Work of this Section.
3. Manufacturers of "or equal" products shall be able to provide same complete selection of standard, custom-color and multi-color cabinets and fume hoods provided by the manufacturers specified, as well as full custom manufacturing capabilities and all accessories.

C. Regulatory Requirements:

1. Provide fume hoods UL listed and labeled for compliance with UL 1805.

2. Safety Glass: Products complying with testing requirements in 16 CFR 1201 for Category II materials.
 3. Flammable Liquid Storage: Where cabinets are indicated for solvent or flammable liquid storage, provide units that are listed and labeled as complying with requirements in NFPA 30 by a testing and inspecting agency acceptable to authorities having jurisdiction and FM Approvals.
 4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 5. Vibration, Seismic, and Wind Requirements: Contractor responsible for this Section shall provide seismic, vibration, and wind controls for Work specified in this Section, per Section 40 05 96, Vibration, Seismic, and Wind Controls.
 6. Accessibility Compliant: Where indicated, casework and fumehoods shall meet the applicable requirements of ADA and local codes.
- D. Special Inspections:
1. OWNER will employ a Coordinating Special Inspector, who will direct an independent testing agency, hired by the Contractor, to perform source quality control testing and special inspections, and to prepare test reports.
 - a. Testing agency will conduct tests at the direction of the Special Inspector, who interprets tests and state in each report whether test specimens comply with or deviate from requirements.
 - b. Allow Coordinating Special Inspector access to places where casework is being fabricated or produced. Cooperate with Special Inspector and provide samples of materials as may be requested for additional testing and evaluation.
- E. Pre-Installation Conference:
1. Prior to installing laboratory casework and fume hoods, arrange a meeting at Site with installer and its foreman, supplier's technical representative, installers of other work in and around laboratory casework and fume hoods that must proceed and follow laboratory casework and fume hood Work, ENGINEER, and other representatives directly concerned with performance of laboratory casework and fume hood Work. Record discussions of conference and decisions and agreements and disagreements and furnish a copy of record to each party attending. Review foreseeable methods and procedures relating to painting Work including:
 - a. Review Project requirements including Contract Documents, approved Shop Drawings, pending and approved Change Orders, requests for information that submitted by CONTRACTOR to ENGINEER, and other pertinent documents.
 - b. Review required samples and submittals, both completed and to be completed.
 - c. Review status of surfaces including, surface preparations and similar considerations.
 - d. Review availability of materials, tradesmen, equipment, and facilities required for progress, to avoid delays, and to protect Work from damage.

- e. Review required inspection, testing, certifying, and quality control procedures.
 - f. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions. Supplemental heating sources required to for working in low-temperature conditions, shall be operating and acceptable to laboratory casework and fume hood installer and ENGINEER.
 - g. Review methods for complying with regulations of authorities having jurisdiction at Site, such as compliance with environmental protection, health, safety, fire, and similar regulations.
2. Reconvene meeting at earliest opportunity if additional information must be developed to conclude the required topics of the meeting.
 3. Record revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.
 4. Keying: Incorporate keying decisions into final keying requirements.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Provide Shop Drawings for laboratory casework, fume hoods, accessories, fittings, and equipment showing plans, elevations, ends, cross-sections, service run spaces, and location and type of service fittings with lines thereto.
 - b. Show details and location of anchorages and fitting to floors, walls, and base.
 - c. Include details of support framing system.
 - d. Include details of exposed conduits, if required, for service fittings.
 - e. Indicate duct connections, electrical connections, and locations of access panels.
 - f. Include roughing-in information for HVAC, plumbing, and electrical connections.
 - g. Include layout of units with relation to surrounding walls, doors, windows and other building components.
 - h. Include coordinated dimensions for laboratory equipment specified in Section 11 53 00 and/or supplied by the OWNER.
 - i. Include a schedule of all casework, fume hoods, and utilities in the same format as the casework, fume hoods, and utilities on the Contract Drawings.
2. Product Data:
 - a. Manufacturer's literature for each type of laboratory casework, fume hoods, accessories, and fittings.
3. Delegated-Design Submittal: For laboratory casework and fume hoods indicated to comply with seismic performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
4. Samples: Unless otherwise directed, approved full-size Samples may become part of the completed Work, if in an undisturbed condition at time of

Substantial Completion. Notify ENGINEER of their exact locations. If not incorporated into the Work, retain acceptable full-size Samples at Project site and remove when directed by ENGINEER.

- a. One Sample each of hinged and sliding doors.
- b. 6-inch- square Samples for each type of countertop material.
- c. One of each service fitting specified, complete with accessories and specified finish.
- d. One of each type of countertop and sink and accessory item specified.
- e. One of each type of hardware item specified.
- f. One sample base cabinet construction and finish.
- g. One sample wall cabinet construction and finish.

B. Informational Submittals: Submit the following:

- 1. Certification:
 - a. Labeled Construction for fire-resistance-rated fume hoods and storage cabinets.
 - b. Accessibility-compliant casework and fume hoods.
- 2. Test and Evaluation Reports:
 - a. Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework and fume hoods with requirements of specified product standard and system structural performance specified in Article 2.1.
 - b. Product test reports for countertop surface, lining, and baffle material: based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface materials with requirements specified for chemical and physical resistance.
 - c. Field test Reports: Results of fume hood tests specified in Article 3.9.
- 3. Supplier's Instructions:
 - a. Installation Data.
 - b. Procedures and precautions for protecting laboratory casework and fume hoods Work.
- 4. Site Quality Control Submittals:
 - a. Special Inspections Reports: Coordinate with the Coordinating Special Inspector. Refer to Section 01 45 33.00CAOH, Code-Required Special Inspections and Procedures for detailed report requirements.
- 5. Qualification Statements:
 - a. Manufacturer.
 - b. Installer.
 - c. Professional Engineer.
 - d. Testing Agency.

C. Closeout Submittals: Submit the following:

- 1. Operations and Maintenance Data: Provide detailed maintenance manual for products specified in this Section. Conform to Section 01 78 23, Operation and Maintenance Data, and include:
 - a. Identify Manufacturer, product name, and model number of each product used in the Work.

- b. Name, address and telephone number of Manufacturer, local distributor, and technical representative.
- c. Detailed procedures for routine maintenance and cleaning.
- d. Detailed procedures for light repairs such as dents, scratches, and staining.

D. Maintenance Material Submittals: Submit the following:

- 1. Spare Parts
 - a. Furnish complete touchup kit for each type and color of laboratory casework and fume hoods provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged laboratory casework and fume hood finish.
 - b. Furnish complete touchup kit for each type and color of laboratory casework and fume hood counter tops provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged count top finish.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:

- 1. Coordinate delivery of tops, sinks, accessories, fittings and equipment with laboratory casework and fume hood items.
- 2. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage products to be embedded in concrete and masonry in ample time to prevent delaying the Work.
- 3. Inspect all boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.
- 4. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:

- 1. Protect finished surfaces from soiling and damage during handling and installation.
- 2. Keep all products off ground using pallets, platforms, or other supports. Protect steel and packaged materials from corrosion and deterioration.
- 3. Keep covered with polyethylene film or other protective covering.
- 4. Conform to Section 01 66 00, Product Storage and Handling Requirements.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install laboratory casework and fume hoods until building is enclosed, utility roughing-in and wet work are complete and dry, and temporary HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.7 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework and fume hoods.
- B. Coordinate installation of laboratory casework and fume hoods with installation of other laboratory equipment.
- C. Coordinate installation of laboratory casework and fume hoods with installation of plumbing, HVAC, and electrical utilities, before and after installation.

1.8 WARRANTY

- A. Provide manufacturer's one year warranty against defects in materials and workmanship. Subject to provisions of the warranty, manufacturer agrees to repair or replace non-conforming products or its parts for the warranty period following substantial completion.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE- GENERAL

- A. System Structural Performance: Laboratory casework and support framing system shall withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:
 - 1. Support Framing System: 600 lb/ft.
 - 2. Suspended Base Cabinets (Internal Load): 160 lb/ft.
 - 3. Work Surfaces (Including Tops of Suspended Base Cabinets): 160 lb/ft.
 - 4. Wall Cabinets (Upper Cabinets): 160 lb/ft.
 - 5. Shelves: 40 lb/sq. ft.
- B. Delegated Design: Design laboratory casework, fume hoods, including comprehensive engineering analysis by a qualified professional engineer, using seismic performance requirements and design criteria indicated.

2.2 SYSTEM PERFORMANCE - FUME HOODS

- A. Ventilation;
 - 1. Refer to contract drawig for fume hood ventilation layout.
 - a. Constant-Volume Fume Hoods: Provide constant-volume fume hoods with by pass.
 - b. Restricted Bypass Fume Hoods: Provide restricted bypass fume hoods. Partial compensating bypass above sash opens after sash is closed to less than 20 percent open. Design partial bypass to maintain sufficient exhaust air volume through hood to adequately dilute hazardous fumes regardless of sash position.

- B. Containment: Provide fume hoods that comply with the following when tested according to ASHRAE 110 at a release rate of 4.0 L/min.:
 - 1. Average Face Velocity: 100 fpm plus or minus 10 percent with sashes fully open.
 - 2. Face-Velocity Variation: Not more than 10 percent of average face velocity.
 - 3. Sash Position: Fully open.
 - 4. As-Manufactured (AM) Rating: AM 0.05.
 - 5. As-Installed (AI) Rating: AI 0.10.
- C. Static-Pressure Loss: Not more than 1/2-inch wg at 100-fpm face velocity when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.

2.3 MANUFACTURERS

- A. Products and Manufacturers: Provide of one of the following:
 - 1. Flush Overlay Casework by ICI Scientific.
 - 2. Flush Overlay Steel Casework by Fisher Hamilton LLC, Thermo Fisher Scientific, Incorporated
 - 3. Or equal.

2.4 LABORATORY CASEWORK MATERIALS

- A. Metals:
 - 1. Shall be prime furniture steel, ASTM A1008/A1008M, stretcher- or roller-leveled, free of scale, buckles, and other defects. Metals shall be ASTM A366, E finish.
 - 2. Minimum Gauge: Provide steel laboratory furniture components of the following minimum US standard gages:
 - a. Solid door interior panels, drawer fronts, scribing strips, filler panels, enclosures, drawer bodies, shelves, security panels and sloping tops: 20 gage. For shelves over 3.0 feet long, provide added reinforcement or use 18-gage material.
 - b. Case tops, ends, bottoms, bases, backs, vertical posts, uprights, glazed door members, door exterior panels and access panels: 18 gage.
 - c. Top front rails, top rear gussets, intermediate horizontal rails, table legs and frames, leg rails and stretchers: 16 gage.
 - d. Drawer runners, door and case hinge reinforcements, and sink supports: 14 gage.
 - e. Leveling and corner gussets: 11 gage.

2.5 MISCELLANEOUS LABORATORY CASEWORK MATERIALS

- A. Auxiliary Cabinets Materials
 - 1. Acid Storage-Cabinet Lining: 1/4-inch-thick, epoxy lining material.
 - 2. Glass for Glazed Doors: Clear tempered glass complying with ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality-Q3; not less than 5.0 mm thick.

- B. Tops, Box Curbs, Splash Rim:
 - 1. Provide smooth, clean, exposed tops and edges, in uniform plane free of defects. Exposed edges and corners shall be uniformly rounded.
 - 2. Top Sizes: Provide tops in maximum lengths available.
- C. Stainless-Steel Shelves: Made from stainless-steel sheet, not less than 0.050-inch nominal thickness, with No. 4 satin finish.

2.6 COUNTERTOP, SINK, AND WORK SURFACE MATERIALS

- A. Stainless Steel:
 - 1. Stainless steel tops and work surfaces shall be Type 304 with #4 finish per ASTM A666, unless otherwise specified.
 - 2. All exposed surfaces shall be 16 GA stainless steel reinforced on the underside with 18 GA galvanized steel hat channels, secured with 3m adhesive and spaced to prevent twisting, oil-canning or buckling, and to provide a mounting surface where the top interfaces with cabinets or table frames beneath.
 - 3. Splash rails and curbs on the back or ends of the top shall be formed from the same sheet, when tooling permits, or spot-welded directly to the top in the case where column notches, umbilical notches or pipe chase notches are employed.
 - 4. In these instances the curb will not have a seamless appearance. Top edges of curbs and backsplash shall be formed into a channel shape.
 - 5. Stainless steel sinks shall be included in the work surface, the sink bowl shall be welded to the top as to form an integral part thereof.
 - a. All welds shall be ground smooth and polished to a uniform satin finish over the entire top and sink bowl assembly.
 - b. Soldering of the sinks, curbs or splash rails to the top shall not be permitted.
 - c. Mechanical joints or field joints, where made necessary by size, shall be a tight butt joint of the top surfaces, reinforced and held in alignment with steel reinforcements.
 - d. Underside of tops and sinks shall be spray coated with a water-soluble sound dampening material unless otherwise specified.

2.7 FABRICATION OF FIXED METAL LABORATORY CASEWORK

- A. General:
 - 1. Fabricate laboratory casework to dimensions, profiles and details shown on approved Shop Drawings and the Specifications.
 - 2. Construction and Arrangement:
 - a. Construction and design of laboratory casework Work shall provide optimal strength and rigidity possible in each sectional unit.
 - b. Fabricate each sectional unit, ready for installation in the overall laboratory furniture and equipment assembly. Each section shall be completely rigid, integral unit to allow relocation in the future.
 - c. Factory-assemble units in components as large as practicable to minimize field-jointing.

- d. Component parts shall be die-formed, shall be uniform and interchangeable, and shall be assembled in jigs for accurate alignment.
 - e. Units shall have smooth, cleanable interior.
- 3. Fastening and Jointing:
 - a. Where units are joined together in assemblies, they shall be fastened by bolting through side panels with 1/4-20 bolts.
 - b. Cabinet parts shall be both electrically welded and notched, keyed, and overlapped to form interlocking joint construction. Electro-welding shall include spot-welding, arc-welding and heliarc-welding.
 - c. Notching, piercing, bending, or framing not specifically called for in the Contract Documents is not allowed.
 - d. Die-pierced slots and perforations, required for mounting case channels, hinges, or shelf brackets, shall not be visible from exterior of assembled furniture. Do not use screws in construction of the unit proper; use screws only where backs, pans, and panels are to be removable for accessibility.
- 4. Doors and Drawers:
 - a. Provide standard cabinet units that allow quick and easy change, after installation, from drawers to doors, or vice-versa. Provide standard cabinet units that allow substitution of two half-depth drawers in place of a standard depth drawer without using drills or machinery, with the purchase of necessary parts for such conversion.
 - b. Doors and drawer heads of shall be removable for decontamination and cleaning. Doors and drawers shall be removable with door hinges readily replaceable.
 - c. Doors and drawers shall be sound-deadened.
- 5. Hardware:
 - a. Factory-install hardware uniformly and precisely after finishing is complete. Set hinges snug and flat in mortises unless otherwise indicated. Turn screws to flat seat. Adjust and align hardware so that moving parts operate freely and contact points meet accurately. Allow for final field adjustment after installation.
 - b. Hinges shall be applied to case and door bodies as specified in this Section. Do not weld hinges to door or case.
- 6. Leveling: Provide sectional units to be located on laboratory floor with leveling devices easily adjustable from within the units, to compensate for unevenness in laboratory floor.

B. Base Units:

- 1. End uprights shall be formed into not less than channel shapes or stronger shapes at front, top, back, and bottom. Upright shall be keyed to mating horizontal members that shall be electro-welded at all junctures.
- 2. Form bottom front horizontal toe space rail to provide rectangular recessed toe space fully enclosed, having channel formation at face and bottom. Toe space shall be integral with cabinet 3-inches deep by 4-inches high and dust-proof.
- 3. Frame assembly shall consist of upper and lower angular sections welded to left and right angular upright sections forming outer frame. Vertical and horizontal intermediates shall be channel sections. Frame assembly shall be

readily removable as a unit for complete and unhindered access to base unit interior. Frame shall have cushioning neoprene gasket against which all drawers and doors will close to prevent dust gaps, provide sound-deadening, and to seal out spillage from cabinet. Frame shall be designed so that all drawers and doors are separated by concealed horizontal support rails.

4. Cupboard bottom shall be full depth and width of all cases to prevent dirt from entering cabinet. Bottom shall be both arc-welded and spot-welded in place to provide rigidity in base of unit. Four 7/8-inch diameter holes shall be punched in cupboard bottom directly over and for access to unit leveling bolts.
5. Backs of all units shall be designed with top and bottom rail, and section between rails shall be left open for simple access to plumbing lines without disassembling entire unit. Units shall be provided with removable backs (removable without using tools) to close space between the top and bottom rails.
6. Adjustable shelves shall be constructed with double channels at front and rear, formed down on ends. Shelves shall be supported by shelf support channel that shall rest on adjustable shelf clips.
7. Roll-out shelves shall be provided on all single cupboard units, 18-inches or 24- inches wide, to provide safe access to rear of shelves. Construct shelves with rolled front edge as strengthener and shelf pull, and allow shelf to be used as tote tray. All other cupboard units shall have half-depth adjustable shelves.
8. Drawer assembly shall consist of drawer back, drawer body, inner drawer head, and outer drawer head. Entire drawer head assembly shall not be at least 3/4-inch thick. Drawer shall operate quietly and smoothly on nylon roller channel suspension with front ball-bearing rollers set into case channels and rear nylon rollers set into drawer channels. No steel-to-steel contact is allowed. Suspension system shall maintain drawer alignment and be equipped with integral drawer stops to eliminate inadvertent removal of drawer. Removal of drawer shall be possible without using tools. Drawers shall be assisted in self-closing during approximately the last three inches of travel and shall lock in fully open position requiring slight lifting of drawer from level position to actuate the self-closing feature. Drawers shall be sound deadened and shall close against neoprene-coated urethane foam gasketing on the unit frame. Drawer parts shall be phosphate-coated and completely painted before final assembly.
9. Door assembly shall consist of an inner and outer door pan. Door assembly shall be 3/4-inch thick. Outer pan shall be punched for attachment of door pull. Inner door pan shall be perforated and embossed for installation of lock. Weld 14-gage hinge reinforcement to inner pan at hinge locations before pan assembly. All parts of door assembly that will be concealed after door is assembled shall be fully painted before door assembly. Assemble door so that it may be taken apart for decontamination when necessary. Provide doors with waffle-type sound deadener, cut to correct size and thickness, and installed before door assembly. When mounted on the case, doors shall swing 180 degrees and will support, without sagging, a 200-pound weight suspended at outer edge of door while door swinging. Door catches shall be of steel with two-way compression springs attached in manner that no turning of handles is required to open door, nor shall catches wear on painted surfaces or edges.

Doors shall close against cushioning neoprene-coated urethane foam gasket on unit frame. Left-hand door on double-cupboard units shall have rubber astragal on outer vertical edge to dust-seal interior of cabinet.

10. Accessibility-Compliant: Where indicated, casework shall meet the applicable requirements of ADA and local codes.

C. Vacuum Pump Storage Cabinets: Shall employ the same materials, hardware and construction methods as standard base cabinets with the following exceptions:

1. Case:
 - a. Shall include acoustical insulation on the interior of the cabinet for noise absorption, rated for flammability to UL94 HF-1.
 - b. Bottomless, to facilitate movement of the mobile pump caddy in and out of the cabinet.
 - c. Removable back for access to services behind cabinet
 - d. Perforated at rear for use of venting apparatus.
2. Doors:
 - a. Hinged doors with integral toe space.
 - b. Includes acoustical insulation affixed to door inner panel, rated for flammability to UL94 HF-1.
3. Mobile Pump Caddy:
 - a. 11 GA steel platform with four integral lips and welded in each corner to safely contain any accidental spills.
 - b. Includes casters, swivel type; locking casters optional.
 - c. Shall have a maximum load capacity of 300 lb.
4. Additional Features:
 - a. Shall incorporate an integral electrical switch (120V, 20 amp) with pilot light to indicate the operational mode of the vacuum pump unit.
 - b. Shall include an electrical duplex, located in the rear of the cabinet, for the vacuum pump plug end. Outlet is to be accessible from the inside of the cabinet and be hard wired to the electrical switch.
 - c. Optional exhaust fan can be employed for greater heat loads or as specified. The exhaust fan assembly will be attached to the exterior of the cabinet and incorporate a 4" diameter duct collar connection. Note: connection by others.

2.8 LABORATORY FUME HOODS

A. Bench-Mounted, Laboratory Fume Hoods:

1. Performance Standard: SEFA 1, Recommended Practices for Fume Hoods.
2. Ventilation Type: Refer to Contract Documents.
3. Dimensions:
 - a. Length: 4.0 feet.
 - b. Width: 31.25 inches.
 - c. Height: 8.0 feet plus 4.25 inches for sash in fully opened position.
4. Metal Cabinet Understructure: Provide double-door acid or flammable liquid storage cabinet to match laboratory casework in material, style and color.
5. Worktop: Epoxy resin to match countertops specified in Article 2.6, below, dished not less than 3/8-inch to retain spillage. Provide nine-inch by three-inch

epoxy resin oval drain cup sink with removable lead strainer. Pre-drill top to accept manufacturer's standard acid storage vent system.

6. Electrical: Provide enclosures as follows:
 - a. Four 120-volt AC flush electric convenience receptacles.
 - b. Exhaust fan controls shall be as specified in Section 23 09 00, Instrumentation and Control for HVAC.
 - c. Manufacturer's standard fluorescent light fixture with one, 40-watt fluorescent luminaire.
7. Provide all side-mounted, remote control fittings for fume hood. Coordinate remote control fittings with fume hood selected. Provide the following:
 - a. Water: Heat-treated, enamel finished, six-inch spread vacuum breaker gooseneck water fitting with straight serrated hose connector, single outlet turret, and rigid gooseneck coupling; 45-degree angle flange, and disc type angle remote control valve with renewable internal assembly; brass tank nipple, locknut and washer. Provide individual hot and cold handles.
8. Cubic Feet per Minute and Static Pressure Data:
 - a. Opening Height: 27 to 30 inches.
 - b. Air Flow Capacity: Minimum 760 cfm total at 100 feet per minute face velocity and 1/4-inch water gage static pressure in air chamber.
9. Features: Provide the following:
 - a. Interior of fume hood lining and baffle shall be 1/4-inch thick polyresin.
 - b. Fixed open center slot and adjustable upper and lower exhaust slots.
 - c. Counterbalanced sash with 1/4-inch thick clear laminated safety glass.
 - d. Hood superstructure and understructure fabricated of cold rolled steel, phosphate coated with baked enamel finish to match laboratory casework. Refer to Article 2.4 above.
 - e. All necessary struts, supports, and other fabrication assemblies for complete, properly operating installation.
10. Hood Accessories:
 - a. Airflow Indicator: Provide each fume hood with airflow indicator:
 - 1) Indicator Type: Thermal anemometer that measures fume hood Fume face velocity and indicates whether it is below normal, normal, or above normal.
 - 1) Indicator Type: Thermal anemometer that measures fume hood face velocity and displays data as digital readout.
 - b. Airflow Alarm: Provide fume hoods with audible and visual alarm that activates when airflow sensor reading is outside of preset range.
 - 1) Provide with thermal-anemometer gage airflow sensor.
 - 2) Provide with reset and test switches.
 - 3) Provide with switch that silences audible alarm and automatically resets when airflow returns to within preset range.
 - c. Sash Alarm: Provide fume hoods with audible and visual alarm that activates when sash is opened beyond preset position.
 - 1) Provide with silence and test switches.
 - d. Sash Stops: Provide fume hoods with sash stops to limit hood opening to 50 percent of sash height. Sash stops can be manually released to open

- sash fully for cleaning fume hood and for placing large apparatus within fume hood.
- e. Bypass Grille Blank-off Panel: Provide fume hoods with blank-off panel on bypass grille designed for use with sash stops to reduce exhaust air volume and provide design face velocity with sash at 50 percent open position.
- 11. Accessibility-Compliant: Where indicated, fumehoods shall meet the applicable requirements of ADA and local codes.
- 12. Products and Manufacturers: Provide products of one of the following:
 - a. SafeAir II Hood with Accessories, by Thermo Scientific, Thermo Fisher Scientific, Incorporated.
 - b. Supreme Air System Laboratory Fume Hoods by Kewaunee Scientific Corporation.
 - c. Or equal.

2.9 MISCELLANEOUS CASEWORK

B. Acid Storage Fume Hood Cabinets:

1. Acid storage fume hood cabinets shall utilize the same gauges of steel and construction features as other base cabinets except they shall be completely lined with a one piece Polyethylene corrosion resistant liner. The liner shall be 1/4" thick, molded into a seamless tub, including top, sides and bottom, with a 1" lip at the bottom front to contain spills. Each door shall have a set of louvers at the top and bottom, and have a 1/8" sheet polyethylene liner. Each cabinet shall be vented into the fume hood with a 1-1/2" vent pipe. It should provide a positive airflow directly into the fume hood exhaust system. Where indicated, supply an epoxy coated wire shelf supported by integral brackets built into the Polyethylene liner.

C. Solvent Storage Cabinets:

1. Solvent storage cabinets shall be specifically designed for the storage of flammable and combustible liquids. Construction shall be based upon the requirements listed by UFC, OSHA and NFPA No. 30 - 1993, and cabinets shall be UL approved and labeled. The bottoms, top, sides and doors shall be fabricated of 18 gauge steel and shall be all double panel construction with a 1-1/2-inch air space between panels. All joints shall be welded, or screwed, to provide a rigid enclosure. The doors shall swing on full-length stainless steel piano hinges and shall be fully insulated. The doors are self-closing and synchronized so that both doors will always fully close. The right hand door is equipped with a three-point latching system that automatically engages when the doors close. Each door is equipped with a fusible-link hold-open feature that will ensure the door closes should the temperature outside the cabinet exceed 165 degrees Fahrenheit. Units 24-inch long has only one door, self-closing, and equipped with a three-point latching system and hold-open feature. A 2-inch deep liquid tight pan that covers the entire bottom of the cabinet shall be furnished to contain liquid leaks and spills. A full-depth adjustable shelf is also provided. The shelf is perforated to allow air circulation within the cabinet. Two diametrically opposed vents with spark

screens are provided in the back of the cabinet as well as a grounding screw. The cabinet shall have interior finish same as exterior. The cabinet shall be labeled: "FLAMMABLE- KEEP FIRE AWAY".

D. Table Apron Units:

1. Table apron units, either freestanding or with leg assemblies shall be assembled from apron sections mounted to adjoining base units or with legs fastened to the apron. Construct entire assembly to be easily disassembled and reassembled with minimum use of tools. Do not weld leg tubing to apron frame.
2. Table legs shall be two-inch square continuous electro-welded tubing. Table legs shall be provided at floor side with die-formed 14-gage gusset with tee nut welded on gusset to receive an adjusting bolt.

2.10 FINISH FOR METAL LABORATORY CASEWORK AND FUME HOODS

- A. General: Prepare, treat, and finish welded assemblies after assembling. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.
- B. Preparation: After assembly, clean surfaces of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply laboratory casework manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.
 2. Colors for Metal Laboratory Casework Finish: Selected by ENGINEER from manufacturer's full range.

2.11 HARDWARE AND ACCESSORIES FOR METAL LABORATORY CASEWORK

- A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.
- B. Hinges: Stainless-steel, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 for doors 48 inches high or less and 3 for doors more than 48 inches high.
 1. Design: Selected from manufacturer's full range.
 2. Overall Size: Selected from manufacturer's full range.
- C. Sliding Door Pulls: Stainless-steel recessed flush pulls.

1. Design and Size: Selected from manufacturer's full range.
- D. Pulls: Selected from manufacturer's full range. Provide 2 pulls for drawers more than 24 inches wide.
- E. Pulls for Metal Cabinets: Selected from manufacturer's full range.
- F. Pulls for Phenolic-Resin Cabinets: Selected from manufacturer's full range.
- G. Catches can be eliminated if self-closing hinges are used. Roller spring catches cost more than magnetic catches but are more effective.
- H. Door Catches: Nylon-roller spring catches. Provide 2 catches on doors more than 48 inches high.
- I. Drawer Slides: Side mounted, epoxy-coated steel, self-closing; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.
 1. Heavy Duty 150 lb: Full-extension, ball-bearing type.
- J. Drawer Slides for phenolic-resin Cabinets: Hardwood runners under centers of drawers with polymer guides fastened to backs of drawers.
- K. Label Holders: Stainless steel, aluminum, or chrome plated; sized to receive standard label cards approximately 1 by 2 inches, attached with screws or rivets. Provide on all drawers.
- L. Locks for Metal Cabinets: Cam or half-mortise type with 5-pin tumbler, brass with chrome-plated finish.
 1. Provide a minimum of two keys per lock and master keys.
 2. Provide where indicated.
 3. Master Key System: Key all locks to be operable by master key.
- M. Locks for phenolic-resin Cabinets: Cam type with 5-pin tumbler, brass with chrome-plated finish.
 1. Provide a minimum of two keys per lock and two master keys.
 2. Provide where indicated.
 3. Keying: Key locks as directed.
 4. Master Key System: Key all locks to be operable by master key.
- N. Sliding-Door Hardware Sets: Laboratory casework manufacturer's standard, to suit type and size of sliding-door units.
- O. Adjustable Shelf Supports for phenolic-resin Cabinets: Powder-coated steel shelf rests complying with BHMA A156.9, Type B04013.
- P. Adjustable Wall Shelf Supports: Surface-type steel standards and steel shelf brackets, with epoxy powder-coated finish.

- Q. Accessibility-Compliant: Where indicated, hardware shall meet the applicable requirements of ADA and local codes.

2.12 COUNTERTOPS, TABLETOPS, WORKING SURFACES, AND SHELVES

- A. Countertops, Tabletop, and Work Surfaces:
1. Stainless steel tops and work surfaces shall be Type 304 with #4 finish per ASTM A666, unless otherwise specified.
- B. Shelves.
1. Stainless-Steel Shelves: Weld shop-made joints. Fold down front edge 3/4 inch; fold up back edge 3 inches. Provide integral stiffening brackets, formed by folding up ends 3/4 inch and welding to upturned back edge. After fabricating, grind welds smooth and polish as needed to produce uniform, directionally textured finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
- C. Accessibility-Compliant: Where indicated, counter tops, work surfaces and shelves shall meet the applicable requirements of ADA and local codes.

2.13 FITTINGS AND APPURTENANCES – GENERAL

- A. Basis of Design Products and Manufacturers: Provide one of the following:
1. ColorTech, by WaterSaver Faucet Company, Inc.
 2. Service Fittings and Fittings by Kewaunee Scientific Corporation
 3. Or equal
- B. Performance Standard:
1. SEFA 7, Laboratory and Hospital Fittings - Recommended Practices.
- C. Materials: Fabricated from cast or forged red brass unless otherwise indicated.
1. Reagent-Grade Water Service Fittings: Polypropylene, PVC, or PVDF for parts in contact with water.
- D. Finish: Acid- and solvent-resistant powder coating complying with requirements in SEFA 7 for corrosion-resistant finishes.
1. Provide chemical-resistant powder coating in laboratory casework manufacturer's standard metallic brown, aluminum, white, or other color as approved by Architect.
- E. Service Fittings: Provide units complete with washers, locknuts, unions, nipples, and other accessories for positive mounting to supporting laboratory furniture and utilities. Include wall and deck flanges, escutcheons, handle extension rods, remote valves, and similar items required. Fabricate units to withstand test pressure of 100 psi unless higher pressure is specified for the related utility piping.
- F. Service Outlet Identification: Provide colored plastic index discs with embossed identification letters at each service fixture handle or knob. Secure discs to fixture

- handles to be virtually tamperproof. Comply with SEFA 7 for colors and embossed identification.
- G. Ground Key Hose Cocks: Tapered core and handle of one-piece forged brass, ground and lapped, held in place under constant spring pressure. Provide units designed for working pressure up to 40 psig, with serrated outlets.
 - H. Handles: Provide three-arm or four-arm forged brass handles for valves, stops, faucets, remote controls, and cocks, except for ground key cocks, steam valves, and micro-adjustable needle cocks. Provide lever-type handles for ground-key cocks for accessibility- compliant fittings. Lever handle aligns with outlet when valve is closed and is perpendicular to outlet when valve is fully open.
 - I. Needle Valves: Provide units with renewable self-centering floating cones and renewable seats of stainless steel or Monel metal.
 - 1. Provide units designed for working pressure up to 125 psig.
 - J. Water Valves and Faucets: ASME A112.18.1; Provide units with renewable barrel locked in valve body. Barrel shall contain all wearing parts, with renewable discs; 80 psig.
 - K. Hand of Fittings: Provide right-hand fittings.
 - L. Accessibility-Compliant: Where indicated, fittings shall meet the applicable requirements of ADA and local codes.

2.14 SERVICE ACCESSORIES

- A. Provide service fittings, media fittings, and fume hood fittings with heat-treated, enamel-coating electrostatically applied and baked to uniformly homogeneous surface, except where noted. All fittings, except burning gas, shall incorporate non-rotating, non-rising spindle with isolating ball valve (Broen Ballofix or equal) on the inlet. Fittings that do not incorporate Ballofix valve shall include separately-furnished inlet valves to be installed inline by CONTRACTOR.
- B. Performance Standard:
 - 1. SEFA 7, Laboratory and Hospital Fittings - Recommended Practices.

- C. Gas, Vacuum, and Compressed Air Service:
1. Ground Key Outlets: Provide ground key valve for vacuum, natural gas, and compressed air with 3/8-inch IPS female threaded, inlet deck-mounted flange.
 2. Basis of design Products and Manufacturers: Provide one of the following:
 - a. ColorTech, by WaterSaver Faucet Company, Incorporated.
 - b. Service Fittings and Fittings by Kewaunee Scientific Corporation
 - c. Or equal.
- D. Potable Hot and Cold Water Mixing Outlets: Use for mixing of hot and cold water (HCW), deck-mounted, as follows:
1. HCW: Swivel goose-neck with vacuum breaker.
 2. Basis of Design Products and Manufacturers: Provide products of one of the following:
 - a. ColorTech, by WaterSaver Faucet Company, Incorporated.
 - b. Service Fittings and Fittings by Kewaunee Scientific Corporation.
 - c. Or equal.
- E. Electrical Service Outlet, Flush Mount Type Fittings: Furnish the following flush mounted fixture units as shown:
1. Flush receptacle in single gang box, single stainless steel face plate with 20-amp, 120-volt, duplex, single phase, three-wire polarized grounding type receptacles.
 2. Flush receptacle in single gang box, single stainless steel face plate with 20-amp, 250-volt, single phase, three-wire polarized grounding type receptacles.
 3. Pedestals, single and double stainless steel face plate with 20-amp, 120-volt, duplex, single phase, three-wire polarized grounding type receptacles.
 4. Pedestals, single and double, single stainless steel face plate with 20-amp, 250-volt, single phase, three-wire polarized grounding type receptacles.
 5. Products and Manufacturers: Provide products of one of the following:
 - a. ColorTech, by WaterSaver Faucet Co. Incorporated.
 - b. Service Fittings and Fittings by Kewaunee Scientific Corporation.
 - c. Or equal.
 6. Undercabinet Task-Light Fittings: Single-tube fluorescent fittings with switch and heavy-duty cord and plug.
 - a. Finish: Baked enamel.
 - b. Diffusers: Virgin acrylic with high resistance to yellowing and other changes due to aging, heat, and UV radiation.
 - c. Ballast Sound Rating: A.
- F. Accessibility-Compliant: Where indicated, service accessories shall meet the applicable requirements of ADA and local codes.

2.15 LABORATORY ACCESSORIES

- A. Reagent Shelves: Provide as indicated, fabricated from same material as adjacent countertop, unless otherwise indicated.

- B. Burette Rods: Stainless-steel rods, 1/2 inch in diameter and 18 inches long, threaded on 1 end to fit tapered plug adapter for flush socket receptacle. Provide with tapered plug adapter and receptacle.
- C. Upright Rod Assembly and Metal Crossbar: Stainless steel. Two vertical rods and 1 horizontal crossbar, 3/4 inch in diameter and 36 inches long, unless otherwise indicated; 2 flush socket receptacles and 2 crossbar clamps. Ends of vertical rods are tapered to fit receptacles; all other rod ends are rounded.
- D. Greenlaw Arm Assembly: Stainless-steel vertical rod, tapered on one end to fit flush socket receptacle. Adjustable crossbar of hardwood with black, acid-resistant finish, secured to upright with adjustable clamp. Provide with receptacle.
- E. Lattice Assembly: Stainless-steel, vertical and horizontal rod lattice assembly with 3/4-inch diameter rods at approximately 12 inches o.c. with 2 flush socket receptacles for mounting.
 - 1. Size: 36 inches wide by 36 inches high.

2.16 LABORATORY EQUIPMENT

- A. Refer to Section 11 53 00, Laboratory Equipment.

2.17 EMERGENCY SHOWERS AND EYEWASH FOUNTAINS

- A. Refer to Section 22 11 16, Domestic Water Piping.

2.18 OFFICE FURNITURE

- A. Refer to Section 12 50 00, Furniture.
- B. Provide pantry area casework as part of laboratory casework.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine substrates and conditions under which laboratory casework Work will be installed. Determine that all plumbing, HVAC, and electrical work is installed to accept laboratory and fume hood fittings. Notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION OF CASEWORK

- A. General:
 - 1. Comply with installation requirements in SEFA 2.3. Install products plumb, level, true, and straight with no distortions.

2. Shim using concealed shims, as required. Refer to Section 06 10 53, Miscellaneous Rough Carpentry.
 3. Where laboratory casework abuts other finished work, scribe and apply filler strips for accurate fit with all fasteners concealed where practicable. Do not exceed the following tolerances:
 - a. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
 - b. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
 - c. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
 - d. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
 - e. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
 4. Install casework, fume hoods and equipment furnished by others as shown.
- B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.
- C. Base Cabinets:
1. Where required, assemble units into one integral unit with joints flush, tight, and uniform.
 2. Provide holes for mechanical and electrical Work as shown or as directed by trades involved.
 3. Fasten each individual cabinet to floor at toe space, with fasteners spaced 2.0 feet on centers. Bolt continuous cabinets together. Secure individual cabinets with at least two fasteners into floor where cabinets do not adjoin other cabinets.
 4. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by the manufacturer.
- D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches o.c.
- E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- F. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.
- G. Countertops:
1. Comply with installation requirements in SEFA 2.3. Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints only where shown on Shop Drawings.
 2. Field Jointing: Where practicable, make in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field joints as shown on approved Shop Drawings, factory prepared so that there is no Site processing of top and edge surfaces.

- a. Use concealed clamping devices for field-made joints in plastic-laminate countertops. Locate clamping devices within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a uniform heavy pressure at joints
- 3. Fastenings:
 - a. Use concealed clamping devices in accordance with manufacturer's instructions to exert a constant, heavy clamping pressure at joints.
 - b. For epoxy tops, secure to cabinets with epoxy cement applied at each corner and along perimeter edges at no greater than 4.0 feet on centers.
- 4. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection. Provide flush hairline joints in top units using clamping devices. At stone-type material joints, use manufacturer's recommended adhesives and holding devices to provide joint widths no more than 1/16-inch wide, completely filled and flush with abutting edges.
- 5. Where necessary to penetrate tops with fasteners, countersink heads approximately 1/8-inch and plug hole flush with material equal in chemical resistance, color, hardness, and texture to top surface.
- 6. After installation, carefully dress joints smooth, remove surface scratches, and clean and polish entire surface.
- 7. Provide all holes and cut-outs required for all mechanical and electrical services to fittings and appliances.
- 8. Provide scribe moldings for closures at junctures of top, curb, and splash with walls as recommended by manufacturer for materials involved. Use chemical resistant, permanently elastic sealing compound where recommended by the manufacturer.

H. Sinks:

- 1. Comply with SEFA 2.3.

I. Accessories:

- 1. Install in accordance with approved Shop Drawings, installation requirements in SEFA 2.3, and with manufacturer's written instructions. Turn screws to flat seat; do not drive screws. Adjust moving parts to operate freely without excessive bind.

3.4 INSTALLATION OF FUME HOODS

- A. General: Install fume hoods according to approved Shop Drawings and manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels, but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Comply with requirements in Article 3.1 above for installing fume hoods on base cabinets, with work tops, and sinks.

- C. Comply with requirements in Article 3.7, below for installing water and laboratory gas service fittings and electrical devices.
- D. Perform field tests as indicated in Article 3.9.

3.5 INSTALLATION OF MISCELLANEOUS ITEMS

- A. Shelves
 - 1. Securely fasten adjustable shelving supports, stainless-steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.
 - a. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.
- B. Pegboards: Securely fasten pegboards to partition framing, wood blocking, or reinforcements
- C. Coordinate the installation of HVAC fans and ductwork after laboratory casework and fume hood installation. Refer to Section 23 31 13, Metal Ductwork and 23 34 14, Mixed-Flow Laboratory Exhaust HVAC Fans.
- D. Coordinate the installation of water, gas, and vacuum after laboratory casework and fume hood installation. Refer to Section 22 10 53, Installation of Plumbing Piping, Section 22 11 16, Domestic Water Piping, and Section 22 13 16, Sanitary Waste and Vent Piping.
- E. Coordinate the installation of electrical service after laboratory casework and fume hood installation. Refer to Section 26 05 33.13, Rigid Conduits; Section 26 05 33.16, Flexible Conduits, and Section 26 05 33.36, Outlet Boxes.

3.6 INSTALLATION OF SERVICE FITTINGS

- A. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.

3.7 INSTALLATION OF ACCESSIBILITY-COMPLIANT CASEWORK AND FUME HOODS

- A. Install in accordance with SEFA 2.3, ADA, and Laws and Regulations.

3.8 CLEANING AND PROTECTION

- A. Repair, or remove and replace, defective Work as directed by ENGINEER.

- B. Clean shop-finished surfaces, touch-up as required, and remove or refinish damaged or soiled areas, as recommended by manufacturer and acceptable to ENGINEER.
- C. Adjust fume hood moving parts for smooth, near silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.
- D. Clean fume hood finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by ENGINEER.
- E. Protect laboratory casework Work and fume hoods from damage until Substantial Completion. Take precautions and provide protective measures as recommended by manufacturer, and coordinate protective practices with work of other trades.

3.9 FIELD QUALITY CONTROL

- A. Field Quality Control:
 - 1. After installation and completion of connections, with ENGINEER, verify installation and proper functionality of all Work included in this Section. Correct deficiencies until all Work functions properly.
- B. Field test installed fume hoods according to ASHRAE 110, as modified in Article 2.2 above, to verify compliance with performance requirements.
 - 1. Adjust fume hoods, hood exhaust fans, and building's HVAC system, or replace hoods and make other corrections until tested hoods perform as specified.
 - 2. After making corrections, retest fume hoods that failed to perform as specified
 - 3. Coordinate fume hood testing with the testing in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

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SECTION 12 50 00

FURNITURE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all furniture Work.
2. Extent of the furniture Work is shown and specified.
3. Types of furniture Work required includes, but is not limited to, the following:
 - a. Desks.
 - b. Chairs.
 - c. File Cabinets.
 - d. Tables.
 - e. Miscellaneous Accessories.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the Work that must be installed with the furniture Work.
2. Notify other contractors in advance of the furniture Work, to provide them with sufficient time for the installation of and coordination of items included in their contracts that must be installed in conjunction with the furniture Work.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities.
2. California Bulletin 117, Requirements, Test Procedures and Apparatus for Testing the Flame Retardance of Resilient Filling Materials Used in Upholstered Furniture.

1.3 QUALITY ASSURANCE

- ###### A. Catalog Standards:
- The use of catalog numbers and the specific requirements set forth in these Specifications are not intended to preclude the use of any other acceptable manufacturer's products which may be equivalent, but are provided for the purpose of establishing a standard of design and quality for materials, construction and workmanship. Some catalog numbers may be void at time of bidding due to catalog revisions. Provide products equal in quality to those specified.

- B. Design Criteria: Provide the following:
1. Fabric of 80 percent wool and 20 percent nylon with acrylic latex backing fluorochemically treated for soil and stain repellency, fire retardant treated and mothproofed.
 2. Upholstered items shall be capable of being reupholstered without special equipment and using the manufacturer's standard interchangeable reupholstery system.
 3. Manufacturers of "or equal" products shall be able to supply exactly the same design, colors, fabrics and textures as the manufacturer specified.

1.4 SUBMITTALS

- A. Action Submittals: Provide the following:
1. Product Data:
 - a. Manufacturer's catalog cuts noting required items and installation instructions for each piece of furniture.
 2. Samples:
 - a. 3-inch by 5-inch sample of all fabric, paint surface and laminate finish and colors.
- B. Informational Submittals: Submit the following:
1. Certification:
 - a. Products specified.
 2. Test and Evaluation Reports:
 - a. Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of furniture with requirements of specified product standard and system structural performance specified in Article 2.1.
 - b. Product test reports for countertop surface material: based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of countertop surface materials with requirements specified for chemical and physical resistance.
 3. Suppliers's Instructions:
 - a. Installation Data.
 - b. Procedures and precautions for protecting furniture Work.
- C. Closeout Submittals: Submit the following:
1. Operations and Maintenance Data: Provide detailed maintenance manual for products specified in this Section:
 - a. Identify Manufacturer, product name, and model number of each product used in the Work.
 - b. Name, address and telephone number of Manufacturer, local distributor, and technical representative.
 - c. Detailed procedures for routine maintenance and cleaning.
 - d. Detailed procedures for light repairs such as dents, scratches, and staining.

- 2. Warranty Documentation:
 - a. Finishes.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Take all necessary precautions to prevent damage to furniture during shipment and delivery. Securely fasten the furniture to the truck to prevent movement or damage during shipment. The ENGINEER shall examine all furniture before and during unloading.
- B. Handling: Carefully handle all furniture to prevent damage. Furniture that is chipped, gouged, dented or otherwise damaged will not be accepted.
- C. Storage of Material: No furniture shall be delivered and stored at the Site until the rooms designated to receive the furniture are completed.

1.6 WARRANTY

- A. Lifetime Guarantee: All metal parts to be free from defects in material and workmanship.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Performance Criteria:
 - 1. Recycled Content: Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content: not less than 25 percent.
 - 2. For regional materials: 10 percent by weight material.
 - 3. For sealants: VOC content: 250 g/L.
 - 4. For adhesives and composite wood products: No urea-formaldehyde.
 - 5. Flame Retardance: State of California Technical Bulletin 117.

2.2 MATERIALS

- A. Office furniture shall be of contemporary design with rectilinear lines. The following furniture construction descriptions shall be considered as a minimum.
- B. Single or Double Pedestal Desks: Where desks are shown to be furnished as a stand-alone desk, double pedestal type shall be provided. Desks shown to be furnished with returns shall be single pedestal types. Desks shall be constructed to include the following:
 - 1. Size: 30-inches deep x 60-inches wide, unless otherwise noted on drawings.
 - 2. All steel construction with enamel finish and chrome plated legs.
 - 3. Plastic laminate work surface with rounded profile ends.
 - 4. Work surface extension on back and sides.
 - 5. Full-height back panel.

6. Desk pedestals shall be 3/4 height, and each shall be provided with one box drawer and one file drawer.
7. Center drawer with lock.
8. All drawers shall ride on heavy-duty ball bearing suspension glides.
9. Full extension drawers.
10. Hanging file folder frame accommodating letter or legal size files.
11. Satin loop pulls.
12. Randomly keyed locks.
13. Plastic leveling glides.
14. Product and Manufacturer: Provide desks from NYS OGS Group 20915 – Furniture, All Types, Category 7.
 - a. Basis of Design - MDC6036C by Haskell Office, LLC.

C. Single Pedestal Returns:

1. Single pedestal desk shall have similar construction and features as double pedestal desk above.
2. Size: 24-inches deep by 42-inches wide, unless otherwise noted on drawings.
3. Product and Manufacturer: Provide desks from NYS OGS Group 20915 – Furniture, All Types, Category 7.
 - a. Basis of Design - MCL6630C Desk with MER4224C Return by Haskell Office, LLC.

D. Executive Chairs:

1. Pneumatic height adjustment.
2. Overall height of chair shall be adjustable from 36 1/2- inches to 41-1/2 inches. Overall width of chair shall be 25 1/2- inches and the overall depth shall be 23 inches.
3. Tilt tension chair and shall be provided with a variable back stop.
4. Polypropylene “T” arms.
5. Fabric upholstered seat, back, and shell.
6. Five-arm, painted, steel base.
7. Hard dual-wheel casters.
8. Product and Manufacturer: Provide chairs from NYS OGS Group 20915 – Furniture, All Types, Category 7.
 - a. Basis of Design - #417121 4 O’clock Series AM+ Chair with Grade 6 Fabric by Vecta Coalesce, a Steelcase company.

E. Guest Chairs:

1. Design complementing the specified executive chairs.
2. Overall height of chair shall be 36 1/2-inches to 41 1/2-inches. Overall width of chair shall be 25-1/2-inches and the overall depth shall be 23-inches.
3. Fabric upholstered seat, back, and shell.
4. Hard plastic glides.
5. Five-arm, painted, steel base.
6. Hard dual-wheel casters.

7. Product and Manufacturer: Provide chairs from NYS OGS Group 20915 – Furniture, All Types, Category 7.
 - a. Bass of Design - #417120 4 O'clock Series AM+ Chair with Grade 6 Fabric, A Steelcase company.

F. Stackable Chairs:

1. Wire rod frame of steel with painted finish.
2. Chair is armless.
3. Chair shell shall be of plastic with soil-retardant upholstered seat and back.
4. Overall height of chair shall be 33 1/4- inches. Overall width of chair shall be 19 3/4-inches and the overall depth shall be 22 3/4-inches.
5. Soft plastic glides.
6. Product and Manufacturer: Provide chairs from NYS OGS Group 20915 – Furniture, All Types, Category 7.
 - a. Basis of Design - Max-Stacker II 473 Chair by Steelcase, Incorporated.

G. Lateral Files:

1. All steel construction with enamel finish.
2. Size: 36-inches wide by 18-inches deep by 52-1/2-inches high, unless otherwise noted on drawings.
3. Five drawers, unless otherwise noted on drawings.
4. Ball bearing suspension glides.
5. Polished chrome pulls and clear plastic label holders.
6. Full extension type.
7. One roll out shelf and a top receding door.
8. Randomly keyed locks.
9. Counterweights.
10. Front and rear levelers.
11. Product and Manufacturer: Provide file cabinets from NYS OGS Group 20915 – Furniture, All Types, Category 7.
 - a. Basis of Design - Captiva Lateral Files LA12-3660-5D-F Haskell Office, LLC.

H. Five-Shelf Bookcases:

1. All steel construction with enamel finish.
2. Size: 36-inches wide by 15-inches deep by 72-inches high, unless otherwise noted on drawings.
3. Adjustable shelves: Four or See drawings.
4. Product and Manufacturer: Provide bookcases from NYS OGS Group 20915 – Furniture, All Types, Category 7.
 - a. Basis of Design - Captiva Bookcases BC# 15-36 by Haskell Office, LLC.

I. Tables:

1. Table shall be provided with a laminate top with soft vinyl edge.
2. Size: Rectangular 36" by 72", unless otherwise noted on drawings.

3. Two painted steel "T" bases.
 4. Adjustable plastic leveling glides.
 5. Product and Manufacturer: Provide tables from NYS OGS Group 20915 – Furniture, All Types, Category 7.
 - a. Basis of Design - HWSST3672RT Top with HTB2627TB Bases by Haskell Office, LLC.
- J. Standard Wastebaskets:
1. Self-Extinguishing ABS plastic construction.
 2. Size: 8 1/2 -inches wide by 15-inches deep by 13 3/4-inches high.
 3. Product and Manufacturer: Provide wastebaskets from NYS OGS Group 20915 – Furniture, All Types, Category 7.
 - a. Basis of Design - Rectangular Wastebasket Series No. 231101 by Smith McDonald Corporation.
- K. Recycling Wastebaskets:
1. Self-extinguishing rubber construction.
 2. Size: 3 1/4 gallons 12 1/8-inches, H x 11 3/8-inches, W x 8 1/4-inches, D: Blue
 3. Product and Manufacturer: Provide wastebaskets from NYS OGS Group 20915 – Furniture, All Types, Category 7.
 - a. Basis of Design - Deskside "WE RECYCLE" Container by Rubbermaid.

2.3 FURNITURE AND ACCESSORIES SCHEDULE

- A. Materials:
1. Furniture Schedule: Quantities are identified on contract drawings..

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Uncrate all furniture and inspect for damage. Replace or repair all damaged material.
- B. Provide a secure storage area to keep the furniture protected and in its original condition.
- C. Store in original containers.
- D. Install furniture Work just prior to Final Acceptance.
- E. Completely assemble all furniture items and install, mount, attach or otherwise place the furniture in the locations designated by the ENGINEER.

- F. Final location of all items specified herein will be provided to CONTRACTOR by the ENGINEER after the award of Contract.

3.2 ADJUSTMENT AND CLEANING

- A. Adjust all furniture and leave in good condition.
- B. Protect all furniture with plastic wrapping until Final Acceptance by the OWNER.
- C. Replace all furniture Work damaged or missing at no additional cost to the OWNER until Final Acceptance.

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SECTION 22 05 27

PIPE SLEEVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install pipe sleeves, other wall pieces, and escutcheons complete with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the pipe sleeves Work.
 - 2. Notify other contractors in advance of the installation of the pipe sleeves system to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the pipe sleeves Work.
- C. Related Sections:
 - 1. Section 22 11 16, Domestic Water Piping.
 - 2. Section 22 13 16, Sanitary Waste and Vent Piping.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American National Standards Institute, (ANSI).
 - a. ANSI A21.4, Cement-Mortar Lining for Cast-Iron and Ductile Iron Pipe and Fittings.
 - b. ANSI A21.6, Cast-Iron Pipe Centrifugally Cast in Metal Molds.
 - c. ANSI A21.10, Cast-Iron and Ductile Iron Fittings, 2 thru 48-inches in Water.
 - d. ANSI A21.11, Rubber Gasket Joints for Cast-Iron and Ductile Iron Pressure Pipe.
 - e. ANSI A21.15, Flanged Cast-Iron and Ductile Iron.
 - f. ANSI A21.51, Ductile Iron Pipe Centrifugally Cast in Metal Molds.
 - g. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
 - 2. American Water Works Association, (AWWA).
 - a. AWWA C104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - b. AWWA C106, Cast-Iron Pipe Centrifugally Cast in Metal Molds.
 - c. AWWA C110, Ductile-Iron and Gray-Iron Fittings for Water.
 - d. AWWA C111, Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

- e. AWWA C115, Flanged Ductile-Iron Pipe or Gray-Iron Threaded Flanges.
- f. AWWA C151, Ductile-Iron Pipe, Centrifugally Cast for Water.

1.3 QUALITY ASSURANCE

- A. Installers' Qualifications:
 - 1. Engage a single installer regularly engaged in pipe sleeves and mechanical seals installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit names and qualifications to ENGINEER.
 - 2. Engage a single installer for the entire pipe sleeves and mechanical seals system with undivided responsibility for performance and other requirements.
- B. Component Supply and Compatibility:
 - 1. Obtain all products included in this Section regardless of the component manufacturer from a single pipe sleeves and mechanical seal manufacturers.
 - 2. The pipe sleeves and mechanical seal manufacturers to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the pipe sleeves and mechanical seal manufacturers.
- C. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. Local and State Building Codes and Ordinances.

1.4 SUBMITTALS

- A. Shop Drawings: Submit the following:
 - 1. Manufacturer's literature, illustrations, specifications and engineering data.
 - 2. Details of installation.
 - 3. Detailed drawings showing all pipe sleeves and mechanical seals for each piping system. Drawings shall show location, installation and material of all pipe sleeves and mechanical seals.
 - 4. Other technical data related to the specified material and equipment as requested by ENGINEER.
 - 5. Installer's Qualifications.
 - 6. Deviations from Contract Documents.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
- B. Storage and Protection:
 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
- C. Acceptance at Site:
 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

- A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
- B. The Drawings show an indication of the arrangement of equipment, piping, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. Piping, equipment, piping, etc. found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.
- C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each case, adequately provide for expansion and circulation and minimize the amount of space required for the same.
- D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval by the ENGINEER.
- E. The Drawings do not show all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to

meet such conditions which are not specified as work "by others", to complete the systems to the true extent of the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe Sleeves:
 - 1. Ferrous and Plastic Pipe: Use standard weight galvanized steel pipe, unless otherwise shown.
 - 2. Copper Pipe: Use standard weight galvanized steel pipe with mechanical link seals as spacers, unless otherwise shown.
- B. Cast Wall Sleeves:
 - 1. Material: Cast-iron furnished with integral wall collar.
 - 2. Dimensions: As required for mechanical joint or calked joint pipe to pass through sleeve. Length as required.
- C. Mechanical Seals: Provide link type mechanical seals with adjusting bolts suitable for 20 psi working pressure where shown or required.
 - 1. Manufacturers: Provide products of one of the following:
 - a. Advance Products & Systems, Inc., Innerlynx.
 - b. GPT Division of Enpro Industries, Link-Seal.
 - c. The Metraflex Company, Metraseal.
 - d. Or equal.
 - 2. Materials: Mechanical seals through non-fire rated walls or floors:
 - a. Pressure Plate: Glass reinforced nylon plastic.
 - b. Bolt and Nut: 18-8 stainless steel.
 - c. Sealing Element: EPDM rubber.
 - 3. Materials: Mechanical seals through fire rated walls or floors; two independent mechanical seal assemblies required for each penetration:
 - a. Pressure Plate: Low carbon steel, zinc galvanized plated or stainless steel.
 - b. Bolt and Nut: Low carbon steel zinc galvanized.
 - c. Sealing Element: Silicone rubber.
 - d. Fire rating: Three-hour.
- D. Wall, Floor and Ceiling Escutcheon Plates:
 - 1. Manufacturers: Provide products of one of the following:
 - a. McGuire Manufacturing, Inc.
 - b. Pegasus Manufacturing, Incorporated.
 - c. Or equal.
 - 2. Bare Pipes Passing Through Walls, Floors and Ceilings in any Room: Provide escutcheon plates of cast brass or stamped steel, chrome plated, hinged with setscrews.

3. Insulated Pipes Passing Through Walls, Floors and Ceilings in Finished Rooms: Provide plated escutcheon plates of stamped steel or cast brass, chrome plated, hinged with setscrews.
- E. Exterior Walls or Floors: Below grade:
1. Manufacturers: Provide products of one of the following:
 - a. GPT Division of Enpro Industries, Century-Line.
 - b. SIGMA Corporation, Omni-Sleeve.
 - c. Or equal.
 2. Type: Thermoplastic sleeve for use in new construction where sleeves are exposed to liquid or on exterior walls or floors exposed to backfill only.
 3. Integral reinforcing ribs, anchor and waterstop collar textured surface for adhesion to concrete.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
1. Install all items as shown, specified, and as recommended by the manufacturer.
 2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
 3. Present conflicts to ENGINEER, in writing, who will determine corrective measures to be taken.
 4. Do not modify structures to facilitate installation of pipe sleeves, mechanical seals, and accessories, unless specifically approved by ENGINEER.
 5. Installation to conform to requirements of all local and state codes.
 6. Protection: Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.
- B. Pipe Sleeves:
1. Use sleeves wherever pipes pass through walls, partitions, floors and roofs, unless otherwise shown.
 2. All sleeves through floor slabs in finished areas shall extend a maximum of 1/4-inch above finished floor.
 3. Anchor sleeves to concrete and masonry walls as shown or otherwise accepted.
 4. Sleeves through walls shall be flush with wall face.
 5. Caulk and seal annular space between pipe and sleeve.
 6. All pipe joints and annular spaces in exterior walls or walls subjected to hydrostatic pressure shall be completely watertight.
 7. All vertical pipes through sleeves shall be installed with Link Seal "Pyro-Pacs" to maintain 2-hour fire rating between the two fire areas.
 8. Size Sleeves to provide annular space as recommended by the mechanical seal manufacturer and as follows:

Sleeve ID Minus Pipe

- | <u>Pipe Size</u> | <u>or Insulation OD</u> |
|------------------|-------------------------|
| Less than 2-in. | 1/2-in. to 3/4-in. |
| 2-in. to 4-in. | 3/4-in. to 1-1/4-in. |
| 6-in. to 12-in. | 1-1/4-in. to 2-in. |
9. For mechanical link seals, size sleeves to provide space required to suit link type seals provided.
 10. Do not install sleeves and pipes through structural members unless specifically required due to coordination or obstructions, each sleeve condition shall be submitted for approval.

3.2 FIELD QUALITY CONTROL

- A. Inspection:
 1. Examine areas to receive pipe sleeves, mechanical seals, escutcheons and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances for pipe sleeves, mechanical seals, escutcheons and accessories.
 - c. Start the Work only when conditions are satisfactory.
 2. The ENGINEER reserves the right to reject or authorize replacement of pipe sleeves, mechanical seals, escutcheons and accessories found to be defective.

3.3 ADJUSTING AND CLEANING

- A. Adjusting:
 1. Adjust all materials for proper settings.
- B. Cleaning:
 1. Thoroughly clean all pipe sleeves, mechanical seals, escutcheons and accessories prior to installation.
 2. Remove all dirt, rust, dust, etc. from all pipe sleeves, mechanical seals and escutcheons in preparation for required painting.
 3. Remove and dispose of all debris and waste from the Site resulting from installation.

+ + END OF SECTION + +

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install hangers and supports complete with accessories for plumbing piping and equipment.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the hangers and supports for plumbing piping and equipment Work.
 - 2. Notify other contractors in advance of the installation of the plumbing pipe and equipment hangers and supports to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the plumbing piping and equipment hangers and supports Work.
- C. Related Sections:
 - 1. Section 05 05 33, Anchor Systems.
 - 2. Section 05 50 13, Miscellaneous Metal Fabrications.
 - 3. Section 09 91 00, Painting.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American National Standards Institute, (ANSI).
 - a. ANSI B1.1, Unified Inch Screw Threads. (ASME B1.1).
 - 2. American Society for Testing and Materials, (ASTM).
 - a. ASTM A 47/A 47M, Specification for Ferritic Malleable Iron Castings.
 - b. ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - c. ASTM A 575, Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
 - d. ASTM A 668/A 668M, Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
 - 3. Federal Specifications, (FS).
 - a. FS WW-H-171, Hangers and Supports, Pipe.
 - 4. Manufacturer's Standardization Society, (MSS).
 - a. MSS SP 58, Pipe Hangers and Supports - Materials, Design and Manufacture.

- b. MSS SP 69, Pipe Hangers and Supports - Selection and Application.
- c. MSS SP 89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- d. MSS SP 90, Guidelines on Terminology for Pipe Hangers and Supports.

1.3 QUALITY ASSURANCE

- A. Installer's Qualifications:
 - 1. Engage a single installer regularly engaged in hangers and supports installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
 - 2. Engage a single installer for the entire plumbing pipe and equipment hangers and supports system with undivided responsibility for performance and other requirements.
- B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. Local and State Building Codes and Ordinances.
 - 2. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.
- C. Component Supply and Compatibility:
 - 1. Obtain all products included in this Section regardless of the component manufacturer from a single plumbing pipe and equipment hangers and supports manufacturer.
 - 2. The plumbing piping and equipment hangers and supports manufacturer shall review and approve all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the plumbing piping and equipment hangers and supports manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Details of installation.
 - b. Detailed drawings showing all hangers and supports for each piping system. Drawings shall show location, installation, material, loads, forces, stresses and deflections of all hangers and supports.
 - 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications and engineering data.
 - b. Other technical data related to the specified material and equipment as requested by ENGINEER.

- B. Informational Submittals: Submit the following:
 - 1. Qualifications Statements:
 - a. Installer's Qualifications.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

- A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
- B. The Drawings show an indication of the arrangement of equipment, piping, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. Piping, equipment, etc. found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.
- C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each case, adequately provide for expansion and circulation and minimize the amount of space required for the same.

- D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval by the ENGINEER.
- E. The Drawings do not show all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others", to complete the systems to the true extent of the Contract Documents.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Components of hangers and supports shall conform to the following:
 - 1. Materials:
 - a. Bolts: ASTM A 307, Grade A, unless otherwise specified below.
 - b. Forgings: ASTM A 668/A 668M.
 - c. Malleable Iron: ASTM A 47/A 47M.
 - d. Rods and Bars: ASTM A 575.
 - e. Threads: Unified Screw Threads, Class 2A and 2B, ANSI B1.1.
 - 2. Finish:
 - a. Steel or Malleable Iron Items: Galvanized, unless otherwise specified or as shown.
 - b. Steel or Malleable Iron Materials Used for the Support of Uninsulated Copper Piping: Copper plated.
 - c. Framing Members and Fittings: Dip painted with corrosion resistive primer as specified in Section 09 91 00, Painting.
 - d. All hangers, rods, bolts, nuts, inserts, washers located in the corrosive areas shall be Type 316 stainless steel.
- B. Pipe Attachments: The following types of pipe attachments shall be considered acceptable:
 - 1. Adjustable Steel Clevis: FS WW-H-171E, Type 1.
 - 2. Steel Double Bolt Pipe Clamp: FS WW-H-171E, Type 3.
 - 3. Steel Pipe Clamp: FS WW-H-171E, Type 4.
 - 4. Adjustable Swivel Pipe Ring: FS WW-H-171E, Type 6.
 - 5. Adjustable Steel Band Hanger: FS WW-H-171E, Type 7.
 - 6. Riser Clamp: FS WW-H-171E, Type 8.
 - 7. Light-Duty Clevis Hanger: FS WW-H-171E, Type 12.
 - 8. Long Clips: FS WW-H-171E, Type 26.
 - 9. Offset J-Hooks: FS WW-H-171E, Type 27.
 - 10. Steel Pipe Covering Protection Saddle: FS WW-H-171E, Type 40A.
 - 11. Insulation Protection Shield: FS WW-H-171E, Type 41.

12. Pipe Saddle Support: FS WW-H-171E, Type 37.
 13. Pipe Stanchion Saddle: FS WW-H-171E, Type 38.
 14. Pipe Saddle Support with Base: FS WW-H-171E, Type 36.
 15. Adjustable Roller Hanger: FS WW-H-171E, Type 42.
- C. Structural Attachments: The following types of structural attachments shall be considered acceptable:
1. Side Beam Clamp: FS WW-H-171E, Type 20.
 2. Center I-Beam Clamp: FS WW-H-171E, Type 21.
 3. Welded Steel Bracket: FS WW-H-171E, Types 32 and 33.
 4. Side Beam Bracket: FS WW-H-171E, Type 35.
 5. Malleable Iron with Galvanized Finish Concrete Insert: FS WW-H-171E, Type 18. The use of steel concrete inserts is prohibited and NOT acceptable.
- D. Hanger Rod Attachments: Use as required to complete assembly:
1. Forged Steel Clevis: FS WW-H-171E, Type 14.
 2. Adjustable Turnbuckle: FS WW-H-171E, Type 15.
 3. Forged Steel Welders Eye Nut: FS WW-H-171E, Type 17.
- E. Expansion Joints:
1. Manufacturers: Provide products of one of the following:
 - a. Flex-Hose Co., Inc.
 - b. The Metraflex Company
 - c. Or equal.
 2. 2-1/2-inch and Smaller Copper Tubing:

Construction: Free flexing expansion joints with stainless steel corrugated members, NSF 372 certified lead-free for use in domestic water systems.

 - c. End Connections: Male and female solder end fittings or screwed ends with adaptors for screwed to sweat ends.
 3. 3-inch and Larger:
 - a. Construction: Free flexing expansion joints with stainless steel corrugated members, NSF 372 certified lead-free for use in domestic water systems.
 - b. End Connections: Welded ends with flanges.
- F. Alignment Guides:
1. Type: Semi-steel spider with four guiding fingers and guiding cylinder with base.
 2. Manufacturers: Provide products of one of the following:
 - a. Flex-Hose Co., Inc.
 - b. The Metraflex Company
 - c. Or equal.
- G. Connection Bolts: Materials shall be as specified in other Sections of these Specifications or as shown. Where materials are not specified or shown, they shall be of Type 304 stainless steel with Monel nuts.

- H. Toggle Bolts:
1. Provide zinc plated spring wing toggle bolts of the size required for secure anchorage of individual items, but not less than 1/4-inch diameter, of length required.
 2. Products and Manufacturers: Provide products by one of the following:
 - a. Cooper B-Line Division of Eaton Corp.
 - b. Powers Fasteners
 - c. Or equal.
- I. CONTRACTOR shall furnish and install all necessary supports, angle iron stands, miscellaneous steel, inserts, anchor bolts and hangers required for all equipment furnished under this Contract, unless otherwise noted. All supports shall meet the requirements of the applicable Sections of Division 05, Metals.

2.2 PAINTING

- A. All pipe hangers, supports and restraints shall be painted as required in accordance with the requirements of Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
1. Install all items as shown, specified, and as recommended by the manufacturer.
 2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
 3. Present conflicts to ENGINEER, in writing, who will determine corrective measures to be taken.
 4. Do not modify structures to facilitate installation of pipe hangers, supports and restraints, unless specifically approved by ENGINEER.
 - a. Hanger supports shall be fastened to web of single tees or provided with cross members such as unistruts spanning single tee webs
 5. Installation to conform to requirements of all local and state codes.
 6. Protection: Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.2 FIELD QUALITY CONTROL

- A. Inspection:
1. Examine areas to receive plumbing piping and equipment hangers and supports and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances for pipe hangers, supports and restraints and accessories.

- c. Start the Work only when conditions are satisfactory.
2. The ENGINEER reserves the right to reject or authorize replacement of pipe hangers, supports and restraints and accessories found to defective.

3.3 ADJUSTING AND CLEANING

- A. Adjusting:
 1. Adjust all materials for proper settings.
- B. Cleaning:
 1. Thoroughly clean all pipe hangers, supports and restraints and accessories prior to installation.
 2. Remove all dirt, rust, dust, etc. from all pipe hangers, supports and restraints in preparation for required painting.
 3. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 MATERIAL SCHEDULES

- A. Hangers, Supports and Restraints for Horizontal Piping:
 1. Space supports and hangers for all piping no farther apart than shown below, unless otherwise shown:
 - a. Copper Tube:
 - 1) All Pipes: 6 feet-0 inch on center.
 - b. Steel Pipe:
 - 1) Pipes up to 1-inch: 6 feet-0 inch on center.
 - 2) Pipes 1-1/4-inch to 6-inch: 8 feet-0 inch on center.
 - c. Cast-Iron Pipe:
 - 1) Two supports per length, maximum 5 feet-0 inches on center.
 - d. Plastic Pipe:
 - 1) 3 feet-0 inch on center for all sizes, unless otherwise recommended by manufacturer for 100°F ambient temperature.
 2. Additional supports are to be provided at all changes of direction, at all no-hub fittings and couplings for cast iron pipe, and at all valves or other in-line devices installed in piping.
 3. Rigid support sway bracing shall be provided at all changes of direction for piping 4" diameter and larger.
 4. Mechanical restraints shall be installed at all fittings for changes of direction in drainage piping 4" and larger in accordance with the CISPI installation guidelines.
 5. Hanger supports shall be fastened to web of single tees or provided with cross members such as unistruts spanning single tee webs.
- B. Hanger Rods: Size hanger rods according to the schedule below, unless noted otherwise.

<u>Nominal Pipe (Inches)</u>	<u>Rod Diameter (Inches)</u>
1/2 through 2	3/8
2-1/2 through 3-1/2	1/2
4 through 5	5/8
6	3/4

- C. Supports for Vertical Piping:
1. Provide riser clamp placed under hub, fitting or coupling with approved solid bearing on steel sleeve at each floor level.
 2. Where riser clamps are used with plastic piping they shall be modified so as not to exert any compressive forces on the pipe.
 3. Support spacing shall not exceed code requirements.
 4. Piping support intervals shall not exceed those listed in Paragraph 3.4.A., above.
 5. Additional supports shall be placed immediately adjacent to any change in piping direction, and on both sides of valves and couplings.
 6. Accurately locate inserts for hanger rods in forms before concrete is placed.
 7. Use Type 304 stainless steel expansion anchor assemblies of the capsule polyester resin adhesive type and only to support rods, hangers and brackets for piping 1-inch and smaller no other type will be considered and only if the expansion anchors are designed to carry 100 percent of the full load, hanger, and/or bracket and pipe load.
- E. Anchor bolts, expansion anchors and concrete inserts shall conform to Section 05 05 33, Anchor Systems.
- F. Miscellaneous metal fabrications shall conform to Section 05 50 13, Miscellaneous Metal Fabrications.
- G. Allow clearances for expansion and contraction of piping.
- H. Anchors shall be designed to prevent any pipe movement at pipe anchorage points. Anchors shall be securely fastened to the construction directly or indirectly through structural framing:
1. Piping 2-1/2-inches and Smaller: Anchor horizontal runs over 50 feet to midpoint to allow expansion toward expansion compensators (anchor intervals shall not exceed 30 feet) or elbows.
 2. Piping 3-inches and Larger: Anchor horizontal runs over 100 feet at mid-points to force expansion toward expansion compensators.
 3. Provide alignment guides in accordance with expansion compensator manufacturer recommendations.
- I. Provide expansion compensators where necessary to absorb expansion and contraction in heating lines and as follows:
1. Thirty feet on center of copper piping.

2. Fifty feet on center of steel piping.
- J. Locate first set of alignment guides within four pipe diameters of the anchor or expansion compensator, the second set of pipe alignment guides shall be located within fourteen pipe diameters of the first guides.

steel
++ END OF SECTION ++

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SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install plumbing piping insulation complete with accessories.
2. The Contract Documents show the general arrangement and extent of the Work under this Section. Exact location and arrangement of all parts of the Work under this Section will be determined as the Work progresses. Exact location of the Work under this Section will be governed in part by building layout and conditions at the Site.
3. The Drawings do not show all offsets, fittings, accessories and details, for which insulation Work may be required. After examining the Contract Documents and conditions at the Site for conditions that affect the plumbing piping insulation Work, shall arrange the Work accordingly, providing all items required for such conditions that are not included under other Sections or other contracts to complete the systems.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before plumbing piping insulation Work.
2. Notify other contractors in advance of the installation of plumbing piping insulation to provide them with sufficient time for installing items included in their contracts that must be installed with or before plumbing piping insulation Work.

C. Related Sections:

1. Section 22 11 16, Domestic Water Piping.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI A117.1, Guidelines for Accessible and Usable Buildings and Facilities.
2. ASTM C449/C449M, Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finish Cement.
3. ASTM D1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
4. Federal Specification (FS) SS-C-160, Cement, Insulation, Thermal.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Installer:

- a. Engage installer regularly engaged in plumbing piping insulation installation and with experience installing the types of materials required; and employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
- b. Engage a single plumbing piping insulation installer for entire piping insulation system, with undivided responsibility for performance and other requirements.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section regardless of component manufacturer, from a single piping insulation Supplier.
2. Plumbing piping insulation Supplier shall review and approve or prepare all Shop Drawings and other submittals for components furnished under this Section.
3. Components shall be suitable for specified service conditions and shall be integrated into overall assembly by plumbing piping insulation Supplier.

C. Regulatory Requirements: Comply with the following.

1. Local and State Building Codes and Ordinances.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:

- a. Manufacturer's literature, illustrations, specifications, and engineering data.
- b. Other technical data related to specified materials as requested by ENGINEER.

B. Informational Submittals: Submit the following:

1. Manufacturer's Instructions:

- a. Manufacturer's recommended installation instructions.

2. Qualifications Statements:

- a. Installer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading:

1. Deliver products to Site to ensure uninterrupted progress of the Work.
2. Inspect all boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.

3. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:

1. Keep all products off ground using pallets, platforms, or other supports, in covered storage. Protect materials from damage and deterioration.
2. Prevent condensation in materials and packaging in accordance with manufacturer's recommendations for long-term storage
3. Conform to Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Fiberglass Insulation:

1. Products and Manufacturers: Provide one of the following:
 - a. Owens-Corning Fiberglass Corporation, Fiberglass SSL II with ASJ Max Fiberglass.
 - b. Johns Manville Division of Berkshire Hathaway, Micro-Lok HP
 - c. Or equal.
2. Type: Heavy-density pre-formed fiberglass sectional pipe insulation with factory-applied indoor foil or polymer jacketing with self-sealing lap.
3. Thermal Conductivity: 0.25-0.29 Btu-inch per hour per square foot per degree F at 125 degrees F mean temperature. Insulation thicknesses shall be as indicated in manufacturer's installation guidelines, except that in no case shall insulation thicknesses be less than required by ASHRAE 90.1.
4. Fire Hazard Classification:
 - a. Flame Spread: 25.
 - b. Fuel Contributed: 50.
 - c. Smoke Developed: 50.
5. Density: Three pounds per cubic foot (pcf) minimum.
6. Fittings: Molded fiberglass.
7. Jointing Materials: Manufacturer's recommended adhesives and tape.
8. Valve Insulation: Miter cut nesting size covering segments of same thickness as pipeline, for insulation of valves.

B. Calcium Silicate Insulation at Insulation Protection Shields:

1. Products and Manufacturers: Provide one of the following:
 - a. Industrial Insulation Group, LLC, IIG.
 - b. Thermo 12 Gold, by Johns-Manville.
 - c. Or equal.
2. Type: Asbestos-free calcium silicate pipe insulation.
3. Thermal Conductivity: 0.40 Btu-inch per hour per square foot per degree F at 200 degrees F mean temperature.
4. Fire Hazard Classification:
 - a. Flame Spread: Zero.
 - b. Smoke Developed: Zero.
5. Density: 14 pounds per cubic foot (pcf).
6. Compressive Strength: 140 psi.

7. Cut insulation 0.5-inch longer than insulation shield upon which it rests.
- C. PVC Pipe Jacketing, Valve and Fitting Covers:
1. Manufacturers: Provide products of one of the following:
 - a. Proto Corporation
 - b. Speedline Corporation.
 - c. Zeston by Johns Manville.
 - d. Or equal.
 2. Type: PVC Jacketing (for insulated piping and appurtenances located indoors, unless otherwise shown or indicated):
 - a. 25/50 PVC, conforming to ASTM D1784, Class 16354-C and C-585
 - b. Thickness: 20 mils.
 - c. Color: White.
 - d. Finish: Glossy.
 - e. Temperature: Suitable for 150 degrees F, minimum.
 - f. Provide insulation adhesive or other means of sealing jacketing per manufacturer insulation instructions.
- D. Handicapped Lavatory Trim Insulation:
1. Products and Manufacturers: Provide one of the following:
 - a. Lav Guard 2 by Truebro, Inc.
 - b. Pro Wrap, by McGuire Manufacturing Company, Inc.
 - c. Or equal.
 2. Type: Flexible vinyl insulation for waste, traps, hot and cold water supplies.
 3. References:
 - a. ADA Article 4.19.4.
 - b. ANSI A117.1.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
1. Piping systems to be insulated and associated insulation thicknesses are specified in the schedule at the end of this Section.
 2. Thoroughly clean all piping, insulation, and accessories prior to installation.
 3. Remove from piping all dirt, rust, dust, and other materials detrimental to proper installation of insulation.
 4. Install items as shown, specified, and as recommended by manufacturer.

5. Request interpretation from ENGINEER if there is conflict between manufacturer's recommendations and the Contract Documents.
6. Do not modify structures to facilitate installation of piping insulation unless approved by ENGINEER.
7. Installation of plumbing piping insulation shall conform to Laws and Regulations.
8. Surfaces of piping, valves, and fittings shall be clean and dry before applying insulation.
9. Install piping insulation after associated piping system has been successfully tested.
10. Provide high-density insulation pipe support inserts at each hanger and shield extending halfway up the pipe insulation cover and extending along pipe at least six inches on each side of hanger. Securely fasten shield with pipe straps at each end. Insulate pipe anchors adequately to prevent moisture condensation problems.
11. Protection: Piping insulation materials applied each day shall have vapor barrier applied the same day and exposed ends shall be temporarily protected with moisture barrier and sealed to pipe.

3.3 ADJUSTING

- A. Adjusting:
 1. Adjust or replace, as required, poorly-fitted joints.

3.4 SCHEDULES

- A. Piping Insulation Schedule: Insulate plumbing piping as specified below, unless otherwise specified or shown:
 1. All hot, cold, and tempered piping 2.5-inch diameter and smaller: Insulation thickness shall be one-inch minimum.
 2. Insulate plumbing piping below handicapped lavatories. Thickness to be manufacturer's standard thickness as specified in Part 2 of this Section.

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SECTION 22 10 53

INSTALLATION OF PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install plumbing piping systems complete with accessories.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the installation of plumbing piping Work.
2. Notify other contractors in advance of the installation of the installation of plumbing piping to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the installation of plumbing piping Work.

C. Related Sections:

1. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American National Standards Institute, (ANSI).
 - a. ANSI B13.1, Code for Pressure Piping.
 - b. ANSI B31.1, Power Piping.
2. American Society for Testing and Materials, (ASTM).
3. American Welding Society, (AWS).
 - a. AWS D10.9, Welding Procedures and Welders for Piping and Tubing.
4. Institute of Electrical and Electronic Engineers, (IEEE).
5. National Electrical Code, (NEC).
6. National Electrical Manufacturers' Association, (NEMA).
7. National Fire Protection Association, (NFPA).
8. Underwriters' Laboratories, Incorporated, (UL).

1.3 QUALITY ASSURANCE

A. Installer's Qualifications:

1. Engage a single installer regularly engaged in plumbing piping installation and with experience in the installation of the types of materials required; and

- who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
2. Engage a single installer for the entire plumbing piping system with undivided responsibility for performance and other requirements.
- B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. Local and State Building Codes and Ordinances.
 2. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.
- C. Component Supply and Compatibility:
1. Obtain all equipment included in this Section regardless of the component manufacturer from a single installation of plumbing piping manufacturer.
 2. The installation of plumbing piping manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the installation of plumbing piping manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. 1/4-inch scale piping layouts, dimensioned to show length of piping runs, pipe sizes, support spacing and expansion provisions.
 - b. Details of installation, including piping supports.
 - c. Submit pipe schedule with laminate construction, sizes, thickness, vacuum pressure, weight per foot pressure, spans, joint type and flange data.
 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications and engineering data.
 - b. Flexible connections.
 - c. Other technical data related to the specified material and equipment as requested by ENGINEER.
 - d. Gasket material.
- B. Informational Submittals: Submit the following:
1. Qualifications Statements:
 - a. Installer's qualifications.
- C. Closeout Submittals: Submit the following:
1. Record Drawings:
 - a. During progress of the Work keep an up-to-date set of the Drawings showing field and Shop Drawing modifications. Immediately upon completion of the piping Work submit CADD drawings showing the

actual in-place installation of all piping and equipment installed under this Section at a scale satisfactory to the OWNER. The Record Drawings shall show all piping on plans and in sections, with all reference dimensions and elevations required for complete Record Drawings of the piping systems. Two paper prints shall also be furnished. The prints and electronic copies of the CADD files shall be furnished no later than 30 days after completion of the Contract and prior to final payment.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

- A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
- B. The Drawings show an indication of the arrangement of equipment, piping, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. The piping, equipment, ducts, etc. found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.

- C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged as to fully and best suit the requirements of each particular case, adequately provide for expansion and perfect circulation and minimize the amount of space required for the same.
- D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval by ENGINEER.
- E. The Drawings do not show all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others," to complete the systems to the true extent of the Contract Documents.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials for piping system shall be specified under applicable Sections of Division 40, Process Integration.

2.2 PAINTING

- A. All equipment and accessories shall be painted in accordance with the requirements of Section 09 91 00, Painting.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install all items as shown, specified, and as recommended by the manufacturer.
 - 2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
 - 3. Present conflicts to ENGINEER, in writing, who will determine corrective measures to be taken.
 - 4. Do not modify structures to facilitate installation of piping, unless specifically approved by ENGINEER.
 - 5. Installation to conform to requirements of all local and state codes.

6. Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.2 FIELD QUALITY CONTROL

- A. Field Tests:
 1. Fill all systems and fully test all equipment, valves, piping, etc. in operation.
 2. Check for excessive vibration while all systems are operating.
 3. Installed systems and components will not be released to OWNER unless all systems have been tested and approved by the ENGINEER.
- B. Inspection:
 1. Examine areas to receive piping, valves and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances for piping, valves and accessories.
 - c. Start the Work only when conditions are satisfactory.
 2. The ENGINEER reserves the right to reject or authorize replacement of piping and accessories found to be defective.

3.3 ADJUSTING AND CLEANING

- A. Adjusting:
 1. While system is operable, balance all equipment, valves, etc. to achieve design conditions.
- B. Cleaning:
 1. Thoroughly clean all piping, fittings, valves, and accessories prior to installation.
 2. Remove all dirt, rust, dust, etc. from piping in preparation for painting.
 3. Remove and dispose of all debris and waste from the Site resulting from installation.

+ + END OF SECTION + +

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SECTION 22 10 63

TESTING OF PLUMBING PIPING SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to complete all testing of the plumbing piping systems.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the testing of plumbing piping systems Work.
 - 2. Notify other contractors in advance of the installation of the testing of plumbing piping systems to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the testing of plumbing piping systems Work.
- C. Related Sections:
 - 1. Section 09 91 00, Painting.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American National Standards Institute, (ANSI).
 - 2. American Society for Testing and Materials, (ASTM).
 - 3. Institute of Electrical and Electronics Engineers, (IEEE).
 - 4. National Electrical Code, (NEC).
 - 5. National Electrical Manufacturers' Association, (NEMA).
 - 6. National Fire Protection Association, (NFPA).
 - a. NFPA 54, National Fuel Gas Code.
 - b. NFPA 99, Standard for Health Care Facilities.
 - 7. Underwriters' Laboratories, Incorporated, (UL).

1.3 QUALITY ASSURANCE

- A. Installer's Qualifications:
 - 1. Contractor regularly engaged in testing of plumbing piping systems and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
- B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. Local and State Building Codes and Ordinances.
2. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Product Data:
 - a. Submit manufacturer's literature and samples for the valve tags.
 2. Testing Plans, Procedures, and Testing Limitations:
 - a. Description of proposed testing method, procedures, and apparatus to the ENGINEER for approval at least 48 hours in advance of testing.
- B. Informational Submittals: Submit the following:
 1. Site Quality Control Submittals:
 - a. Submit a test report for each test to the ENGINEER certifying the test pressure, duration of test, and test performance of all installed piping.
 2. Qualifications Statements:
 - a. Installer's qualifications.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Provide all necessary equipment and materials, including gages and pumps, to perform the testing operations.

PART 3 – EXECUTION

3.1 GENERAL

- A. Conduct water, air and smoke tests as required, on all piping systems as specified below.
- B. Conduct all tests in the presence of, and in a manner approved by ENGINEER, all state and local authorities having jurisdiction. Repeat test for these authorities if requested by them.
- C. Repair and retest all lines, which do not pass the tests as specified herein.
- D. Inspect all valves, joints, and specialties for tightness and for proper operation while under test pressure.
- E. Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through the testing. Piping shall be tightly covered and protected against contamination.

3.2 FIELD QUALITY CONTROL

A. Water Tests:

1. Drainage and Vent system piping:
 - a. Perform tests either on the entire system or on successive sections of the system.
 - b. Tightly close all openings, except the highest opening of the system or section to be tested.
 - c. Fill the system or section with water to the point of overflow.
 - d. Test with a head of at least ten feet of water, except for the uppermost ten feet of the system.
 - e. Allow water to stand in the system for at least 15 minutes before inspecting.
 - f. Inspect the system or section for leaks, and repair any leaks found.
2. Water Piping:
 - a. Water piping shall be tested and proved tight under a pressure not less than 1-1/2 times the working pressure under which it is to be used, but not less than 100 psig for 30 minutes with no loss of pressure.
 - b. Potable water shall be used for testing potable water systems. Non-potable water shall be used for testing non-potable water systems.

B. Air Tests:

1. Attach air compressor testing apparatus to any suitable opening after closing all other inlets and outlets. Force dehydrated oil-less compressed air, pressure dew point -40°F, into system until there is a uniform gage pressure without the introduction of additional air. Below is a list of required gage pressures:
 - a. Drainage and Vent Piping (substitute for water test): Five psi for 15 minutes.

C. Smoke Tests:

1. Finished Plumbing: Final test for gas and water tightness of the completed drainage and vent system:
 - a. Fill all traps with water.
 - b. Introduce a pungent thick smoke, produced by one or more smoke machines, into the system.
 - c. When the smoke appears at stack openings on the roof, close the system.
 - d. Maintain a pressure in the system equivalent to a 1-inch water column for the period of the inspection.
 - e. Inspect the system for leaks and repair any leaks found.

+ + END OF SECTION + +

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SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install domestic water piping systems complete with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the domestic water piping systems Work.
 - 2. Notify other contractors in advance of the installation of the domestic water piping systems to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the domestic water piping systems Work.
- C. Related Sections:
 - 1. Section 09 91 00, Painting.
 - 2. Section 22 05 27, Pipe Sleeves for Plumbing
 - 3. Section 22 05 29, Hangers and Supports for Plumbing Piping
 - 4. Section 22 07 19, Plumbing Piping Insulation
 - 5. Section 22 10 53, Installation of Plumbing Piping
 - 6. Section 22 10 63, Testing of Plumbing Piping

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. ADA Accessibility Guidelines (ADAAG)
 - 2. ANSI A13.1, Scheme for Identification of Piping Systems.
 - 3. ANSI A21.1, Practice Manual, Computation Strength, Thickness.
 - 4. ANSI A21.4, Cement-Mortar Lining/Cast and Ductile Iron Pipe and Fittings (AWWA C105).
 - 5. ANSI A21.10, Cast-Iron and Ductile Iron Fittings, 2-inches through 48-inches, for Water (AWWA C110).
 - 6. ANSI A21.11, Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings (AWWA C111).
 - 7. ANSI A21.51, Ductile-Iron Pipe Centrifugally Cast, in Metal Molds (AWWA C151).
 - 8. ANSI A112.1.2, Air Gaps in Plumbing System.

9. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 150 and 800.
10. ANSI B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
11. ANSI B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (ASME B16.22).
12. ANSI B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, 150 and 300 lbs (ASME B16.24).
13. ANSI B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
14. ANSI B16.39, Malleable Iron Threaded Pipe Unions.
15. ANSI B16.42, Ductile Iron Pipe Flanges and Flanged Fittings.
16. ANSI B40.1, Gages - Pressure Indicating Dial - Elastic Element.
17. ANSI H 23.1, Seamless Copper Water Tube, (ASTM B 88).
18. ANSI Z358.1, Emergency Eyewash and Shower Equipment.
19. American Society of Sanitary Engineers (ASSE), ASSE 1001, Performance Requirements for Atmospheric Type Vacuum Breakers.
20. ASSE 1013, Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
21. ASSE 1018, Trap Seal Primer Valves – Water Supply Fed.
22. ASSE 1020, Performance Requirements for Pressure Vacuum Breaker Assembly.
23. ASTM A 126, Specification for Gray Iron Casting for Valves, Flanges and Pipe Fittings.
24. ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
25. ASTM B 32, Specification for Solder Metal.
26. ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
27. ASTM B 88, Specification for Seamless Copper Water Tube.
28. ASTM D 1330, Specification for Rubber-Sheet Gaskets.
29. AWWA C511, Reduced-Pressure Principle Backflow Prevention Assembly.
30. FS O-F-506, Flux, Soldering: Paste and Liquid.
31. FS WW-U-516, Unions, Brass or Bronze, Threaded Pipe Connections and Solder-Joint Tube Connections.
32. Plumbing and Drainage Institute (PDI), PDI WH 201, Water Hammer Arresters.
33. NSF 61: Drinking Water System Components – Health Effects
34. NSF 372: Drinking Water System Components – Lead Content
35. The United States Safe Drinking Water Act

1.3 QUALITY ASSURANCE

A. Installer's Qualifications:

1. Engage a single installer regularly engaged in domestic water piping installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.

2. Engage a single installer for the entire domestic water piping system with undivided responsibility for performance and other requirements.
- B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 1. Local and State Building Codes and Ordinances.
- C. Component Supply and Compatibility:
 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single domestic water piping systems manufacturer.
 2. The domestic water piping systems manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the domestic water piping systems manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. 1/4-inch scale piping layouts, dimensioned to show length of piping runs, pipe sizes, support spacing and expansion provisions.
 - b. Details of installation, including piping supports.
 - c. Submit pipe schedule with laminate construction, sizes, thickness, vacuum pressure, weight per foot pressure, spans, joint type and flange data.
 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications and engineering data.
 - b. Flexible connections.
 - c. Other technical data related to the specified material and equipment as requested by ENGINEER.
 - d. Gasket material.
- B. Informational Submittals: Submit the following:
 1. Qualifications Statements:
 - a. Installer's qualifications.
- C. Project Closeout Submittals: Submit the following:
 1. Record Documentation:
 - a. During progress of the Work keep an up-to-date set of the Drawings showing field and Shop Drawing modifications. Immediately upon completion of piping Work, submit CADD drawings showing the actual in place installation of all piping and equipment installed under this Section at a scale satisfactory to the OWNER. The drawings shall reflect all of the piping Work on plans and in sections, with all reference dimensions and elevations required for complete Record

Drawings of the piping systems. Two paper prints shall also be furnished. The prints and electronic copies of the CADD files shall be furnished no later than 30 days after completion of the Contract and prior to final payment.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

- A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
- B. The Drawings show an indication of the arrangement of equipment, ducts, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. Piping, equipment, ducts, etc. found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions, without additional cost to the OWNER.
- C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each case, adequately provide for expansion and perfect circulation and minimize the amount of space required for the same.

- D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval by the ENGINEER.
- E. The Drawings do not show, all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others", to complete the systems to the true extent of the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. General Requirements:
 - 1. All piping, couplings and fittings to be used in the potable domestic water distribution system shall be certified NSF 61 Annex G/NSF 372 lead-free.
 - 2. All piping and fittings to be used for domestic water shall comply with the current requirements of the United States Safe Drinking Water Act.
- B. Copper Water Tube:
 - 1. Tube:
 - a. Reference: ANSI H23.1, ASTM B 88.
 - b. Type: K or L.
 - c. Temper: Hard-drawn or soft-annealed.
 - 2. Fittings:
 - a. Reference: ANSI B16.22.
 - b. Reference: ANSI B16.26.
 - c. Reference: ANSI B16.18.
 - 3. Joints:
 - a. Sweat:
 - 1) Solder Metal: ASTM B 32, Type 95-5TA.
 - 2) Flux: FS O-F-506, Type 1.
 - b. Flanged:
 - 1) Flanges: ANSI B16.24, 150 lb. class.
 - 2) Gaskets: Red rubber, ASTM D 1330, Grade 1, 1/8-inch thick.
 - 3) Nuts and Bolts: ASTM A 307.
 - 4. Unions:
 - a. Reference: FS WW-U-516.
 - b. Material: Bronze.
 - c. Rating: 250 lb. W.O.G.

2.2 VALVES

A. General Valves Requirements:

1. All valves, strainers and appurtenances to be used in the potable domestic water distribution system shall be certified NSF 61 Annex G/NSF 372 lead-free. Where specified products are third-party certified lead-free, uncertified products shall not be acceptable equals for substitution.
2. All valves, strainers and appurtenances to be used for domestic water shall comply with the current requirements of the United States Safe Drinking Water Act.

B. Bronze Body Globe Valves:

1. Products and Manufacturers: Provide one of the following:
 - a. Apollo Valves Division of Conbraco Industries, Inc., 120S-LF Series
 - b. Milwaukee Valve, Fig. No. UP1502
 - c. Or equal.
2. Type: Composition disc, screwed bonnet.
3. Materials: Lead-free Brass and bronze.
4. Rating: 150 lb. SWP.
5. End Connections: Solder joint.

C. Bronze Body Check Valves:

1. Products and Manufacturers: Provide one of the following:
 - a. Apollo Valves Division of Conbraco Industries, Inc., 161S-LF Series
 - b. Milwaukee Valve, Fig. No. UP1509
 - c. Or equal.
2. Type: Swing, bronze disc, screw-in cap.
3. Materials: Lead-free Brass and bronze.
4. Rating: 200 PSI CWP
5. End Connections: Solder joint.

D. Bronze Body Ball Valves:

1. Products and Manufacturers: Provide one of the following:
 - a. Apollo Valves Division of Conbraco Industries, Inc., 77FLF-200 Series.
 - b. Milwaukee Valve, Fig. No. UPBA150S
 - c. Or equal.
2. Type: Non-blowout stem, two-piece, quarter turn, full port ball valve.
3. Materials:
 - a. Body: Lead-free bronze or brass.
 - b. Ball: Chrome plated brass.
 - c. Packing and Seats: Teflon.
4. Rating: 200 PSI CWP.
5. End Connections: Soldered End.

E. Strainers:

1. Manufacturers: Provide products of one of the following:
 - a. Watts

- b. Zurn Industries
 - c. Or equal.
 - 2. Type: Self-cleaning wye body with blow-off cock.
 - 3. Construction:
 - a. Basket: Perforated stainless steel basket.
 - b. Perforations: 0.045-inches diameter, minimum.
 - c. Free Area: Four times, cross sectional area of connecting pipe, minimum.
- F. Digitally Controlled Master Mixing Valve:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Armstrong International, Inc.
 - b. Heat-Timer Corporation.
 - c. Or equal.
 - 2. Type: Thermostatically controlled water-blending device.
 - 3. Valve:
 - a. Materials:
 - 1) Body and Trim: Lead-Free Stainless Steel
 - b. Operation: Valve is to be electronically actuated by motor/controller supplied by manufacturer to maintain outlet flow temperature within +/- 2 degrees Fahrenheit of set point for full range of flows specified on drawings with integral emergency shut-off.
 - 4. Controller:
 - a. Performance Capability: The controller shall be provided with a digital display for all control settings and digitally adjustable set-points for operation and emergency overheat temperature. The controller shall be factory configured to receive all required sensor inputs and provide all required control outputs.
 - b. Actuator: Electric motor actuator with all required linkages shall be provided by manufacturer as required for system operation.
 - c. Power: The controller shall be configured to operate on 120VAC, 60Hz power supply, and shall be equipped to provide all low voltage power output as required to all system components.
 - 5. Approvals: ASSE 1017, NSF 61/372, and UL Listing
 - 6. Low outlet temperature type valve shall be adjustable from 60 to 140°F minimum adjustable range.
 - 7. Maximum Inlet Supply Pressure: 200 PSI
- G. Point-of-Use Thermostatic Anti-Scalding Valve:
 - 1. Manufacturers: Provide products of one of the following:
 - a. The Bradley Corporation, S59-4016 Series
 - b. Watts, Series LFMMV
 - c. Or equal
 - 2. Type: Thermostatically operated point-of-use anti-scalding with integral supply checks.
 - 3. End Connection: Soldered-end.
 - 4. Maximum Supply Pressure: 150 PSI
 - 5. Maximum Supply Temperature: 180° F

6. Approvals: ASSE 1070, NSF 61/372

2.3 EQUIPMENT

A. Water Hammer Arresters:

1. Products and Manufacturers: Provide one of the following:
 - a. Zurn-Wilkins Division of Zurn Industries, 1260XL Series
 - b. Watts, LF15 Series
 - c. Or equal.
2. Materials:
 - a. Casing: Copper Tube
 - b. Piston: Polycarbonate
 - c. Tailpiece: Low-lead brass
3. Connection: Male NPT thread.
4. Maximum Working Pressure: 250 psig.
5. Sizing and Certification: PDI WH 201.
6. References: ASSE 1010, NSF 61 / NSF372

B. Pipe Labels:

1. Type: Self-adhering, temperature resistant, waterproof, corrosion resistant.
2. Marker size, marker color, legend size, and legend color shall conform to ANSI A13.1.

C. Flexible Connections:

1. Manufacturers: Provide products of one of the following:
 - a. Flex Hose Co., Inc.
 - b. The Metraflex Company
 - c. Or equal.
2. Type: Flexible connections for piping 2-1/2-inches and smaller.
3. Construction:
 - a. Hose: 316 Stainless Steel
 - b. Braid: 316 Stainless Steel
4. Pressure Ratings: 190 psig working pressure at 250°F temperature.
5. End Connections: Threaded or flanged pipe connection.
6. References: NSF 61/NSF 372

D. Automatic Air Vents:

1. Manufacturers: Provide products of one of the following:
 - a. Armstrong Fluid Technologies.
 - b. Bell and Gossett.
 - c. Or equal.
2. Type: Automatic vent air eliminator with built-in air chamber.
3. Construction:
 - a. Body: Bronze.
 - b. Finish: Chrome plated exterior.
 - c. Overflow Connector: Provide connection for 1/4-inch OD copper tubing.
4. Ratings: 75 psig working pressure.

5. References: NSF 61/NSF 372

E. Thermometers:

1. Manufacturers: Provide products of one of the following:
 - a. H.O. Trerice Company.
 - b. Weksler Instruments Division of Ashcroft, Inc.
 - c. Or equal.
2. Range: 30°F to 240°F temperature range in maximum of 2°F increments.
3. Type: Adjustable Angle Column Type Thermometer.
 - a. Construction:
 - 1) Scales and Lens: Nine-inch high satin finish aluminum scales, black numerals, front reading tubes for non-mercury fluid.
 - 2) Wells: Insertion well with brass separable sockets.
 - 3) Neck: 2-1/2-inch extension neck.
 - 4) Case: Cast aluminum.
 - 5) Window: Glass or clear acrylic plastic.

F. Pressure Gages:

1. Manufacturers: Provide products of one of the following:
 - a. H.O. Trerice Company.
 - b. Weksler Instruments Division of Ashcroft, Inc.
 - c. Or equal.
2. Reference ANSI B40.1 for Grade AA gages.
3. Type: Direct mounted, dial type pressure gage.
4. Construction:
 - a. Case: Six-inch diameter cast aluminum, flangeless with black finish and bottom 1/4-inch N.P.T.
 - b. Ring: Chrome plated close type.
 - c. Dial: White face, black numbers and graduations.
 - d. Window: Glass or clear acrylic plastic.
 - e. Pointer: Micrometer type, black finish, red tip.
 - f. Movement: Stainless steel, rotary type, delrin sector and bushings.
 - g. Bourdon Tube: Type 316 stainless steel
 - h. Socket and Tip: Forged brass, alloy steel and Type 316 stainless steel.
5. Accuracy: One percent minimum.
6. Gage Cocks: Provide brass tee handle isolation cock before each gage.
7. All gauges are to be filled with non-mercury organic fluids.

J. Vacuum Breakers:

1. Pressure Type: PVB:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Conbraco Industries, Incorporated, Series SVB 4ALF
 - 2) Watts, Series LF8003)
 - 3) Or equal.
 - b. Type: An assembly containing an independently operating internally loaded check valve and an independently operating loaded air inlet valve located on the discharge side of the check valve. The assembly

shall also be equipped with test cocks and shut off valves on the inlet and outlet of the assembly.

- c. Materials:
 - 1) Springs: Stainless steel.
 - 2) Bonnet: Glass filled PPO
 - 3) Vent Disc: Silicone rubber.
 - 4) Disc Holder Float: Polypropylene.
 - 5) Check Valve Disc: Silicone rubber.
 - 6) Check Valve Seat: NORYL
 - 7) Body: Lead-free copper alloy
 - d. Accessories:
 - 1) Ball valves on inlet and outlet on the assembly.
 - 2) Ball valve test cocks on the assembly.
 - e. Reference: ASSE 1020, NSF 61/NSF 372.
 - f. Working Pressure: 150 psi.
 - g. Installation: Vertical, minimum 12-inches above fixture vacuum breaker serves.
2. Atmospheric Type: AVB:
- a. Products and Manufacturers: Provide one of the following:
 - 1) Apollo Valves Division of Conbraco Industries, Inc, Series 38LF-100
 - 2) Watts, Series LF288A.
 - 4) Or equal.
 - b. Type: An assembly containing an air inlet valve, a check seat and an air inlet port to prevent reverse flow of water and allow air into the water line to break a siphon.
 - c. Materials:
 - 1) Hood: Polished Chrome Finish
 - 2) Body: Lead-Free Bronze.
 - 3) Vent Disc: Silicone.
 - 4) Disc Holder Float: Polyethylene.
 - 5) Body: Lead-Free Bronze.
 - d. Reference: ASSE 1001.
 - e. Working Pressure: 210°F at 125°F.
 - f. Installation: Vertical, minimum 6-inches above fixture vacuum breaker serves.

K. Aquastats:

- 1. Manufacturers: Provide products of one of the following:
 - a. Honeywell.
 - b. Johnson Controls.
 - c. Or equal.
- 2. Type: Immersion type for regulating water temperature in hot water piping, tepid water piping, or hot water storage tanks.
- 3. Electrical Rating: 120 VAC.
- 4. Set point Range:
 - a. Domestic Hot Water: Make contacts on temperature drop below 112°F; break contacts on temperature rise above 120°F.

- b. Tepid Water: Make contacts on temperature drop below 70°F; break contacts on temperature rise above 90°F.
 - 5. Adjustment: Adjustable setpoint through knob on cover.
 - 6. Differential: Adjustable 3°F to 10°F.
 - 7. Accessories: Provide immersion well.
- L. Trap Primer Valve:
 - 1. Manufacturers: Provide products of one of the following:
 - a. MIFAB
 - b. Watts.
 - b. Or equal.
 - 2. Construction:
 - a. Body: Brass.
 - b. Seals: O-ring 40°F to 450°F.
 - c. Inlet and Outlet Size: 1/2-inch.
 - d. Integral backflow preventer.
 - e. Provide multiple outlet distribution units, as required.
 - f. Reference: ASSE 1018, NSF 61/NSF 372
 - g. Accessories: Floor drain trap primer distribution unit.
- M. Hot Water Temperature Maintenance Heat Tracing:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Raychem Products Division of
 - b. Thermon Manufacturing Company.
 - c. Or equal.
 - 2. General: Furnish and install a complete UL listed system of heat trace cable(s) and components approved and designed specifically for maintaining various hot water temperatures ranging from 110°F to 140°F. Hot water from hot water heater(s) to plumbing fixtures and as shown, shall be electrically traced with self-limiting heaters. Manufacturer shall assist in selecting the correct tracer and develop Bill of Materials. All connections and equipment shall be moisture-proof.
 - 3. The heater cable assembly shall consist of two No. 14 AWG parallel nickel-plated copper bus wires imbedded in a self-regulating core and covered in a cross-linked polyolefin insulating jacket. The heater assembly shall be covered with tinned copper metallic braid and an outer jacket of cross-linked polyolefin insulation, nominally of 40-mil thickness, and color-coded for easy identification.
 - 4. The cable shall be rated for 120 or 208 Volt operation.
 - 5. Pipe and heat trace shall be insulated with 1-1/2-inch thick fiberglass insulation as described in Section 22 07 19, Plumbing Piping Insulation.
 - 6. Provide all splice power-to-tracing connectors, thermostats, end terminations, straps, ground fault circuit breakers, junction boxes, etc., as required.

2.4 PAINTING

- A. Piping and accessories shall be painted in accordance with Section 09 91 00, Painting.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install all items as shown, specified, and as recommended by the manufacturers.
 - 2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
 - 3. Present conflicts between piping systems and/or equipment and/or structures to ENGINEER, in writing, who will determine corrective measures to be taken.
 - 4. Do not modify structures to facilitate installation of piping, unless specifically approved by ENGINEER.
 - 5. Installation shall conform to requirements of all local and state codes.
 - 6. Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.
 - 7. Unless otherwise required by the tubing manufacturer or AHJ, copper tubing, fittings, couplings, and soldered joints shall be installed according to methods and procedures described in "The Copper Tube Handbook" reference publication by the Copper Development Association.
 - 8. All valves and equipment are to be installed perfectly plumb and level, in horizontal runs of piping (except where specifically indicated for vertical piping installation).
 - 9. All required access shall be provided for valves and equipment. Where valves or equipment are installed behind walls, above ceilings, or in otherwise inaccessible locations, 18"x18" access panels are to be provided by the general contractor at locations to be coordinated.
 - 10. All fixtures are to be installed perfectly plumb and level with finished walls and floors, and are to be in perfect working condition.
 - 11. All workmanship is to be neat, clean, and free of any visible defect or damage.

3.2 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Fill all systems and fully test all equipment, valves, dampers, etc. in operation.
 - 2. Check for excessive vibration while all systems are operating.

3. Installed systems and components will not be released to OWNER, unless all systems have been tested and approved by the ENGINEER.

B. Inspection:

1. Examine areas to receive piping, valves and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances for piping, valves and accessories.
 - c. Start the Work only when conditions are satisfactory.
2. The ENGINEER reserves the right to reject or authorize replacement of piping and accessories found to defective.

3.3 ADJUSTING AND CLEANING

A. Adjusting:

1. Adjust all controls for proper settings.
2. While system is operable balance all equipment, valves, dampers, etc. to achieve design conditions.

B. Cleaning:

1. Thoroughly clean all piping, fittings, valves, and accessories prior to installation.
2. Remove all dirt, rust, dust, etc. from piping in preparation for painting.
3. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 MATERIAL SCHEDULES

A. Piping:

1. Use types of pipe and fittings as specified below, unless otherwise specified or shown.
2. All potable water supply, hot and cold water piping 2-1/2-inches and smaller, run within the interior of a building, shall be hard-drawn copper Type "L" with solder joints and connections.
3. All potable water piping 2-1/2-inches and smaller run underground shall be soft-annealed copper Type "K" copper tubing.
4. All exposed water piping and valves to plumbing fixtures shall be chrome-plated brass.
5. All valves for copper tubing less than 3 inches diameter shall be bronze bodied, unless otherwise specified.
6. Use "wrought copper" fittings for copper tubing.
7. Use "butt welded" fittings for welded steel pipe connections.

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SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install sanitary waste and vent piping systems complete with accessories.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the sanitary waste and vent piping systems Work.
2. Notify other contractors in advance of the installation of the sanitary waste and vent piping systems to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the sanitary waste and vent piping systems Work.

C. Related Sections:

1. Section 09 91 00, Painting.
2. Section 22 05 27, Pipe Sleeves for Plumbing.
3. Section 22 05 29, Hangers and Supports for Plumbing Piping.
3. Section 22 10 53, Installation of Plumbing Piping.
4. Section 22 10 63, Testing of Plumbing Piping Systems.
5. Section 31 23 05, Excavation and Fill.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American Society of Sanitary Engineering, (ASSE).
2. The American Society of Mechanical Engineers (ASME).
 - a. ASME A112.14.1, Backwater Valves
 - b. ASME B16.29, Standard for Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings – DWV.
2. American Society for Testing and Materials, (ASTM).
 - a. ASTM A 74, Specification for Cast-Iron Soil Pipe and Fittings.
 - b. ASTM A 518/A 518M, Specification for Corrosion-Resistant High-Silicon Iron Castings.
 - c. ASTM A 861, Specification for High-Silicon Iron Pipe and Fittings.
 - d. ASTM A 888, Specification for Hubless Cast-Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
 - e. ASTM B 306, Standard Specification for Copper Drainage Tube (DWV)

- f. ASTM C 564, Specification for Rubber Gaskets for Cast-Iron Soil Pipe and Fittings.
 - g. ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 - h. ASTM D 1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - i. ASTM D 2665, Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.
 - j. ASTM F441/441M, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
 - k. ASTM F 493, Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
 - l. ASTM F 656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
 - m. ASTM F 2618 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems.
- 3. Cast-Iron Soil Pipe Institute, (CISPI).
 - a. CISPI 310 Specification for Couplings for Use in Connection with Hubless Cast-Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
 - b. CISPI HSN, Specification for Neoprene Rubber Gaskets for Hub and Spigot Cast-Iron Soil Pipe and Fittings.
 - 4. Federal Specifications, (FS).
 - a. FS QQ-C-40, Calking Lead Wool and Lead Pig.
 - 5. National Sanitation Foundation (NSF).
 - a. NSF 14: Plastic Piping System Components and Related Materials

1.3 QUALITY ASSURANCE

- A. Installer's Qualifications:
 - 1. Engage a single installer regularly engaged in sanitary piping installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
 - 2. Engage a single installer for the entire sanitary waste and vent piping system with undivided responsibility for performance and other requirements.
- B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. Local and State Building Codes and Ordinances.
 - 2. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.

- C. Component Supply and Compatibility:
1. Obtain all equipment included in this Section regardless of the component manufacturer from a single sanitary waste and vent piping systems manufacturer.
 2. The waste and vent piping systems manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the sanitary waste and vent piping systems manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. 1/4-inch scale piping layouts, dimensioned to show length of piping runs, pipe sizes, support spacing and expansion provisions.
 - b. Details of installation, including piping supports.
 - c. Submit pipe schedule with laminate construction, sizes, thickness, vacuum pressure, weight per foot pressure, spans, joint type and flange data.
 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications and engineering data.
 - b. Flexible connections.
 - c. Other technical data related to the specified material and equipment as requested by ENGINEER.
 - d. Gasket material.
- B. Informational Submittals: Submit the following:
1. Qualifications Statements:
 - a. Installer's Qualifications
- C. Record Documentation: Submit the following:
1. Record Drawings:
 - a. During progress of the Work keep an up-to-date set of the Drawings showing field and Shop Drawing modifications. Immediately upon completion of piping Work, submit CADD drawings showing the actual in place installation of all piping and equipment installed under this Section at a scale satisfactory to the OWNER. The drawings shall reflect all of the piping Work on plans and in sections, with all reference dimensions and elevations required for complete Record Drawings of the piping systems. Two paper prints shall also be furnished. The prints and electronic copies of the CADD files shall be furnished no later than 30 days after completion of the Contract and prior to final payment.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
- B. Storage of Materials:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

- A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
- B. The Drawings show an indication of the arrangement of equipment, piping, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. Piping, equipment, etc., found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.
- C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each case and adequately provide for expansion and perfect circulation and minimize the amount of space required for the same.
- D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval by the ENGINEER.
- E. The Drawings do not show all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall carefully examine all of the General

Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work “by others”, to complete the systems to the true extent of the Contract Documents.

PART 2 - PRODUCTS

2.1 PIPING

- A. Cast-Iron Soil Pipe and Fittings:
 - 1. Pipe and Fittings: ASTM A 74.
 - 2. Weight: Service Weight.
 - 3. Joints:
 - a. Compression:
 - 1) Gasket: Neoprene Rubber, ASTM C 564, CISPI HSN.
 - 2) Lubricant: As recommended by pipe manufacturer.
 - b. Calked:
 - 1) Lead: FS QQ-C-40, Type I, Grade AA.
 - 2) Jute Packing: FS HH-P-117, Type I.
- B. DWV Copper Tubing:
 - 1. Pipe: ASTM B306, hard-drawn, seamless, copper tubing.
 - 2. Weight: DWV.
 - 3. Fittings: ASME B16.29, DWV, Wrot Copper, solder-end fittings.
 - 4. Joints: 95-5 tin-antimony solder, soldered joints and fittings.
- C. Hubless Cast-Iron:
 - 1. No-Hub Pipe and Fittings: ASTM A 888.
 - 2. Joints: CISPI 310.
- D. Polyvinyl Chloride Pipe and Fittings:
 - 1. Pipe: ASTM D 1785, Type 2110.
 - 2. Weight: Schedule 40.
 - 3. Fittings: ASTM D 2665, drainage type.
 - 4. Joints: Solvent weld with manufactures recommended solvents.
 - 5. Reference: NSF 14.
- E. High Silicon Cast-Iron Pipe:
 - 1. Silicon Content: 14.5 percent.
 - 2. Weight: 0.255 lbs. per cubic inch.
 - 3. Melting Point: 2,300°F.
 - 4. Hardness, Brinell: 520.
 - 5. Tensile Strength (1/2-inch diameter): 20,000 psi.
 - 6. Joints: Hub and spigot with acid, resistant packing followed by lead.
 - 7. Fittings: Same material as pipe.
 - 8. Reference: ASTM A 518/A 518M and ASTM A 861.

- F. Chlorinated Polyvinyl Chloride (CPVC) Pipe and Fittings, Gravity Drainage:
 - 1. ASTM F 2618, certified corrosive waste grade and stamped NSF-cw.
 - 2. Weight: Schedule 40
 - 3. Fittings: ASTM F2618, DWV, socket-weld type, certified corrosive waste grade and stamped NSF-cw.
 - 4. Joints: Solvent cement welded with cement formulated for chemical waste applications, conforming to ASTM F493, NSF certified for use in corrosive waste systems. Use ASTM F656 CPVC primer as recommended by manufacturer or required by local codes.
 - 5. Temperature: Rated for non-pressure use up to 220° F.
 - 6. Other References: NSF 14.
- G. Chlorinated Polyvinyl Chloride (CPVC) Pipe and Fittings, Pressure Application:
 - 1. ASTM F 441/441M, CPVC pipe for use with corrosive chemicals.
 - 2. Weight: Schedule 80
 - 3. Fittings: ASTM D1784 material, dimensional tolerances described in ASTM F493, socket-weld type, FRP re-enforced.
 - 4. Joints: Solvent cement welded with cement formulated for improved resistance to corrosive chemicals, conforming to ASTM F493, with ASTM F656 CPVC primer as recommended by manufacturer or required by local codes.
 - 5. Rating: 2,000 PSI at 73° F, maximum temperature rating up to 200° F.
 - 6. Reference: NSF 14.

2.2 DRAINS AND CLEANOUTS

- A. Drains and Cleanouts:
 - 1. Floor Drain and Shower Drain, acid and corrosion resistant: (FD).
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Jay R. Smith, Fig. 2010--U-NB with A.R.E. coating.
 - 2) Zurn Industries, Fig. ZN-415S-P-VP with A.R.E. coating.
 - 3) Or equal.
 - b. Materials:
 - 1) Body: Enameled cast-iron.
 - 2) Collar: Cast-iron, reversible, threaded for strainer heads, enamel coated.
 - 3) Strainer Head: Square 8-inch by 8-inch nickel bronze grate with bronze body, heel proof grate, and vandal proof screws.
 - c. Outlet Connection: Bottom outlet, calk or no-hub, as required.
 - d. Trap primer connection on body with thread to solder adapter, as required.
- B. Cleanouts:
 - 1. Cleanout Deck Plates (FCO-1) (Finished Areas):
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Jay R. Smith, Fig. 4043S.
 - 2) Zurn Industries, Fig. No. Z-1400-K-BP.
 - 3) Or equal.

- b. Materials: Cast-iron body and adjustable nickel bronze top.
 - c. Outlet Connection: Standard spigot.
 - d. Accessories:
 - 1) Square nickel bronze top.
 - 2) Cast bronze taper thread plug.
 - 2. Wall Cleanout Plate:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Jay R. Smith, Fig. 4402-BP.
 - 2) Josam Company, 58600-C Series.
 - 3) Or equal.
 - b. Materials: Cast bronze taper thread plug.
 - c. Accessories:
 - 1) Stainless steel round shallow wall plate.
 - 2) Cast-iron calked ferrule.
- C. Acid Neutralization Tank (AN):
- 1. Products and Manufacturers: Provide one of the following:
 - a. Zurn Industries, Fig. No. Z9A-PHIX.
 - b. Orion Industries, Incorporated, a Watts Brand, Style T5 Tank Series,.
 - c. Or equal.
 - 2. Materials:
 - a. Tank: Cylindrical high density polyethylene.
 - b. Cover: Polyethylene, bolt down.
 - c. Gasket: Neoprene.
 - 3. Connections:
 - a. Inlet: 1-1/2-inch.
 - b. Outlet: 1-1/2-inch.
 - c. Vent: 2-inch.
 - 4. Capacity: Five gallon nominal.
 - 5. Fill with limestone or marble chips one to three inches in size to a level just below tank outlet.

2.3 BACKWATER VALVES

- A. Cast Iron Backwater Valve:
- 1. Products and manufacturers: Provide one of the following:
 - a. Watts, Model BV-200
 - b. Jay R Smith, Fig. No. 7012
 - c. Or equal
 - 2. Materials:
 - a. Body: Cast iron.
 - b. Valve Assembly: Bronze
 - 3. End Connections: No-Hub.
 - 4. References: ASME 112.14.1

2.4 PAINTING

- A. All piping and accessories shall be painted in accordance with the requirements of Section 09 91 00, Painting.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install all items as shown, specified, and as recommended by the manufacturer.
 - 2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
 - 3. Present conflicts to ENGINEER, in writing, who will determine corrective measures to be taken.
 - 4. Do not modify structures to facilitate installation of piping, unless specifically approved by ENGINEER.
 - 5. Installation shall conform to requirements of all local and state codes.
 - 6. Installation of piping shall be in accordance with Section 22 10 53, Installation of Plumbing Piping.
 - 7. Installation of hangers and supports shall be in accordance with Section 22 05 29, Hangers and Supports for Plumbing and Piping Equipment.
 - 8. Protection: Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.
 - 9. Reference 031 23 05, Excavation and Fill for underslab piping work.

3.2 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Tests: Water or smoke test piping in accordance with Section 22 10 63, Testing of Plumbing Piping Systems.
 - 2. Fill all systems and fully test all equipment, valves, etc. in operation.
 - 3. Check for excessive vibration while all systems are operating.
 - 4. Installed systems and components will not be released to OWNER, unless all systems have been tested and approved by the ENGINEER.
- B. Inspection:
 - 1. Examine areas to receive piping, valves and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances for piping, valves and accessories.
 - c. Start the Work only when conditions are satisfactory.

2. The ENGINEER reserves the right to reject or authorize replacement of piping and accessories found to defective, blistered, cracked or deviated from allowable tolerances as described above.

3.3 ADJUSTING AND CLEANING

- A. Adjusting:
 1. While system is operable, balance all equipment, valves, etc. to achieve design conditions.
- B. Cleaning:
 1. Thoroughly clean all piping, fittings, valves, and accessories prior to installation.
 2. Remove all dirt, rust, dust, etc. from piping in preparation for painting.
 3. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 MATERIAL SCHEDULES

- A. Piping:
 1. Use types of pipe and fittings as specified below, unless otherwise specified or shown.
 2. All exposed gravity sanitary waste and vent piping 1-1/2-inches and larger run within the interior of a building shall be no-hub cast-iron.
 3. All gravity sanitary waste and vent piping 1-1/2-inches and larger located in concrete slabs or underground to exterior limits as shown shall be service-weight cast-iron soil pipe with hub-and-spigot fittings.
 4. All gravity sanitary waste and vent piping, smaller than 1-1/4-inches diameter shall be DWV copper tubing.
 5. All chemical resistant waste piping from laboratory sinks, floor drains, receptors and other fixtures to the neutralizing tank shall be high silicon cast-iron.
 6. Use polyvinyl chloride piping and fittings only as required and as allowed by local building code.

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SECTION 22 33 00

DOMESTIC WATER HEATERS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install domestic water heaters complete with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before domestic water heaters Work.
 - 2. Notify other contractors in advance of installing domestic water heaters to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before domestic water heaters Work.
- C. Related Sections:
 - 1. Section 09 91 00, Painting.
 - 2. Section 22 05 29, Hangers and Supports for Plumbing Piping and Equipment.
 - 3. Section 22 11 16, Domestic Water Piping.
 - 4. Section 26 05 05, General Provisions for Electrical Systems.
 - 5. Section 26 28 16.33, Disconnect Switches.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ASME Boiler and Pressure Vessel Code.
 - 2. ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 3. NSF/ANSI 61, Drinking Water System Components – Health Effects.
 - 4. NSF/ANSI 372, Drinking Water System Components – Lead Content

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Shall have minimum of five years experience producing equipment substantially similar to that required and shall be able to document evidence of at least five installations in satisfactory operation for at least five years each.
- B. Component Supply and Compatibility:
 - 1. Obtain each type of domestic water heater equipment included in this Section,

regardless of component manufacturer, from one domestic water heater equipment manufacturer.

2. Each domestic water heater manufacturer shall review and approve, or shall prepare, all Shop Drawings and other submittals for components furnished under this Section for the particular equipment type.
3. Materials and equipment shall be suitable for the required service conditions and shall be integrated into each assembly by the associated domestic water heater manufacturer.

C. Regulatory Requirements: Comply with Laws and Regulations, including the following.

1. State and Local Building Codes.
2. SCAQMD Rule 1146.2, Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Schedule of domestic water heaters for the Project, indicating for each the installation location, model or type, and other distinguishing information.
 - b. Drawings showing fabrication methods, assembly, accessories, and installation details.
 - c. Detailed drawings of each equipment item's and component's wiring diagrams.
 - d. Detailed installation drawing of each individual component showing:
 - 1) Mounting requirements.
 - 2) Item locations, such as in a panel, installed on floor, or elsewhere.
 - 3) Piping and wiring connections labeled and coded.
 - 4) Data sheets.
 - e. Detailed description of each component.
2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.

B. Informational Submittals: Submit the following:

1. Manufacturer's Instructions:
 - a. Special shipping, storage and protection, and handling instructions.
 - b. Installation data for the equipment, including setting drawings, templates, and directions for installing anchorage devices.
2. Source Quality Control Submittals:
 - a. Submit results of required factory tests and inspections.
3. Qualifications Statements:
 - a. Manufacturer, when submittal of qualifications is required by ENGINEER.

- C. Closeout Submittals: Submit the following:
 - 1. Operations and Maintenance Data:
 - a. Submit in accordance with Section 01 78 23, Operations and Maintenance Data.
 - b. Include maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 - 1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.
 - 2. Comply with Section 01 65 00, Product Delivery Requirements.
- B. Storage and Protection:
 - 1. Store materials and equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
 - 2. Comply with Section 01 66 00, Product Storage and Handling Requirements.

1.6 QUALITY ASSURANCE

- A. All products are to be certified NSF 61 and NSF 372 lead-free, all electrical components are to be UL Listed for specific use, and all systems are to be third-party certified to all applicable equipment standards.

PART 2 – PRODUCTS

2.1 ELECTRIC WATER HEATER

- A. Electric Water Heater – EWH-1.
 - 1. Heater Type: Electric with UL label.
 - 2. Service Conditions:
 - a. Nominal Capacity: 119 gallons.
 - b. Working pressure: 150 psig.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. A.O. Smith, Model DVE-120.
 - b. Rheem Manufacturing Company, E120-12-G.
 - c. Or equal.
 - 4. Heater Style: Standard vertical.
 - 5. Materials:
 - a. Tank: Welded steel.
 - b. Tank Lining: Glass-lining, fired to minimum temperature of 1,400 degrees F.
 - c. Outer Shell: Steel with baked enamel finish.
 - d. Insulation: Polyurethane foam.

- e. Cathodic Protection Anode: High-density magnesium.
- f. Water Connections: Brass.
- g. Base and Legs: Steel or cast-iron.
- 6. Heaters shall not have:
 - a. Sharp edges.
 - b. Scratches on enameled surfaces.
 - c. Loose fasteners.
 - d. Loose panels.
 - e. Dents on outer jacket.
- 7. Electric Heat Source:
 - a. Heating Element and Operation: Immersion type, 24 KW element.
 - b. Heating Elements: Heavy-duty with incoloy sheaths and ceramic terminal blocks.
 - c. Power Supply: 480-volt, three-phase, 60 Hertz.
- 8. Controls:
 - a. Fused transformer for 120-volt control circuit power.
 - b. Thermostat: Immersion type. 110 degrees F to 170 degrees F adjustable water temperature range, set at 140°F.
 - c. Element operation shall be simultaneous switched through individual magnetic contactors.
 - d. Manual reset high temperature cut-off. High limit energy cut-off to interrupt electrical current in event water inside heater tank exceeds 200 degrees F.
 - e. Local power disconnect switch to be provided under Division 26, Electrical.
- 9. Water Connections: 1.25-inch diameter inlet and outlet pipe nipples for connections to water piping system.
- 10. Drain Valve: Manufacturer's standard drain valve on front at tank bottom or lower side to completely drain tank.
- 11. Source Quality Control: Perform hydrostatic test on tank at the factory at 300 psi. Duration of test shall be manufacturer's standard. Criteria for acceptance: Zero leakage.
- 12. Standards: Comply with UL 1453, NSF 61, NSF 372, and ASHRAE 90.1.

2.7 ACCESSORIES

- A. Temperature and Pressure Relief Valve: Provide one of the following on each storage-type water heater unit furnished:
 - 1. Valve: Temperature and pressure relief valve in accordance with ASME/ANSI Z21.22.
 - 2. Capacity and size of valve to relieve heater capacity at specified temperatures and pressure setting of domestic water heater tank.
 - 3. Settings:
 - a. Temperature Relief Setting: 210 degrees F.
 - b. Pressure Relief Setting: 150 psig.
- B. Cathodic Protection for Water Heaters with Tanks: Provide rigidly-supported anode rods in heater tank.

- C. Vacuum Breakers: Provide one for each storage-type water heater furnished:
 - 1. Products and Manufacturers: Provide one of the following:
 - a. Watts 36ALFN36, Vacuum Relief Valve.
 - b. Johnson, VB8.Cash Acme, VR-801, Lead-Free
 - c. Or equal.
- D. Pre-Pressurized Expansion Tank: Provide where shown or indicated on the Drawings:
 - 1. Type: Diaphragm type pre-pressurized expansion tank designed for potable hot water systems.
 - 2. Service Conditions:
 - a. Tank Volume: 4 gallons
 - b. Maximum Working Pressure: 125 psig.
 - c. Maximum Working Temperature: 200 degrees F.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. Amtrol, Incorporated, Therm-X-Trol, ST Series Model ST.
 - b. Watts Regulator, Model DET.
 - c. Or equal.
 - 4. Construction:
 - a. Shell: Welded carbon steel.
 - b. Diaphragm: Heavy-duty butyl rubber or comparable material for intended service. Schrader valve tapping.
 - c. Heads: Dished.
 - d. Polypropylene-lined water reservoir.
 - 5. Factory Charge: Precharged to 40 psig.
 - 6. Finish: Factory-applied primer coat, to be compatible with required field painting specified in Section 09 91 00, Painting.
 - 7. Standards: Equipment shall be listed in NSF/ANSI 61.

2.8 FINISHING

- A. Factory-paint ferrous surfaces in accordance with Section 09 91 00, Painting. Do not paint enameled surfaces, stainless steel, brass, chrome-plated, and other finished surfaces.

2.9 SOURCE QUALITY CONTROL

- A. All equipment shall be completely manufactured and pre-assembled in accordance with applicable reference standards indicated in this Section. Perform the following tests and inspections at factory before shipment:
 - 1. For each assembled unit, test and inspect equipment in accordance with UL requirements.
 - 2. Test and inspect in accordance with ASME Boiler and Pressure Vessel Code.
 - 3. Perform hydrostatic testing tanks as required in this Section for individual equipment items.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. General:
 - 1. Thoroughly clean materials, equipment, and accessories prior to installation.
 - 2. Install items as in accordance with the Contract Documents, Laws and Regulations, manufacturer's recommendations, and good practice. Obtain interpretation from ENGINEER if manufacturer's instructions or Laws or Regulations conflict with the Contract Documents.
 - 3. Do not modify structures or facilities to facilitate installation of equipment without approval of ENGINEER.
 - 4. Provide each domestic water heater with shut off valves for required water supplies.

3.3 FIELD QUALITY CONTROL

- A. Site Tests:
 - 1. ENGINEER shall witness field tests.
 - 2. Fill all systems and verify that equipment, valves, and appurtenances operate successfully and in accordance with the Contract Documents.
 - 3. Check for excessive vibration while systems are operating.
 - 4. For materials and equipment that do not successfully pass field tests, make repairs or modifications and retest until acceptable results are achieved.
- B. Manufacturer's Services: Provide a qualified, factory trained serviceman to perform the following:
 - 1. Supervise installation of equipment.
 - 2. Instruct CONTRACTOR in installing equipment.
 - 3. Inspect and adjust equipment after installation and ensure proper operation.
 - 4. Instruct operations and maintenance personnel in operation and maintenance of the equipment.
 - 5. Manufacturer's technician shall make visits to the Site as follows:
 - a. First visit shall be for instructing CONTRACTOR in proper equipment installation, and assisting in installing equipment. Minimum number of hours on-Site: 1 hours.
 - b. Second visit shall be for checking completed installation, start-up of system; and performing field quality control testing. Minimum number of hours on-Site: 2 hours.
 - c. Third visit shall be to instruct operations and maintenance personnel.

- 1) Furnish services of manufacturer's qualified, factory-trained specialists to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of equipment.
- 2) Training requirements, duration of instruction, and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
- 3) Number of hours on-Site shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
- d. Technician shall revisit the Site as often as necessary until installation is acceptable.
6. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.4 ADJUSTING AND CLEANING

A. Adjusting:

1. Adjust controls for proper settings.
2. While system is operable, balance all equipment, including valves, appurtenances, and similar equipment, to achieve specified service conditions.
3. Adjust thermostats to desired water outlet temperature.

B. Cleaning:

1. Upon completion of the Work, remove all non-permanent labels, and remove dirt, grease, markings, and other objectionable matter from equipment.
2. In preparation for painting, remove dirt, rust, dust, and objectionable materials from materials and equipment.

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SECTION 22 40 00

PLUMBING FIXTURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install plumbing fixtures complete with accessories.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before plumbing fixtures Work.
2. Notify other contractors in advance of installing plumbing fixtures to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before plumbing fixtures.

C. Related Sections:

1. Section 09 91 00, Painting.
2. Section 22 11 16, Domestic Water Piping
3. Section 22 13 16, Sanitary Waste and Vent Piping.
4. Section 22 07 19, Plumbing Piping Insulation.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI/ASME A112.19.1, Enameled Cast Iron and Enameled Steel Plumbing Fixtures.
2. ANSI/ASME A112.19.2, Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals.
3. ANSI/ICC A117.1, Accessible and Usable Buildings and Facilities.
4. ASHRAE 18, Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration.
5. ASME A112.6.1M, Floor-affixed Supports for Off-the-floor Plumbing Fixtures for Public Use.
6. ASME A112.18.1, Plumbing Supply Fittings.
7. ASME A112.18.2, Plumbing Waste Fittings.
9. ASSE 1016, Performance Requirements for Individual Thermostatic, Pressure Balancing, and Combination Control Valves for Individual Fixture Fittings.
10. ASSE 1037, Performance Requirements for Pressurized Flushing Devices for Plumbing Fixtures.

11. ASSE 1070, Performance Requirements for Water-temperature Limiting Devices.
12. AWWA C651, Disinfecting Water Mains.
13. FS WW-P-541/1, Plumbing Fixtures (Water Closets).
15. NSF 61: Drinking Water System Components – Health Effects.
16. NSF 372: Drinking Water System Components – Lead Content.
17. UL 399, Standard for Drinking-Water Coolers
18. US EPA WaterSense Program Certification and Labeling.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Shall have minimum of five years experience producing equipment substantially similar to that required, and shall be able to document evidence of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain each type of plumbing fixture included in this Section, regardless of component manufacturer, from one plumbing fixtures and trim manufacturer.
2. Each plumbing fixtures and trim manufacturer shall review and approve, or shall prepare, all Shop Drawings and other submittals for components furnished under this Section for the particular fixture type.
3. Materials and equipment shall be suitable for the required service conditions and shall be integrated into each assembly by the associated plumbing fixtures and trim manufacturer.

C. Regulatory Requirements: Comply with Laws and Regulations, including the following.

1. ADAAG, Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities.
3. State and Local Building Codes

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Schedule of plumbing fixtures and trim for the Project, indicating for each the installation location, model or type, and other distinguishing information.
 - b. Drawings showing fabrication methods, assembly, accessories, installation details and wiring diagrams.
 - c. Detailed installation drawings of each individual components showing:
 - 1) Mounting requirements.
 - 2) Piping and roughing connections, labeled and coded.
 - 3) Instructions.
 - 4) Materials of construction.

- 5) Data sheets.
 - d. Detailed description of each component.
 - 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
- B. Informational Submittals: Submit the following:
- 1. Manufacturer's Instructions:
 - a. Special shipping, storage and protection, and handling instructions.
 - b. Installation data for the equipment, including setting drawings, templates, and directions for installing anchorage devices.
 - 2. Field Quality Control:
 - a. Submit results of bacteriological testing.
 - 3. Qualifications Statements:
 - a. Manufacturer, when submittal of qualifications is required by ENGINEER.
- C. Closeout Submittals: Submit the following:
- 1. Operations and Maintenance Data:
 - a. Submit in accordance with Section 01 78 23, Operations and Maintenance Data.
 - b. Include maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
- 1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.
 - 2. Comply with Section 01 65 00, Product Delivery Requirements.
- B. Storage and Protection:
- 1. Store materials and equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
 - 2. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General:
- 1. Exposed valves and escutcheons shall be chrome plated.

2. Where applicable, materials and equipment furnished shall comply with FS WW-541/8.
3. Provide materials and equipment with USEPA WaterSense label, when products with label are available from at least one manufacturer.
4. All faucets, supply kits, stop valves, and other components to be installed in the domestic water system are to be certified NSF 61/NSF 372 lead-free.
5. All tempered water supplies for lavatory faucets or other handwashing fixtures are to be provided with anti-scalding valves conforming to ASSE 1070. Anti-scalding valves to be as specified in section 22 11 16, Domestic Water Piping, except that faucets with integral ASSE 1070 compliant temperature limiting devices do not require a valve to be installed on the fixture supply.

B. Water Closet, Handicapped – Type WC:

1. Products and Manufacturers: Provide one of the following:
 - a. American Standard, Fig. No. 3351.128.
 - b. TOTO, Fig. No. CT708E.
 - c. Zurn, Fig. No. Z5615.
 - d. Or equal.
2. Type: Flush-valve, siphon jet, high efficiency type, 1.28 gallons per flush.
3. Style: Wall-hung, elongated bowl.
4. Standards: Comply with ANSI/ASME A112.19.2 and ANSI/ICC A117.1.
5. Accessories:
 - a. Flush Valve and Vacuum Breaker:
 - 1) Products and Manufacturers: Provide one of the following:
 - a) Sloan, “Royal” Model No. 111-1.28.
 - b) TOTO, Model TMT1LN32#CP.
 - c) Or equal.
 - 2) Standards: ASME A112.19.2, ASSE 1037, US EPA WaterSense Certified.
 - b. Seat and Cover:
 - 1) Products and Manufacturers: Provide one of the following:
 - a) Church Division of Bemis Manufacturing, #9500C.
 - b) Kohler, Fig. No. K-4666-C.
 - c) Or equal.
 - 2) Standards: Comply with FS WW-P-541/1, Type IV, Class 2.
 - 3) Type: Solid plastic, elongated, open front.
 - 4) Color: White.
6. Closet Supports:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Jay R. Smith, Fig. 0200-50 “High Set” Series, as required.
 - 2) Zurn Industries, ZR-1200, as required.
 - 3) Or equal.
 - b. Provide one support for each water closet complete with required hardware and gaskets, suitable for floor construction.
 - c. Standards: ASME A112.6.1M.

C. Lavatory – Type LAV:

1. Products and Manufacturers: Provide one of the following:
 - a. American Standard 9140.047.
 - b. Kohler, Model K-12638.
 - c. Or equal.
2. Type: Wheelchair flat slab, front overflow for concealed arm support.
3. Material: Vitreous china.
4. Size: 20-inch wide by 27-inch deep.
5. Standards: ASME A112.19.2, ANSI A117.1.
6. Faucets:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) American Standard America, Inc. Model 775B.303.
 - 2) Chicago Faucets Division of Geberit Group, Model EQ-A11A-13ABBN.
 - 3) Or equal.
 - b. Type: Self-metering battery-powered sensor faucet, single-hole, exposed deck mounting, with integral thermostatic temperature control, lead-free, non-aerated vandal-proof spray, maximum 0.25gpm per metering cycle.
 - c. Inlets: 3/8-inch compression.
 - d. Outlet: 0.35 gpm vandal-resistant, pressure compensating outlet.
 - e. Material: Chrome plated brass.
 - f. Standards: ANSI A117.1, ASSE 1070, ASME A112.18.1, NSF 61/NSF 372.
7. Supplies:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) BrassCraft, Part No. KTSCS400AX C.
 - 2) McGuire Manufacturing, Model LF172LK.
 - 3) Or equal.
 - b. Description: Lead-free 1/2" Sweat x 3/8" compression rigid riser supply kit with escutcheon flange and loose-key angle stops, to be installed on hot and cold water supplies.
 - c. Material: Chrome plated brass.
 - d. Standards: ASME A112.18.1, NSF 61/NSF 372.
8. Drain Plug:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Kohler, Model K-13885.
 - 2) McGuire Manufacturing, Model HD155WC.
 - 3) Or equal.
 - b. Description: Cast grid strainer with 1.25-inch offset drain assembly, chrome-plated.
 - c. Standards: ASME A112.18.2.
9. Trap:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Kohler, Model K-8999.
 - 2) McGuire Manufacturing, Model 8902C.
 - 3) Or equal.

- b. Description: Adjustable cast brass “P” trap with cleanout. Slip joint inlet and 17-gage tubing outlet to wall with escutcheon, 1.25-inch by 1.5-inch outlet, chrome finish.
 - c. Standards: ASME A112.18.2.
- 10. Carrier:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Jay R. Smith, Fig. No. 0700-27-M31.
 - 2) Zurn Industries, Fig. No. Z-1231-79 Series.
 - 3) Or equal.
 - b. Description: Floor-mounted concealed arm carrier for wheelchair lavatories.
 - c. Standards: ASME A112.6.1M.
- 11. Insulation: As specified in Section 22 07 19, Plumbing Piping Insulation.

D. Shower – Type SH:

- 1. Products and Manufacturers: Provide one of the following:
 - a. Symmons Safetymix Visu-Temp, Model 1-100VT-E.
 - b. Leonard Valve Company, Advantage Series 6701-TB.
 - c. Or equal.
- 2. Type: Single-handle pressure balanced mixing valve with integral thermometer. Valve shall have single bronze stem, housing stainless steel balancing piston. All-bronze valve body, housing cap, and renewable seats, adjustable temperature limit stop. Valve body shall incorporate thermowell for thermometer bulb. Provide thermometer mounted in Lexan escutcheon color-coded to match valve. Metal shall be triple chrome-plated.
- 3. Materials:
 - a. Shower Head: Chrome-plated brass, swivel neck with 1.5 gpm flow restrictor.
 - b. Shower Valve: Pressure-balanced lever handle with check-stops.
 - c. Shower Head: Chrome-plated brass, swivel neck with 1.5 gpm flow restrictor.
- 4. Accessories: Provide integral service stops.

E. Mop Sink - Type MS:

- 1. Products and Manufacturers: Provide one of the following:
 - a. Zurn Z1996-24.
 - b. Mustee 63M.
 - c. Or equal.
- 2. Type: Floor mounted 24”x24”x10” one piece molded fiberglass basin with integral molded-in drain.
- 3. Accessories:
 - a. Faucet:
 - 1) Products and Manufacturers: Provide one of the following:
 - a) Zurn Z1996-SF.
 - b) Mustee 63.600A.
 - c) Or equal.

- 2) Description: Exposed service sink faucet with vacuum breaker, integral stops, lever or four-arm hot and cold handles, with $\frac{3}{4}$ " hose thread on spout and pail hook, 1/2-inch diameter IPS female couplings and renewable seats.
- 3) Standards: ASME A112.18.1.

2.2 FINISHING

- A. Factory-paint ferrous surfaces in accordance with Section 09 91 00, Painting. Do not paint porcelain, china, enameled surfaces, stainless steel, brass, chrome-plated, and other finished surfaces.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. General:
 1. Thoroughly clean materials, equipment, and accessories prior to installation.
 2. Install items as in accordance with the Contract Documents, Laws and Regulations, manufacturer's recommendations, and good practice. Obtain interpretation from ENGINEER if manufacturer's instructions or Laws or Regulations conflict with the Contract Documents.
 3. Do not modify structures or facilities to facilitate installation of fixtures without approval of ENGINEER.
 4. Provide each fixture with shut off valves or stops for required water supplies.
 5. All fixtures are to be provided with all required mounting hardware for a complete installation as described in the manufacturer installation instructions or as otherwise required.
 6. All fixtures are to be installed in perfect working condition at the completion of work.
- B. Installation of Specific Fixture Types:
 1. Handicap Fixtures:
 - a. Provide insulation for all plumbing piping under handicapped lavatories.
 - b. Install the following with vertical distance of 1.5 feet from floor to top of seat:
 - 1) Water Closet, Handicapped – Type WC

3.3 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. ENGINEER shall witness field tests.
 - 2. Operating Tests:
 - a. Fill all systems and verify that equipment, fixtures, valves, and appurtenances operate successfully.
 - b. Load-test in accordance with manufacturer recommendations each wall-hung fixture after installation.
 - 3. For materials and equipment that do not successfully pass field tests, make repairs or modifications and retest until acceptable results are achieved.

3.4 ADJUSTING AND CLEANING

- A. Adjusting:
 - 1. Adjust all controls for proper settings.
 - 2. While system is operable, balance all equipment, including valves, appurtenances, and similar equipment, to achieve design conditions.
- B. Cleaning:
 - 1. Upon completion of the Work, remove all labels, and remove dirt, grease, markings, and other objectionable matter from fixtures and trim.
 - 2. In preparation for painting, remove dirt, rust, dust, and objectionable materials from materials and equipment.

3.5 DISINFECTING

- A. Prior to placing potable water system into service, disinfect equipment, piping and accessories in accordance with AWWA C651, Laws, and Regulations, and requirements of authorities having jurisdiction. Perform bacteriological testing in accordance with Article 3.3 of this Section.

+ + END OF SECTION + +

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC DUCTWORK, PIPING, AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install hangers and supports complete with required appurtenances for HVAC ductwork, piping, and equipment.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the hangers and supports for HVAC ductwork, piping, and equipment Work.
 - 2. Notify other Contractors in advance of the installation of hangers and supports for HVAC ductwork, piping, and equipment to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed with, or before, the hangers and supports for HVAC ductwork, piping, and equipment Work.
- C. Related Sections:
 - 1. Section 05 05 33, Anchor Systems.
 - 2. Section 05 50 13, Miscellaneous Metal Fabrications.

1.2 REFERENCES

- A. American National Standards Institute (ANSI).
 - 1. ANSI B1.1 – Unified Inch Screw Threads (ASME B1.1).
- B. American Society for Testing and Materials (ASTM).
 - 1. ASTM A36/A36M – Standard Specification for Carbon Structural Steel.
 - 2. ASTM A47/A47M – Standard Specification for Ferritic Malleable Iron Castings.
 - 3. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - 6. ASTM A575 – Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
 - 7. ASTM A668/A688M – Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.

- C. American Welding Society (AWS).
 - 1. AWS B2.1 – Specification for Welding Procedure and Performance Qualification.
- D. Manufacturers Standardization Society (MSS).
 - 1. MSS SP 58 – Pipe Hangers and Supports-Materials, Design and Manufacture.
 - 2. MSS SP 69 – Pipe Hangers and Supports - Selection and Application.
- E. National Fire Protection Association (NFPA).
 - 1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
- F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
 - 1. HVAC Duct Construction Standards – Metal and Flexible.
 - 2. Seismic Restraint Manual: Guidelines for Mechanical Systems.
 - 3. Thermoset FRP Duct Construction Manual.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer:
 - a. Engage an experienced installer to perform the work of this Section who has specialized in installing hangers and supports for HVAC ductwork, piping, and equipment similar to that required for this Project and who is acceptable to manufacturer.
 - 2. Welding:
 - a. Qualify processes and operators in accordance with AWS B2.1 as appropriate for material to be welded.
 - b. Provide certification that operators employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.
- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single hangers and supports for HVAC ductwork, piping, and equipment manufacturer.
 - 2. Require the hangers and supports for HVAC ductwork, piping, and equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the hangers and supports for HVAC ductwork, piping, and equipment manufacturer.
- C. Regulatory Requirements:
 - 1. International Building Code (IBC).
 - 2. National Fire Protection Association (NFPA).
 - 3. Local and State Building Codes and Ordinances.

4. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, and installation details.
 - b. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
 - c. Drawings showing floor supported components and installation arrangement.
 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.
 - c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - f. Other technical data related to specified material and equipment as requested by Engineer.
- B. Informational Submittals: Submit the following:
 1. Certificates:
 - a. Independent certification reports.
 2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 3. Source Quality Control Submittals:
 - a. Factory test reports.
 4. Qualifications Statements:
 - a. Manufacturer, when requested by Engineer.
 - b. Installer, when requested by Engineer.
 - c. Welding, when requested by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of that Work.
 3. Comply with manufacturer's recommendations for rigging of equipment.
- B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Provide product of one of the following:

1. Erico International Corporation.
2. Anvil International.
3. Or equal.

2.2 DETAILS OF CONSTRUCTION

A. Materials:

1. Hangers, supports, restraints, and appurtenances located in corrosive areas shall be Type 316 stainless steel. Fiberglass reinforced plastic (FRP) hangers and supports shall be allowed for nonmetal ductwork only.
2. Hangers, supports, restraints, and appurtenances located in non-corrosive or dusty areas shall be hot dipped galvanized steel in accordance with ASTM A123/A123M and ASTM A153/A153M.
3. Hangers, supports, restraints, and appurtenances located outdoors shall be Type 316 stainless steel.
4. Steel used for the support of uninsulated copper piping or plastic piping shall be PVC coated.

B. Components of hangers and supports shall conform to the following:

1. Bolts: ASTM A307, Grade A, unless otherwise specified below.
2. Forgings: ASTM A668/A688M.
3. Malleable Iron: ASTM A47/A47M.
4. Rods and Bars: ASTM A575.
5. Threads: Unified Screw Threads, Class 2A and 2B, ANSI B1.1.
6. Structural Steel: ASTM A36/A36M.

C. Hanger Attachments: The following types of attachments shall be considered acceptable:

1. Adjustable Steel Clevis: FS WW-H-171E, Type 1.

2. Steel Double Bolt Pipe Clamp: FS WW-H-171E, Type 3.
3. Steel Pipe Clamp: FS WW-H-171E, Type 4.
4. Adjustable Swivel Pipe Ring: FS WW-H-171E, Type 6.
5. Adjustable Steel Band Hanger: FS WW-H-171E, Type 7.
6. Riser Clamp: FS WW-H-171E, Type 8.
7. Light-Duty Clevis Hanger: FS WW-H-171E, Type 12.
8. Long Clips: FS WW-H-171E, Type 26.
9. Offset J-Hooks: FS WW-H-171E, Type 27.
10. Steel Pipe Covering Protection Saddle: FS WW-H-171E, Type 40A.
11. Insulation Protection Shield: FS WW-H-171E, Type 41.
12. Pipe Saddle Support: FS WW-H-171E, Type 37.
13. Pipe Stanchion Saddle: FS WW-H-171E, Type 38.
14. Pipe Saddle Support with Base: FS WW-H-171E, Type 36.
15. Adjustable Roller Hanger: FS WW-H-171E, Type 42.

D. Structural Attachments: The following types of attachments shall be considered acceptable:

1. Side Beam Clamp: FS WW-H-171E, Type 20.
2. Center I-Beam Clamp: FS WW-H-171E, Type 21.
3. Welded Steel Bracket: FS WW-H-171E, Types 32 and 33.
4. Side Beam Bracket: FS WW-H-171E, Type 35.

E. Hanger Rod Attachments: Use as required to complete assembly:

1. Forged Steel Clevis: FS WW-H-171E, Type 14.
2. Adjustable Turnbuckle: FS WW-H-171E, Type 15.
3. Forged Steel Welders Eye Nut: FS WW-H-171E, Type 17.

F. Concrete anchorage shall be provided in accordance with Section 05 05 33, Anchor Systems.

G. Miscellaneous metal fabrications shall be provided in accordance with Section 05 50 13, Miscellaneous Metal Fabrications.

2.3 SOURCE QUALITY CONTROL

A. Shop Tests:

1. Equipment shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
 - a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label or equal.
 - b. Factory test equipment to ensure that the entire package has been properly fabricated and assembled, that the package meets the specified performance requirements including manufacturer's data report.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Surface Preparation:
 - 1. Attachment to hollow core slabs or double tee slabs shall be provided in accordance with details shown on the structural drawings to prevent damage to pre-stressing strands.

3.3 INSTALLATION

- A. General:
 - 1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 2. Install in accordance with Laws and Regulations.
 - 3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
 - 4. Installation to conform to requirements of all local and state codes.
- B. Ductwork:
 - 1. The construction and installation of hangers and supports for ductwork shall conform to the recommendations given in the SMACNA HVAC Duct Construction Standards and the SMACNA Thermoset FRP Duct Construction Manual, except as specified.
 - 2. Hanger rods shall have threaded ends.
 - 3. All ductwork shall be supported from trapeze type hangers. No sheet metal duct hangers or straps will be allowed.
 - 4. A pair of rods shall be provided at each duct support point.
 - 5. For nonmetal ductwork, there shall be not less than a 1/4-inch buildup of FRP over the duct at each support. Each support shall be furnished with a 1/8-inch thick Teflon sheet to shield the duct from the support.
- C. Piping:
 - 1. Insulated pipes with vapor barriers shall have an insulation protection shield conforming to FS WW-H-171E, Type 41 tack-welded to hanger.
 - 2. Insulated pipes without vapor barriers shall have a steel protection saddle conforming to FS WW-H-171E, Type 40A.
 - 3. All uninsulated copper piping shall be supported by plastic coated steel pipe attachments.
 - 4. All insulated piping 3-inch diameter and larger shall be supported by roller hangers conforming to FS WW-H-171E, Type 42.

5. Additional supports shall be placed immediately adjacent to any change in direction.
6. Supports for Vertical Piping:
 - a. Provide riser clamp placed under hub, fitting or coupling with approved solid bearing on steel sleeve at each floor level.
 - b. Where riser clamps are used with plastic piping they shall be modified so as not to exert any compressive forces on the pipe.
 - c. Support spacing shall not exceed code requirements.
7. Allow clearances for expansion and contraction of piping.

D. Anchorages and Base Plates:

1. Provide anchorages in new or existing concrete, as applicable, in accordance with equipment manufacturer's recommendations and the Contract Documents. Install anchors in accordance with Section 05 05 33, Anchor Systems.
2. Where used, pour concrete bases up to one inch below equipment baseplate or support leg as applicable. Base with equipment mounted shall then be accurately shimmed to grade and spaces between filled with non-shrink grout in accordance with Section 03 00 05, Concrete. After grout has reached its initial set, exposed edges shall be neatly cut back 1/2 inch.

3.4 ADJUSTING

- A. Adjust all equipment for proper settings.

3.5 CLEANING

- A. Thoroughly clean all equipment and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from equipment and accessories after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

3.6 SCHEDULES

A. Hangers and Supports for Ductwork:

1. Spacing:
 - a. Ductwork shall be supported at distances not exceeding the spacing specified below:
 - 1) Metal Ductwork:
 - a) Maximum Spacing: 10 feet.
 - 2) Flexible and Other Factory-Made Ductwork (such as FRP):
 - a) Maximum Spacing: In accordance with the manufacturer's installation instructions.
2. Hanger Rod Sizes:
 - a. Hanger rods shall be sized based on static and dynamic loads imposed by the supported ductwork and shall include a safety factor of 2 for the yield strength.

- b. Rod load shall not exceed rod manufacturer's recommended capacity.
- B. Hangers and Supports for Piping:
 - 1. Spacing:
 - a. Piping shall be supported at distances not exceeding the spacing specified below or in accordance with MSS SP 58:
 - 1) Copper Tube:
 - a) Maximum Horizontal Spacing: 6 feet.
 - b) Maximum Vertical Spacing: 10 feet.
 - 2) Copper Pipe:
 - a) Maximum Horizontal Spacing: 12 feet.
 - b) Maximum Vertical Spacing: 10 feet.
 - 3) Steel Pipe:
 - a) Maximum Horizontal Spacing: 12 feet.
 - b) Maximum Vertical Spacing: 15 feet.
 - 2. Hanger Rod Sizes:
 - a. Hanger rods shall be sized based on static and dynamic loads imposed by the supported piping and shall include a safety factor of 2 for the yield strength.
 - b. Rod load shall not exceed rod manufacturer's recommended capacity.
- C. Hangers and Supports for HVAC Equipment:
 - 1. Provide spacing and hanger rod sizes in accordance with equipment manufacturer's installation instructions.

+ + END OF SECTION + +

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to perform the testing, adjusting, and balancing for HVAC as specified herein.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the testing, adjusting, and balancing for HVAC Work.
2. Notify other Contractors in advance of the testing, adjusting, and balancing for HVAC to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed with, or before, the testing, adjusting, and balancing for HVAC Work.

C. Related Sections:

1. Section 10 14 00, Signage.
2. Section 23 09 00, Instrumentation and Control for HVAC.

1.2 REFERENCES

A. Associated Air Balance Council (AABC).

1. AABC National Standards for Total System Balance.

B. American National Standards Institute/American Industrial Hygiene Association (ANSI/AIHA).

1. ANSI/AIHA Z9.5 – Laboratory Ventilation.

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

1. ASHRAE Handbook – Fundamentals.

D. National Environmental Balancing Bureau (NEBB).

1. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

1. SMACNA HVAC Systems – Testing, Adjusting & Balancing Handbook.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Balancer:

- a. Engage an experienced balancer to perform the work of this Section who has specialized in testing, adjusting, and balancing for HVAC systems similar to that required for this Project.
- b. Minimum of five years of experience in testing, adjusting, and balancing substantially similar equipment and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
- c. Submit name and qualifications to Engineer along with the following information on a minimum of five successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for projects.
 - 2) Approximate contract cost of the testing, adjusting, and balancing for HVAC Work.
 - 3) Amount of area tested, adjusted, and balanced.
 - 4) Biographical information on employee proposed to directly supervise the testing, adjusting, and balancing Work.

B. Regulatory Requirements:

1. Associated Air Balance Council (AABC).
2. National Electrical Code (NEC).
3. National Environmental Balancing Bureau (NEBB).
4. National Fire Protection Association (NFPA).
5. Underwriters Laboratories Inc. (UL).
6. Local and State Building Codes and Ordinances.
7. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:
 - a. Data sheets with name of devices, manufacturer's name, model number, latest date of calibration, and correction factors for each testing, adjusting, and balancing instruments.
 - b. Other technical data related to specified material and equipment as requested by Engineer.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Certification by National Environmental Balancing Bureau (NEBB), Association Air Balance Council (AABC), or equal.
2. Source Quality Control Submittals:
 - a. Specimen copies of report forms for Engineer's review and approval.
 - 1) Forms shall be 8-1/2 by 11-inch paper for loose-leaf binding, with blanks for certification of report and listing all required testing, adjusting, and balancing requirements and ratings.
3. Field Quality Control Submittals:
 - a. Written startup and field test reports presenting results of required field testing, adjusting, and balancing.
 - 1) Certified reports shall be in typed format on approved forms imprinted with the company's name.
 - 2) Reports shall include procedure outline used to test, adjust, and balance the systems and the types of instruments used.
 - 3) Minimum three certified copies of testing, adjusting, and balancing reports to the Engineer for review.
 - 4) Reports must be submitted to Engineer and Owner for approval prior to Owner's acceptance for responsibility.
4. Qualifications Statements:
 - a. Balancer, when requested by Engineer.

C. Closeout Submittals: Submit the following:

1. Maintenance Contracts:
 - a. Maintenance and Repair:
 - 1) Provide all labor, tools, and equipment to provide a Preventive Maintenance Program and make repairs for all equipment and controls during the One Year Correction Period after the Final Acceptance by

Owner. Contractor shall provide the following services for the same period of one year:

- a) Receive calls for all problems and take steps to immediately correct deficiencies, which may exist.
- b) Provide a monthly inspection of all equipment, and record the findings on a checklist hereinafter specified.
- c) Provide a Preventive Maintenance Schedule for the principle items of equipment.
- d) Respond to Owner and make repairs for all equipment and controls within 24-hours of notification by Owner.

b. Check List:

- 1) Provide a checklist and post a copy of it, where directed by the Owner.
- 2) Include each piece of equipment specified or shown.
- 3) Provide four columns for required quarterly inspections.
- 4) Provide columns for the following:
 - a) Equipment condition.
 - b) Equipment operation.
 - c) Equipment lubrication.
 - d) Preventive maintenance.
- 5) Preventive maintenance shall be performed in accordance with the manufacturer's recommendations and accepted practice.

2. Operations and Maintenance Data:

- a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
- b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

1.5 SITE CONDITIONS

A. Environmental Requirements:

- 1. Testing, adjusting, and balancing for HVAC shall be performed when outside ambient conditions are approximate to the local ASHRAE Handbook – Fundamentals design conditions (3.5) degrees F for heating and (90) degrees F for cooling) for all heating and cooling functions.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. Equipment Description:

1. Air Balance Instruments:

- a. Provide all velometers, anemometers, pitot tubes, differential air pressure gages, manometers, hook gages, static pressure probe units, and all other instruments and accessories as required to perform all air balance tests of HVAC equipment, ducts, registers, grilles, etc.
- b. Flow-measuring hoods (manufactured, not fabricated) shall be acceptable for measurement of ceiling diffuser performance only.

2. System Performance Measuring Instruments:

- a. Provide insertion thermometers, sling psychrometers, tachometers, revolution counters, clamp-on volt-ammeter recorders, and other instruments as required to measure all facets of the complete HVAC system performance.

B. Performance Criteria:

1. Instrumentation shall be in accordance with NEBB, AABC, or SMACNA requirements and shall be calibrated to the accuracy standards demanded by these organizations.

2.2 ACCESSORIES

A. Balancing Sheaves and Belts:

1. Balancing sheaves and belts shall be provided for all belt driven equipment.
2. Sheaves and belts shall be provided to match construction and duty provided by the equipment manufacturer.
3. Equipment sheaves and belts replaced or not required to achieve balancing shall be submitted to the Owner as spare parts.

2.3 IDENTIFICATION

- #### A.
1. All equipment and component identification, including valve tags, shall be provided in accordance with Section 10 14 00, Signage.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Heating, ventilating and air conditioning equipment and components shall be completely installed and in continuous operation, as required, to accomplish the testing, adjusting and balancing Work specified.
- B. Inspect all HVAC equipment and components for proper operation prior to testing, adjusting and balancing.
 - 1. Fan Belt Deflection: Not less than 1/4-inch or more than 1/2-inch.
- C. Pre-Startup Inspection:
 - 1. Verify proper equipment mounting and setting.
 - 2. Verify that control, interlock and power wiring is complete.
 - 3. Verify alignment of motors and drives.
 - 4. Verify proper piping connections and accessories.
 - 5. Verify that lubrication is completed.
- D. First Run Observations:
 - 1. Verify direction of rotation.
 - 2. Verify setting of safety controls.
 - 3. Monitor heat build-up in bearings.
 - 4. Check motor loads against nameplate data.
- E. Equipment Check:
 - 1. Verify proper overload heater sizes.
 - 2. Verify function of safety and operating controls.
 - 3. Verify proper operation of equipment.
 - 4. Report on inspection, observation and checking procedures.
- F. Promptly report defects which may affect the Work to Engineer.
- G. Should corrective measures caused by faulty installation require re-testing, adjusting and balancing, such Work shall be at no additional cost to the Owner.

3.2 APPLICATION

- A. General:
 - 1. Test, adjust, and balance all systems, ductwork, piping, etc. and their control systems in accordance with the AABC National Standards for Total System Balance, NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems,

SMACNA HVAC Systems - Testing, Adjusting & Balancing Handbook, or in compliance with the standard procedure manual published by the testing, adjusting, and balancing organization affiliated with Contractor. Contractor shall submit one copy of the standard procedure manual to the Engineer for their records.

2. Contractor shall provide all necessary instruments, tools, ladders, etc. to complete all testing, adjusting, and balancing Work.
3. Contractor shall assume full responsibility for safe keeping of all instruments, tools, ladders, etc. during the course of the Work.
4. Contractor shall be solely responsible for the protection and safeguarding of the Work and shall provide every protection against accidents, injury, and damage to persons and property.
5. Contractor shall keep dust, dirt, and debris to an absolute minimum and reinstall all removed ceiling components to their original positions at the end of each day's Work.
6. Contractor shall be fully responsible for removal and reinstallation of ceiling system and replacement of any component damaged.
7. Contractor shall install additional access panels at no extra cost to the Owner, as is required to gain access to equipment concealed above ceilings, behind walls, or any other concealed space.
8. Systems shall be tested, adjusted, and balanced with clean filters and strainers.
9. Where equipment is provided with a variable speed controller (VSC) or variable frequency drive (VFD), balance the equipment first with the VSC or VFD and then with balancing dampers (air systems) or valves (hydronic systems). All systems shall be optimized through the VSC or VFD by balancing with the minimum static pressure needed to meet design flow conditions.

B. Air Systems:

1. Preliminary:
 - a. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals.
2. Central Systems:
 - a. Test rpm for all equipment, including adjusting of each fan, air handling unit, and air conditioning unit to design requirements within the limits of mechanical equipment provided.
 - b. Test and record motor voltages and running amperes including motor nameplate data, and starter heater ratings for each unit as listed above.

- c. Make pitot tube traverse of main supply, exhaust and return ducts, determine airflow at all fans and units and adjust fans and units to within five percent of design requirements.
 - d. Test and record system static pressure, suction and discharge.
 - e. Test and adjust system for design outside air, (cfm).
 - f. Test and adjust system for design recirculated air, (cfm).
 - g. Test and record heating apparatus entering air temperatures, (dry bulb).
 - h. Test and record cooling apparatus entering air temperatures, (dry bulb and wet bulb).
 - i. Test and record heating apparatus leaving air temperatures, (dry bulb).
 - j. Test and record cooling apparatus leaving air temperatures, (dry bulb and wet bulb).
 - k. Record all fan and air handling unit speeds.
 - l. Record air quantity delivered by each fan and air-handling unit.
3. Distribution:
- a. Sheave and belt replacement shall be provided as the first means of accomplishing the balancing Work before volume dampers are adjusted from their initial open positions.
 - b. Adjust volume dampers, control dampers, splitter dampers, etc., to proper design airflow in main ducts, branch ducts, and zones.
4. Air Terminals:
- a. Identify each air terminal as to location and determine required flow reading.
 - b. Test and adjust each air terminal to within tolerance of design requirements as listed below.
 - 1) Positive Zones:
 - a) Diffusers and Supply Air Terminals: 0 percent to +10 percent.
 - b) Exhaust and Return Air Terminals: 0 percent to -10 percent.
 - 2) Negative Zones:
 - a) Diffusers and Supply Air Terminals: 0 percent to -10 percent.
 - b) Exhaust and Return Air Terminals: 0 percent to +10 percent.
 - 3) Neutral Zones:
 - a) All Air Terminals: -10 percent to +10 percent.

- c. Test procedure on air terminals shall include recording comparison of required airflow and observed airflow, adjustment of terminal, and recording of final airflow.
 - d. Adjust flow patterns from air terminal units to minimize drafts to the extent that the design and equipment permits.
- 5. Laboratory Fume Hoods:
 - a. Laboratory fume hoods shall be tested and certified in accordance with the latest edition of ANSI/AIHA Z9.5. Refer to the Drawings for airflow and performance requirements.
- 6. Verification:
 - a. Prepare summation of readings of observed airflow for each system, compare with required airflow, and verify that duct losses are within specified allowable range.
 - b. Verify design airflow at fans as described above.
 - c. If determined that the air system has not been properly balanced, Contractor shall rebalance and recheck all equipment and components in the presence of the Engineer and as accepted by the Engineer.
- C. Automatic Temperature Control System:
 - 1. In cooperation with Section 23 09 00, Instrumentation and Control for HVAC, and the control manufacturer's representative, set and adjust automatically operated devices to achieve required sequence of operations.
 - 2. Testing organization shall verify all controls for proper calibration and list those controls requiring adjustment by control system installer.

3.3 FIELD QUALITY CONTROL

- A. Balancer's Services:
 - 1. Provide a qualified, factory-trained service person to perform the following:
 - a. After HVAC equipment installation, inspect and adjust equipment, verify proper operation, and assist with field testing.
 - b. Instruct operations and maintenance personnel in operation and maintenance of the equipment.
 - 2. Balancer's service person shall make visits to the Site as follows:
 - a. First visit shall be for checking completed installation, start-up of system; and performing field testing. Minimum number of hours on-Site: (4) hours.
 - b. Second visit shall be to instruct operations and maintenance personnel.

- 1) Furnish services of balancer's qualified, factory-trained specialists to instruct operations and maintenance personnel in recommended operation and maintenance of equipment.
 - 2) Training requirements, duration of instruction, and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
 - 3) Number of hours on-Site shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
- c. Technician shall revisit the Site as often as necessary until installation is acceptable.
3. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.4 SCHEDULES

- A. Test, adjust, and balance the air terminal devices, ductwork, and their control systems associated with the following HVAC equipment:
1. Refer to HVAC Equipment Schedules

+ + END OF SECTION + +

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install duct insulation complete with accessories.
 - 2. This Work also includes:
 - a. Repairing all existing duct insulation in all areas that is damaged or displaced due to new construction by Contractor with materials and procedures identical to the existing duct insulation.
- B. Coordination:
 - 1. Duct insulation shall not be installed until ductwork has been field tested and approved by Engineer.
 - 2. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the duct insulation Work.
 - 3. Notify other Contractors in advance of the installation of duct insulation to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed with, or before, the duct insulation Work.
- C. Related Sections:
 - 1. Section 09 91 00, Painting.
 - 2. Section 10 14 00, Signage.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM).
 - 1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM C411 – Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- B. National Fire Protection Association (NFPA).
 - 1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - 2. NFPA 90B – Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - 3. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.

- C. Underwriters Laboratories Inc. (UL).
 - 1. UL 181 – Factory-Made Air Ducts and Air Connectors.
 - 2. UL 723 – Test for Surface Burning Characteristics of Building Materials.

1.3 DEFINITIONS

- A. Concealed spaces – spaces in which ductwork are installed and are withdrawn or removed from observation or kept from plain sight. Spaces above hung ceiling are examples of concealed spaces.
- B. Exposed spaces – spaces in which ductwork are installed and laid open to view; unconcealed. All outdoor locations shall be considered exposed spaces.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer:
 - a. Minimum of five years of experience producing substantially similar material and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
 - b. Material shall be manufactured in the United States.
 - 2. Installer:
 - a. Engage an experienced installer to perform the work of this Section who has specialized in installing duct insulation similar to that required for this Project and who is acceptable to manufacturer.
 - b. Submit name and qualifications to Engineer along with the following information on a minimum of three successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for projects.
 - 2) Approximate contract cost of the duct insulation.
 - 3) Amount of area installed.
- B. Regulatory Requirements:
 - 1. National Fire Protection Association (NFPA).
 - 2. Underwriters Laboratories Inc. (UL).
 - 3. Local and State Building Codes and Ordinances.
 - 4. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, and installation details.
 - 2. Product Data:

- a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all material.
 - b. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - c. Other technical data related to specified material and equipment as requested by Engineer.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Independent certification reports:
 - 1) UL Label.
 - 2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the material.
 - b. Installation Data.
 - 3. Source Quality Control Submittals:
 - a. Factory test reports.
 - 4. Qualifications Statements:
 - a. Manufacturer, when requested by Engineer.
 - b. Installer, when requested by Engineer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all material in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to material or components. Replace lost material or components and repair damage to new condition, in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Design Criteria:

1. All insulation systems including covering, mastics, adhesives, sealers and facings shall have the following Fire Hazard Classifications in accordance with ASTM E84 or UL 723:
 - a. Flame Spread Index: 25 maximum.
 - b. Smoke Developed Index: 50 maximum.
2. All insulation systems shall not flame, glow, smolder or smoke when tested in accordance ASTM C411 at service temperature of 250 degrees F.
3. All insulation systems shall meet fire safety standards NFPA 90A, 90B, and 255 where applicable.

B. Performance Criteria:

1. Acoustical thermal insulation used as internal insulation and exposed to the airstream in ducts shall be shown to be durable when tested in accordance with UL 181.

2.2 MANUFACTURERS

A. Manufacturer: Provide product of one of the following:

1. CertainTeed.
2. Johns Manville.
3. Owens Corning.
4. Or equal.

2.3 DETAILS OF MATERIALS

A. Flexible Thermal Insulation:

1. Type: Flexible fiberglass blanket with vapor barrier facing.
2. Density: Minimum one pound per cubic foot.
3. Facing: Foil-Scrim-Kraft (FSK).
4. Thermal Conductivity: Maximum 0.27 Btu-in/hr-ft²-degree F at 75 degrees F mean temperature.
5. Water Vapor Transmission: Maximum 0.05 perm.

B. Rigid Thermal Insulation:

1. Type: Rigid fiberglass board with vapor barrier facing.
2. Density: Minimum six pound per cubic foot.
3. Facing: Foil-Scrim-Kraft (FSK).
4. Maximum Thermal Conductivity: 0.22 Btu-in/hr-ft²-degree F at 75 degrees F mean temperature.
5. Water Vapor Transmission: Maximum 0.05 perm.

C. Acoustical Thermal Insulation:

1. Type: Rigid fiberglass duct liner board with black mat surface and antimicrobial coating.
2. Density: Minimum three pound per cubic foot.
3. Thermal Conductivity: Maximum 0.23 Btu-in/hr-ft²-degree F at 75 degrees F mean temperature.

2.4 ACCESSORIES

- A. Stainless Steel Protective Jacketing:
 - 1. Product and Manufacturer: Provide one of the following:
 - a. Model Strap-On, as manufactured by Pabco-Childers Metals.
 - b. Model Insul-Mate, as manufactured by RPR Products, Inc.
 - c. Or equal.
 - 2. Material: Smooth Type 316 stainless steel, Standard 2B mill finish.
 - 3. Thickness: 0.016-inch.
 - 4. Moisture Retarder: 3-mil thick coextrusion of polyethylene and DuPont's Surlyn.
 - 5. Fastening: Continuous modified Pittsburgh Z-lock longitudinal seam with self-gauging 2-inch built-in overlap.
 - 6. Bands: 1/2-inch stainless steel bands with wing seals.
 - 7. Fittings:
 - a. Type: Pre-fabricated Type 316 stainless steel fittings.
 - b. Thickness: 0.016-inch.

2.5 FINISHING

- A. Field Primer and Finish Coats:
 - 1. All rigid thermal insulation exterior surfaces and appurtenances in exposed spaces shall receive field primer and finish coating in accordance with Section 09 91 00, Painting. Finish color shall be selected by Engineer from standard colors.
 - 2. Submit notarized certification that field primer and finish coating system complies with Section 09 91 00, Painting.

2.6 IDENTIFICATION

- A. All external duct insulation shall be legibly printed or identified at intervals not greater than 36 inches with the name of the manufacturer, the thermal resistance R-value at the specified thickness and the flame spread and smoke-developed indexes of the composite materials.
- B. All duct insulation identification shall be provided in accordance with Section 10 14 00, Signage.

2.7 SOURCE QUALITY CONTROL

- A. Shop Tests:
 - 1. Material shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
 - a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label.
 - b. Factory test material to ensure that the entire package has been properly fabricated and assembled, and that the package meets the specified performance requirements including manufacturer's data report.

- c. Flame Spread.
- d. Smoke Developed.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. All ductwork leaks shall be repaired prior to installation of duct insulation.
- C. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 INSTALLATION

- A. General:
 - 1. Install the material in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 2. Install in accordance with Laws and Regulations.
 - 3. Do not modify structures to facilitate installation of material, unless approved in writing by Engineer.
 - 4. Installation to conform to requirements of all local and state codes.
- B. Duct insulation shall be continuous through walls and floor openings except where walls or floors are required to be firestopped or required to have a fire resisting rating.
- C. Install insulation so as to make surfaces smooth, even, substantially flush with adjacent insulation and installed in a manner to maintain the integrity of the vapor barrier.

3.3 CLEANING

- A. Thoroughly clean all exterior and interior surfaces of ductwork and accessories prior to installation and prior to putting into service.
- B. Remove all dirt, rust, dust, etc. from material after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 SCHEDULES

- A. Insulation Thicknesses:
 - 1. Insulation for supply and return ductwork located outdoor shall be minimum 2 inches thick with a minimum installed thermal resistance value of R-12.
 - 2. Insulation for outside air intake ductwork and ductwork located outdoor shall be minimum 2 inches thick with a minimum installed thermal resistance value of R-8.
 - 3. Insulation for all other ductwork shall be minimum 1-1/2 inches thick with a minimum installed thermal resistance value of R-5.
- B. Insulation Types:
 - 1. Flexible thermal insulation shall be used on ductwork in concealed spaces.
 - 2. Rigid thermal insulation shall be used on ductwork in exposed spaces.
 - 3. Acoustical thermal insulation shall be used on ductwork shown on the Drawings
- C. Insulation Omitted - Do not insulate the following:
 - 1. Access door, test hole fittings, damper quadrants, except as otherwise specified. The adjoining insulation shall be neatly finished around such devices.
 - 2. Exhaust ductwork need not be thermally insulated, except the portion of the duct between motorized spill damper and spill louver.
 - 3. Omit insulation on ductwork where shown on the Drawings.
- D. Insulation Locations:
 - 1. All supply, return, and exhaust ductwork and plenums including appurtenances (e.g., , volume dampers, diffusers, grilles, etc.) associated with air conditioning units (except those located within air conditioned spaces).
 - 2. All outside air intake ducts and plenums from the outside air intake louver, outside air intake shaft, or roof mounted intake up to the point where the duct or plenum is connected to the unit in heated or air conditioned spaces.
 - 3. All heated or air conditioned ductwork located outdoors or in unheated spaces.
 - 4. Any additional ductwork and plenums including appurtenances where condensation may occur due to contact with surrounding atmosphere.
- E. All insulated ductwork located outdoors shall be covered with weatherproof stainless steel protective jacketing.

+ + END OF SECTION + +

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SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install HVAC piping insulation complete with accessories.
- B. Coordination:
 - 1. HVAC piping insulation shall not be installed until piping has been field tested and approved by Engineer.
 - 2. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the HVAC piping insulation Work.
 - 3. Notify other Contractors in advance of the installation of HVAC piping insulation to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed with, or before, the HVAC piping insulation Work.
- C. Related Sections:
 - 1. Section 09 91 00, Painting.
 - 2. Section 10 14 00, Signage.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM).
 - 1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM C411 – Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - 3. ASTM C449 – Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- B. National Fire Protection Association (NFPA).
 - 1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - 2. NFPA 90B – Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - 3. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.
- C. Underwriters Laboratories Inc. (UL).
 - 1. UL 723 – Test for Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Installer:
 - a. Engage an experienced installer to perform the work of this Section who has specialized in installing HVAC piping insulation similar to that required for this Project and who is acceptable to manufacturer.

B. Regulatory Requirements:

1. National Fire Protection Association (NFPA).
2. Underwriters Laboratories Inc. (UL).
3. Local and State Building Codes and Ordinances.
4. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, and installation details.
2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all material.
 - b. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - c. Other technical data related to specified material and equipment as requested by Engineer.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Independent certification reports:
 - 1) UL Label.
2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the material.
 - b. Installation Data.
3. Source Quality Control Submittals:
 - a. Factory test reports.
4. Qualifications Statements:
 - a. Manufacturer, when requested by Engineer.
 - b. Installer, when requested by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
2. Store all material in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to material or components. Replace lost material or components and repair damage to new condition, in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Criteria:

1. All insulation systems including covering, mastics, adhesives, sealers and facings shall have the following Fire Hazard Classifications in accordance with ASTM E84 or UL 723:
 - a. Flame Spread Index: 25 maximum.
 - b. Smoke Developed Index: 50 maximum.
2. All insulation systems shall not flame, glow, smolder or smoke when tested in accordance ASTM C411 at service temperature of 220 degrees F.
3. All insulation systems shall meet fire safety standards NFPA 90A, 90B, and 255 where applicable.

2.2 DETAILS OF MATERIALS

A. Fiberglass Thermal Insulation:

1. Product and Manufacturer: Provide one of the following:
 - a. Model FIBERGLAS SSL II – ASJ, as manufactured by Owens Corning.
 - b. Model Micro-Lok HP, as manufactured by Johns Manville.
 - c. Or equal.
2. Type: Heavy density sectional pipe insulation with a smooth, reinforced, wrinkle resistant all-service vapor retarder jacket and self-sealing adhesive lap.
3. Density: Minimum three pound per cubic foot.
4. Thermal Conductivity: Maximum 0.23 Btu-in/hr-ft²-degree F at 75 degrees F mean temperature.
5. Water Vapor Transmission: Maximum 0.02 perm.
6. Fittings: Molded fiberglass, or pre-cut fiberglass inserts.
7. Fittings Covers: One piece high impact polyvinyl chloride fitting covers.
8. Jointing Materials: Manufacturer's recommended adhesives and tape.

9. Valve Insulation: Miter cut nesting size covering segments of same thickness as pipeline, for insulation of valves.
- B. Flexible-Elastomeric Thermal Insulation (for refrigerant piping):
1. Product and Manufacturer: Provide one of the following:
 - a. Model Armaflex Tube Insulation, as manufactured by Armacell.
 - b. Model Insul-Tube Insulation, as manufactured by K-Flex USA.
 - c. Or equal.
 2. Type: Expanded close cell structure elastomeric thermal insulation.
 3. Density: Minimum three pound per cubic foot.
 4. Thermal Conductivity: 0.21 - 0.27 Btu-in/hr-ft²-degree F at 75 degrees F mean temperature.
 5. Water Vapor Transmission: Maximum 0.05 perm.
 6. Provide manufacturer's approved contact adhesive for sealing seams and butt joints.
- C. Calcium Silicate Insulation at Insulation Protection Shields:
1. Product and Manufacturer: Provide one of the following:
 - a. Model Thermo-12 Gold, as manufactured by Johns Manville.
 - b. Model 1B, as manufactured by Insul-Therm International, LLC.
 - c. Or equal.
 2. Type: Calcium silicate pipe insulation.
 3. Density: Minimum 14 pound per cubic foot.
 4. Thermal Conductivity: Maximum 0.41 Btu-in/hr-ft²-degree F at 200 degrees F mean temperature.
 5. Compressive Strength: 100 psi.
 6. Cut insulation 1/2-inch longer than insulation shield upon which it rests.
 7. Provide manufacturer's approved asbestos free, hydraulic setting, refractory type insulating cement for sealing seams and butt joints. Cement shall be noncorrosive to ferrous metals.
 8. Provide manufacturer's approved asbestos free, fire retardant coating meeting ASTM C449.

2.3 ACCESSORIES

- A. Stainless Steel Protective Jacketing:
1. Product and Manufacturer: Provide one of the following:
 - a. Model Strap-On, as manufactured by Pabco-Childers Metals.
 - b. Model Insul-Mate, as manufactured by RPR Products, Inc.
 - c. Or equal.
 2. Material: Smooth Type 316 stainless steel, Standard 2B mill finish.
 3. Thickness: 0.016-inch.
 4. Moisture Retarder: 3-mil thick coextrusion of polyethylene and DuPont's Surlyn.
 5. Fastening: Continuous modified Pittsburgh Z-lock longitudinal seam with self-gauging 2-inch built-in overlap.
 6. Bands: 1/2-inch stainless steel bands with wing seals.
 7. Fittings:
 - a. Type: Pre-fabricated Type 316 stainless steel fittings.

- b. Thickness: 0.016-inch.

2.4 FINISHING

- A. Field Primer and Finish Coats:
 - 1. All thermal insulation exterior surfaces and appurtenances (exposed in rooms or outdoor) shall receive field primer and finish coating in accordance with Section 09 91 00, Painting. Finish color shall be selected by Engineer from standard colors.
 - 2. Submit notarized certification that field primer and finish coating system complies with Section 09 91 00, Painting.

2.5 IDENTIFICATION

- A. All HVAC piping insulation identification shall be provided in accordance with Section 10 14 00, Signage.

2.6 SOURCE QUALITY CONTROL

- A. Shop Tests:
 - 1. Material shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
 - a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label.
 - b. Factory test material to ensure that the entire package has been properly fabricated and assembled, and that the package meets the specified performance requirements including manufacturer's data report.
 - c. Flame Spread.
 - d. Smoke Developed.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. All HVAC piping leaks shall be repaired prior to installation of HVAC piping insulation.
- C. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 INSTALLATION

- A. General:
 - 1. Install the material in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 2. Install in accordance with Laws and Regulations.
 - 3. Do not modify structures to facilitate installation of material, unless approved in writing by Engineer.
 - 4. Installation to conform to requirements of all local and state codes.
- B. HVAC piping insulation shall be continuous through walls and floor openings except where walls or floors are required to be firestopped or required to have a fire resisting rating.
- C. Where hangers are in direct contact with low temperature piping the hanger and supporting rod shall be wrapped with foil-faced blanket insulation and vapor sealed. Hanger rod insulation and vapor barrier shall extend up to the rod a minimum distance equal to the diameter of the pipe.
- D. Install insulation so as to make surfaces smooth, even, substantially flush with adjacent insulation and installed in a manner to maintain the integrity of the vapor barrier.
- E. Provide insulation protection shields for insulated piping supported by pipe hangers.

3.3 CLEANING

- A. Thoroughly clean and dry all exterior surfaces of HVAC piping and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from HVAC piping insulation after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 PROTECTION OF EXECUTED WORK

- A. All insulation applied in one day shall have the vapor barrier applied the same day and any exposed ends shall be temporarily protected with a moisture barrier and sealed to the piping.

3.5 SCHEDULES

- A. See Schedule below for minimum insulation thickness and locations where required.

<u>Pipe Service</u> (Including Valves, Fittings, and Accessories)	<u>Pipe Size</u>	Minimum Insulation <u>Thickness</u>	<u>Location</u>
Refrigerant	<1	0.5 inches	All piping
Air Conditioning Condensate (interior)	<1	0.5 inches	All Piping

- B. All insulated piping located outdoors shall be covered with weatherproof stainless steel protective jacketing.

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SECTION 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, material, equipment, related services, supervision and incidentals required, including, but not limited to, manufacturing, fabrication, configuration and installation for a complete HVAC Monitoring and Control System (HMCS) including all necessary hardware and all operating and applications software as required for the complete performance of the Work as shown on the Drawings and as specified herein.

B. Description

1. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.
2. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet.
3. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.
4. System shall use the BACnet protocol for communication between the control modules and web server. Communication between the web server and the user's browser shall be HTTP or HTTPS protocol utilizing HTML5. Use of Adobe Flash technology is not acceptable.
5. HVAC equipment summarized below are provided with factory control systems. This equipment shall communicate with the HMCS via a BACnet interface for global monitoring and control via the HMCS.:
 - a. RTU-1
 - b. RTU-2
 - c. ACCU-1/AC-1, AC-2
 - d. CUH
 - e. EF-1
 - f. EF-2
 - g. EF-3
 - h. Laboratory Airflow Control System (LACS)

- C. CONTRACTOR shall be responsible for providing control wiring, conduct, and appurtenances for interconnecting factory controls provided with HVAC equipment including but not limited to remote control devices, thermostats, temperature sensors, controllers, etc.
- D. The HMCS is a standalone system and does not require connectivity to other buildings onsite.
- E. Distributed HMCS panels shall be acceptable for housing local Direct Digital Controllers (DDCs) in conjunction with or in lieu of locating all DDCs within the HMCS panel. All panels shall be accessible for maintenance and service and clearance requirements maintained in accordance with the National Electric Code (NEC).
- F. CONTRACTOR is required to load, configure, develop, test, document and place into satisfactory operation all software associated with the HMCS and all its ancillary devices as described herein, required by other Sections as shown and as necessary to provide a properly operating and integrated system.
- G. The system configuration shall be as specified herein and as described in Sequence of Operation indicated on drawings. Some variations in the configuration will be considered provided functional constraints as intended for the various components of the system are met. Hardware requirements are specified in this Section.
- H. The Contract Documents illustrate and describe the overall functional and operational requirements. CONTRACTOR is responsible for tagging, integrating, and verifying the functionality of all system components.
- I. Network level components of the system – workstations, servers, etc. shall communicate using the BACnet protocol, as defined by ASHRAE Standard 135, EIA standard 709.1. No gateways shall be used for communication to controllers furnished under this section.
- J. At a minimum, provide controls for the following:
 - a. Air conditioning units.
 - b. Exhaust fans.
 - c. Cabinet unit heaters.
 - d. Monitoring and control points for packaged equipment.
- K. The Work also includes:
 - a. HMCS panels.
 - b. Direct digital controllers.
 - c. Web servers.
 - d. Sensors, controllers, thermostats, mounting accessories, junction boxes, face plates, wall plates, covers, mounting hardware as required.
 - e. Relays, selector switches, pushbuttons, indicating lights, “HAND/OFF/AUTOMATIC” selector switches.
 - f. Transformers.

- g. Power disconnects switches.
- h. Motor starters.
- i. Control panels.
- j. Other control devices and appurtenances, as required.
- k. Power and control wiring and conduit: The conduit and wiring to be provided under this Section shall include the following:
 - 1) All wiring and conduit from each HMCS panel to sensors, controllers, switches, dampers, valves, louvers, HVAC equipment panels, smoke purge panels, audio visual alarms, etc.
 - 2) All wiring and conduit between HVAC equipment panels and associated field devices.
 - 3) Any other HVAC device requiring control under this Contract.
 - 4) All power wiring and conduit to HMCS panels, except where specified to be provided under the Electrical Contract.
 - 5) Conduit layouts for these wiring requirements are not shown; CONTRACTOR shall determine the requirements based upon the arrangement of the components being furnished.

L. Work Furnished Under the Electrical Contract:

- 1. All 3 phase power wiring and conduit.
- 2. 120 volt, single phase power wiring and conduit for the following:
 - a. Power to HMCS panels.
 - b. Power from HMCS panels to single phase fans and pumps controlled from the HMCS panels.
 - c. All wiring and conduit between 120V unit heaters and associated 120V thermostats.
- 3. Starters.
- 4. Disconnects, except where specified to be furnished under the HVAC Contract.
- 5. "HAND/OFF/AUTOMATIC" selector switches, lockout stops, pushbuttons, "START/STOP" switches, and indicating lights, except those located at HMCS panels, which shall be provided under the HVAC Contract.
- 6. Control wiring and conduit and status wiring and conduit from motor control centers to HMCS panels.
- 7. Control wiring and conduit and status wiring and conduit from VFD's to HMCS panels except where VFD's are provided within packaged HVAC equipment.
- 8. Control wiring and conduit and status wiring and conduit from the Fire Alarm System panels to the HMCS panels for each fire alarm zone.
- 9. Smoke detectors.
- 10. Signal wiring and conduit where specified to be provided under the Electrical Contract.

M. Coordination:

- 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, Instrumentation and Control for HVAC Work.

2. Notify other contractors in advance of the installation of Instrumentation and Control for HVAC items to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, Instrumentation and Control for HVAC Work.

N. Related Sections:

1. Section 10 14 00, Signage.
2. Section 26 05 19, Low Voltage Electrical Power Conductors and Cables.
3. Section 26 05 29, Hangers and Supports for Electrical Systems.
4. Section 26 05 33.13, Rigid Conduit.
5. Section 26 05 33.16, Flexible Conduits.
6. Section 26 05 33.33, Pull, Junction and Terminal Boxes.
7. Section 26 05 53, Identification for Electrical Systems.
8. Division 23 related sections.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American National Standards Institute, (ANSI).
2. Institute of Electrical and Electronic Engineers, (IEEE).
3. The Instrumentation, Systems and Automation Society, (ISA).
4. National Electrical Code, (NEC).
 - a. NFPA 79, Electrical Standard for Industries Machinery.
5. National Electrical Manufacturers Association, (NEMA).
6. National Fire Protection Association, (NFPA).
 - a. NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems
7. Underwriters' Laboratories, Inc., (UL).
 - a. UL 873, Standard for Temperature-Indicating and -Regulating Equipment.
 - b. UL 916, Standard for Energy Management Equipment.
 - c. UL 555S, Standard for Smoke Dampers.
8. ANSI/ASHRAE Standard 135, BACnet - A Data Communication Protocol for Building Automation and Control Systems

1.3 DEFINITIONS

A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.

B. Definitions:

1. Supplier: The Supplier shall be Contractor and manufacturer jointly, that has undivided responsibility for the engineering, design, installation and commissioning of a complete and fully functional HMCS with all required appurtenances. An approved representative of the manufacturer is an

acceptable substitute to for the manufacture where independent control
Contractors are authorized by the manufacturer to provide their products and
services.

C. Acronyms:

1. General

- a. ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers
- b. AHU: Air Handling Unit
- c. ASC: Application Specific Controllers
- d. BACnet: Building Automation Controls Network
- e. BMS: Building Management System
- f. BAS: Building Automation System
- g. DDC: Direct Digital Control
- h. EIA: Electronic Industries Alliance
- i. GUI: Graphical User Interface
- j. HVAC: Heating, Ventilation, and Air Conditioning
- k. IEEE: Institute Electrical Electronic Engineers
- l. MBPS: Mega Bites Per Second
- m. MER: Mechanical Equipment Room
- n. PID: Proportional, Integral, Derivative

2. Communications and protocols

- a. ARP: Address Resolution Protocol
- b. BACnet: Building Automation and Control Networks
- c. CORBA: Common Object Request Broker Architecture
- d. CSMA/CD: Carrier Sense Multiple Access/Collision Detect
- e. DDE: Dynamic Data Exchange
- f. FTP: File Transfer Protocol
- g. FTT: Free Topology Transceivers
- h. HTTP: Hyper Text Transfer Protocol
- i. IIOP: Internet Inter-ORB Protocol
- j. IP: Internet Protocol
- k. LAN: Local Area Network
- l. LON: Echelon Communication – Local Operating Network
- m. MS/TP: Master Slave Token Passing
- n. OBIX: Open Building Information Exchange
- o. ODBC: Open Database Connectivity
- p. ORB: Object Request Broker
- q. SNVT: Standard Network Variables Types
- r. SQL: Structured Query Language
- s. UDP: User Datagram Protocol
- t. XML: eXtensible Markup Language

3. Controllers

- a. ASD: Application Specific Device
- b. AAC: Advanced Application Controller
- c. ASC: Application Specific Controller.
- d. CAC: Custom Application Controller.

- e. DCU: Distributed Control Unit
- f. LCM: Local Control Module
- g. MC: MicroControllers
- h. MPC: Multi-purpose Controller
- i. NSC: Network Server Controller
- j. PEM: Package Equipment Module
- k. PPC: Programmable Process Controller
- l. RC: Room controller
- m. SDCU: Standalone Digital Control Units
- n. SLC: Supervisory Logic Controller
- o. UEC: Unitary Equipment Controller
- p. VAVDDC: Variable Air Volume Direct Digital Controller
- 4. Tools and Software
 - a. AFDD: Automated Fault Detection and Diagnostic
 - b. APEO: Automated Predictive Energy Optimization
 - c. DR: Demand Response
 - d. CCDT: Configuration, Commissioning and Diagnostic Tool
 - e. BPES: BACnet Portable Engineering Station
 - f. LPES: LON Portable Engineering Station
 - g. POT: Portable Operator's Terminal
 - h. PEMS: Power and Energy Management Software
 - i. MTBF: Mean Time Between Failure

1.4 SYSTEM PERFORMANCE

- A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for display through the user's web browser.
 - 1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
 - 2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
 - 3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
 - 4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
 - 5. Alarm Response Time. An object that goes into alarm shall be annunciated at the browser within 45 sec.
 - 6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec.
 - 7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.

8. Multiple Alarm Annunciation. Each user, connected to network accessing the system through their browser (workstation), shall receive alarms within 5 seconds of one another.
9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
10. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2

Table-1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C (±1°F)
Ducted Air	±0.5°C (±1°F)
Outside Air	±1.0°C (±2°F)
Dew Point	±1.5°C (±3°F)
Water Temperature	±0.5°C (±1°F)
Delta-T	±0.15° (±0.25°F)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO ₂)	±50 ppm

General Note: Comprehensive variable list applicable for all projects.

Note 1: Accuracy applies to 10%–100% of scale

Note 2: For both absolute and differential pressure

Note 3: Not including utility-supplied meters.

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0–1.5 kPa (0–6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0°C (±2.0°F)	
Duct Temperature	±1.0°C (±2.0°F)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1–150 psi) 0–12.5 kPa (0–50 in. w.g.) differential

General Note: Comprehensive variable list applicable for all projects.

1.5 QUALITY ASSURANCE

A. General:

1. The HMCS shall be furnished by a single Supplier responsible for the adequacy, performance and configuration of all items.
2. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the approved manufacturer's local field office.
3. Supervision, hardware and software engineering, calibration and checkout of the system shall be by the employees of the manufacturer or manufacturers approved technical representative.
4. Provide HMCS components and ancillary equipment, which are UL-916 listed and labeled.
5. All components used in conditioned air streams, spaces or return air plenums shall comply with NFPA 90A Flame/Smoke rating of 25/50.
6. All wiring shall conform to the National Electrical Code.
7. All smoke dampers shall be rated in accordance with UL 555S.
8. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.
9. Comply with FCC, Part 68 rules for telephone modems and data sets.

B. Supplier's Qualifications:

1. Shall have a minimum of 5 years of installation experience with the manufacturer and shall provide documentation in the bid and submittal package verifying longevity of the installing company's relationship with the manufacturer.
2. Shall have an in place support facility within 100 miles of the site with factory certified technicians and engineers, spare parts inventory and all necessary test and diagnostic equipment for the installed system.
3. Shall have the capability to provide on-site service within a 2 hour period.
4. Shall have 24 hours/day, 7 days/week emergency service available.
5. Shall be a financially sound firm having at least five years continuous experience in designing, implementing, supplying and supporting control systems at similar facilities which are comparable to the HMCS in terms of hardware, software, cost and complexity.
6. Shall have manufactured and supported standard lines of digital processing and control equipment and application software continuously for the last five years.
7. Shall have in existence an experienced engineering and technical staff capable of designing, implementing, supplying and supporting the HMCS and handling the HMCS submittal and training requirements.
8. Shall provide system hardware components and software packages of fully developed, field proven standardized designs and therefore shall furnish a system which is not a highly unique, custom one-of-a-kind system.
9. Shall have a minimum of five years' experience in software configuration, hardware application, programming, and data highway systems.

10. Shall provide standard course offerings in general control applications and in operation, programming and maintenance of the control system and equipment at a facility specifically utilized for training purposes. The facility shall have been in operation continuously for the last two years.
11. Shall have a demonstrated record of prompt response to field failures.
12. Shall have a documented program of failure analysis.
13. Shall utilize a UL approved panel shop.

C. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of the component manufacturer from a single Supplier.
2. The Supplier shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the Supplier.

1.6 SUBMITTALS

A. Action Submittals: Submit the following:

1. All shop drawings shall be prepared in Visio Professional or AutoCAD software. In addition to the drawings, the Contractor shall furnish a CD containing the identical information. Drawings shall be 11" x 17" size or larger.
2. Shop drawings shall include a riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller.
3. Submittal data shall contain manufacturer's data on all hardware and software products required by the specification. Valve, damper and air flow station schedules shall indicate size, CV where applicable, configuration, capacity and location of all equipment.
4. Software submittals shall contain narrative descriptions of sequences of operation, program listings, point lists, and a complete description of the graphics, reports, alarms and configuration to be furnished with the workstation software. If color has been used to differentiate information, the information shall be in color.
5. Information common to the entire system shall be provided. This shall include but not be limited to the following.
 - a. Product manuals for the key software tasks.
 - b. Operating the system.
 - c. Adminstrating the system.
 - d. Engineering the operator workstation.
 - e. Application programming.
 - f. Engineering the network.
 - g. Setting up the web server.
 - h. Report creation.

- i. Graphics creation.
- j. All other engineering tasks.
- k. System architecture diagram.
- l. List of recommended maintenance tasks associated with the system servers, operator workstations, data servers, web servers and web clients.
- m. Define the task.
- n. Recommend a frequency for the task.
- o. Reference the product manual that includes instructions on executing the task.
- p. Licenses, guarantees, and warranty documents for equipment and systems.
- q. Submit one copy for each building, plus two extra copies.
- 6. Information common to the systems in a single building shall be provided.
 - a. System architecture diagram for components within the building annotated with specific location information.
 - b. As-built drawing for each control panel.
 - c. As-built wiring design diagram for all components.
 - d. Installation design details for each I/O device.
 - e. As-built system flow diagram for each system.
 - f. Sequence of operations for each system.
 - g. Binding map for the building.
 - h. Product data sheet for each component.
 - i. Installation data sheet for each component.
 - j. Submit two copies for each building and two extra copies.
- 7. Software shall be provided:
 - a. Submit a copy of all software installed on the servers and workstations.
 - b. Submit all licensing information for all software installed on the servers and workstations.
 - c. Submit a copy of all software used to execute the project even if the software was not installed on the servers and workstations.
 - d. Submit all licensing information for all the software used to execute the project.
 - e. All software revisions shall be as installed at the time of the system acceptance.
 - f. Firmware Files
 - g. Submit a copy of all firmware files that were downloaded to or pre-installed on any devices installed as part of this project.
 - h. This does not apply to firmware that is permanently burned on a chip at the factory and can only be replaced by replacing the chip.
 - i. Submit a copy of all application files that were created during the execution of the project.
 - j. Submit a copy of all graphic page files created during the execution of the project.
- 8. Panel and Cabinet Information:
 - a. Layout Drawings, including the following:
 - 1) Front views to scale.

- 2) Dimensional information.
- 3) Functional name of components mounted in and on panel.
- 4) Product information on all panel components.
- 5) Nameplate location and legend including text, letter size and colors to be used.
- 6) Location of anchoring connections and holes.
- 7) Location of external wiring connections.
- 8) Mounting, support and installation details.
- b. Wiring diagrams, including the following:
 - 1) Name of panel, console or cabinet.
 - 2) Wiring sizes and types.
 - 3) Terminal strip numbers.
 - 4) Color coding.
 - 5) Functional name and manufacturer's designation for components to which wiring is connected.
- c. Electrical control schematics in accordance with NFPA 79 Standards.
- 9. Conduit Layout Information:
 - a. Conduit layout drawings showing proposed routing of exposed and concealed conduits.
 - b. Drawings shall show locations of pull boxes, junction boxes, and all building penetrations.
 - c. All conduits shall have proper identification as to size and quantity of wire.
- B. Informational Submittals: Submit the following:
 - 1. Source Quality Control Submittals:
 - a. Submit factory test reports.
 - 2. Site Quality Control Submittals:
 - a. Submit field Test Reports.
 - 3. Qualifications Statements:
 - a. Supplier's Qualifications Data:
 - 1) Submit qualifications data as required in Paragraph 1.5.B, above.
- C. Closeout Submittals: Submit the following
 - 1. Operations and Maintenance Manuals:
 - a. Operation and Maintenance Manuals shall conform to the requirements of Section 01 78 23, Operation and Maintenance Data and the supplemental requirements below.
 - b. The Operation and Maintenance Manuals shall include the following:
 - 1) Name, address, e-mail address and telephone number of the Supplier's local service representative.
 - 2) Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spares.
 - 3) Copy of all approved submittal information and system Shop Drawings.

- 4) The following is a list of post construction submittals that shall be updated to reflect any changes during construction and re-submitted as "As-Built".
 - a) System architecture drawing.
 - b) Layout drawing for each control panel
 - c) Wiring diagram for individual components
 - d) System flow diagram for each controlled system
 - e) Instrumentation list for each controlled system
 - f) Sequence of operation
 - g) Binding map
 - h) A matrix sheet detailing all system addresses and communication settings
 - 5) Safety considerations relating to operation and maintenance procedures.
2. Record Documentation:
- a. CONTRACTOR and Supplier shall revise all system drawings, submittals and software documentation to reflect as-built conditions in accordance with the requirements of the Contract Documents.
 - b. Half-size black line prints of wiring diagrams and any program or configuration printouts applicable to each control panel shall be placed inside a clear plastic envelope and stored in a suitable print pocket or container inside each control panel.
- D. Maintenance Material Submittals: Furnish the following:
1. Spare Parts:
 - a. Spare parts and testing equipment list with recommended quantities to be provided.

1.7 SOFTWARE OWNERSHIP

- A. The OWNER shall retain licenses to software.
- B. The OWNER shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to the OWNER as defined by the manufacturer's license agreement but shall protect the manufacturer's rights to disclosure of Trade Secrets contained within such software.
- C. The licensing agreement shall not preclude the use of the software by individuals under contract to the OWNER for commissioning, servicing or altering the system in the future. Use of the software by individuals under contract to the OWNER shall be restricted to use on the OWNER's computers and only for the purpose of commissioning, servicing, or altering the installed system.
- D. All project developed software, files and documentation shall become the property of the OWNER. These include but are not limited to:
 1. Server and workstation software

2. Application programming tools
3. Configuration tools
4. Network diagnostic tools
5. Addressing tools
6. Application files
7. Configuration files
8. Graphic files
9. Report files
10. Graphic symbol libraries
11. All documentation

1.8 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. HMCS equipment shall be packaged at the factory prior to shipment to protect each item from damage during shipment and storage. Containers shall be protected against impact, abrasion, corrosion, discoloration and/or other damages.
2. Clearly label contents of each container and provide information on the required storage conditions necessary for the equipment. Keep OWNER and ENGINEER informed of equipment delivery.
3. Deliver materials to the Site to ensure uninterrupted progress of the Work.

B. Storage and Protection:

1. Store materials and equipment to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms or other supports. Protect metal enclosures and parts and other material from corrosion.
2. Supplier shall notify CONTRACTOR, in writing, of the storage requirements and recommendations for the equipment prior to shipment.
3. Protection of materials and equipment shall comply with the requirements of Division 01, General Requirements, and in accordance with manufacturer's instructions and relevant organization standards.
4. Store all material in covered storage and protect from condensation and in accordance with the manufacturer's recommendations.
5. Store computers and electronic devices in a secure environmentally control warehouse.

C. Acceptance At Site:

1. All boxes and crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to the components or equipment. Replace lost equipment or components and repair damage to like new condition in accordance with the manufacturer's requirements.

1.9 WARRANTY

- A. The warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents.
- B. All components, system software, and parts furnished and installed by the Supplier shall be guaranteed against defects in materials and workmanship for 1 year after substantial completion. Labor to repair, reprogram, or replace these components shall be provided. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. The following manufactures are acceptable provided they meet the requirements of the Contract Documents.
 - 1. Schneider Electric.
 - 2. Siemens.
 - 3. Johnson Controls.
 - 4. Or equal.

2.2 GENERAL REQUIREMENTS

- A. Design requirements:
 - 1. All HMCS components necessary to meet functional and operational requirements shall be provided to meet the intent of the Work.
 - 2. Components located in Industrial Process and Industrial Non-Process Areas shall be heavy-duty type, designed for continuous service in industrial environments.
 - 3. Components located in electrically classified areas (NFPA Class 1, Division 1 and 2) areas shall be rated for use in those areas. CONTRACTOR shall refer to the Electrical Drawings and the General Code Criteria Chart on the Drawings for areas that are electrically classified.
 - 4. Components located in corrosive or wet electrically unclassified areas shall be provided with NEMA 4X enclosures.
 - 5. Components located in or exposed to corrosive atmospheres shall be constructed of materials suitable for use in areas containing wet hydrogen sulfide, sodium hypochlorite, and sodium hydroxide laden atmosphere. Suitable exposed materials shall be Type 316 stainless steel, epoxy or Teflon coated aluminum or other similar materials approved by the ENGINEER. Steel, galvanized steel, and Type 304 stainless steel are not suitable materials for exposure in corrosive areas.
 - 6. Design all logic and control loops to fail safe.

7. HMCS shall be designed to return automatically to accurate measurement within (10) seconds upon restoration of power after a power failure or when transferred to standby power supply.
8. Surge protection shall be provided for all instruments and all other control system components, which could be damaged by electrical surges.
9. Relays with interconnections to field devices shall be wired through terminal blocks. Terminals as part of the relay base are not an acceptable alternate.
10. Panel mounted instruments, switches, and other devices shall be selected and grouped for functionality and arranged to present a pleasing coordinated appearance. Similar type front of panel mounted devices shall be of the same manufacturer and model line.
11. Components furnished, including field and panel instruments, shall be tagged with the item number and nomenclature indicated as shown and/or approved Shop Drawings.
12. Ranges and scales shall be coordinated to suit equipment furnished.
13. Components shall be protected from exposure to freezing temperatures.

B. Power Supplies:

1. Electrically powered monitoring equipment, control equipment and devices shall be suitable for operation on 115 volt ± 10 percent, 60 Hz ± 2 Hz power. If a different voltage or closer regulation is required, a suitable regulator or transformer shall be provided.
2. Appropriate power supplies shall be provided. Power supplies shall be mounted in panels.
3. Design power supplies for a minimum of 130 percent of the maximum simultaneous current draw.
4. A power on-off switch or an air circuit breaker shall be furnished for each item requiring electrical power.

C. Environmental Conditions:

1. The HMCS shall be designed and constructed for continuous operation in the temperature and humidity atmosphere in which the equipment is installed. Provide automatically controlled closed loop ventilation fans or closed loop air conditioners with filtered air louvers if required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure.

D. Spare Control Points:

1. Provide sufficient control point capacity within each HMCS panel in order to provide an additional 20 percent of each type of input and output. These inputs/outputs shall be designated as spares.

2.3 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.
- B. All IP based controllers shall be capable of providing IPv4 and IPv6 protocol standards as defined by the Internet Data Communications Standard.
- C. The BMS contractor shall furnish and install all communication media, connectors, repeaters and network switches/routers, and network devices necessary to provide a complete and workable control network for both high speed Ethernet communications network/LAN and serial networks. The control network shall adhere to the owner's testing, labeling, administration, and documentation requirements established and presented for the site. The dedicated control's network shall be capable of connecting to a separate owner/customer LAN.
- D. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- E. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
 - 1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
 - 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute specified sequences of operation. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
- F. BACnet Secure Connect (BACnet/SC). BACnet/SC is a datalink option that makes the full use of TLS WebSocket connections as defined by addendum bj to the ANSI/ASHRAE Standard 135.
 - 1. The BMS contractor shall furnish and install a network designed to allow for implementation of BACnet/SC. The network shall be installed with as many devices capable of using BACnet/SC at time of installation.
 - 2. The BMS contractor shall furnish and install all BACnet workstations/servers, routers, and building controllers capable of using BACnet/SC. Any BACnet workstations/servers, routers, or building controllers that do not have BACnet/SC capability at time of installation shall have the ability to provide BACnet/SC capability with a software/firmware update/patch. BACnet/SC capability shall not require the physical replacement of the BACnet workstation/server, router, or building controller hardware.

- G. Building Control Panels, and Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight saving and standard time as applicable.
- H. System shall be expandable to at least twice the required BACnet objects. No additional licensing/software fees shall be required to add controllers, associated devices, and wiring.
- I. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards. Web services support shall as a minimum be provided at the workstation or web server level and shall enable data to be read from or written to the system.
 - 1. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.
 - 2. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.
 - 3. For read or write requests, the system shall require user name and password authentication and shall support TLS (Transport Layer Security) or equivalent data encryption.
 - 4. System shall support discovery through a Web services connection or shall provide a tool available through the Operator Interface that will reveal the path/identifier needed to allow a third party Web services device to read data from or write data to any object in the system which supports this service.

2.4 OPERATOR INTERFACE

- A. Operator Interface. The web server shall reside on high-speed network with building controllers. Web pages generated by this server shall be compatible with the latest versions of Microsoft Internet Explorer or Edge, Google Chrome, Mozilla Firefox, and Apple Safari browsers. Any of these supported browsers connected to the server shall be able to access all system information. Mobile devices shall be recognized by the web server and shall supply the appropriate system content as needed. The Operator Interface (web server with client devices) shall conform to the BACnet Operator Workstation (B-OWS) or BACnet Advanced Workstation (B-AWS) device profile as specified in ASHRAE/ANSI 135 BACnet Annex L. This includes the ability to configure and/or reconfigure the system from the client device (change programs, graphics, labels, etc.).
- B. Communication. Web server and controllers shall communicate using BACnet protocol, including BACnet/SC. Web server and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and

BACnet/IP addressing as specified in ANSI/ASHRAE 135, BACnet Annex J. Communication between the web server and client (workstation) shall be HTTP or HTTPS protocol utilizing HTML5 language. Use of Adobe Flash in any part of the communication infrastructure is not acceptable.

C. Hardware.

1. Web server and/or workstation. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified elsewhere in this document. The web server may also be configured in client/server fashion to accommodate a "workstation" definition. In "workstation" configuration, the workstation will also perform as a server supplying additional clients as needed. The following hardware requirements apply:
 - a. System storage shall have sufficient memory to accommodate:
 - 1) All required system software.
 - 2) A DDC database to accommodate, as a minimum, twice the size of the delivered system database.
 - 3) One year of archival trend data based on the points specified to be trended at their specified trend intervals.
 - b. Provide additional hardware (communication ports, video drivers, network interface cards, cabling, etc.) to facilitate all control functions and software requirements specified for the DDC system.
 - c. Minimum hardware configuration shall include the following:
 - 1) Quad Core Processor
 - 2) 4-24 GB RAM (size dependent on size of system)
 - 3) 500 GB hard disk providing data at 3.0 Gb/sec (size dependent on historical data storage requirements)
 - 4) 16x DVD+/-RW drive
 - 5) Qwerty Keyboard
 - 6) Optical Mouse
 - 7) 24-inch LED Color monitor with 75Hz refresh rate and 1080P resolution to provide a minimum screen resolution of 1920 x 1080 pixels.
 - 8) Serial (USB) and network communication ports, with cables as required for proper DDC system operation.

D. System Software.

1. Operating System. Web server shall have an industry-standard professional-grade operating system. Operating system shall meet or exceed the BMS manufacturer's minimum requirements for their software. Acceptable systems include Microsoft Windows 8.1 or 10, Windows Server 2012 R2 or 2016 or 2019 or 2020, Red Hat Enterprise Linux 8.3, or Ubuntu Desktop 18.04 or 20.04 LTS.
2. Security. The web server application shall support Transport Layer Security (TLS) 1.3 capable of encryption of up to 256 bit elliptical curve for transmitting private information over the Internet using HTTPS. Additionally, the web server shall have SHA-2 certificate support capability.

3. Database. System shall support any JDBC (Java DataBase Connectivity) compliant engine. This includes: MS SQL, My SQL, Apache Derby, PostgreSQL and Oracle.
4. The BMS system shall allow an unlimited number of concurrent users.
5. The BMS manufacturer shall provide all software and tools necessary to provide the following capabilities:
 - a. Create and/or edit any programming used in controllers
 - b. Create and/or edit any graphics used in the system
 - c. Software shall not be subscription based and be given to owner at time of turnover. If software is subscription based, manufacturer shall include 10 years of subscription service.
 - d. The owner shall have the ability to install software on a minimum of five (5) additional owner furnished computers without additional licenses or fees.
6. System Graphics. The operator interface software shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
 - a. Minimum graphics resolution shall be 1920 x 1080 for display of detailed system graphics.
 - b. Floor Plan Graphics. Floor plan graphics shall be capable of allowing the floor plan graphic to dynamically size relative to the end user's monitor resolution.
 - c. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
 - d. Animation. Graphics shall be able to animate by displaying different image files for changed object status.
 - e. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - f. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, GIF, or SVG. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in or shall only require widely available no-cost plug-ins.
7. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system used to create and modify graphics that are saved in the same formats as are used for system graphics.
8. Graphics Library. Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other

equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

- E. System Applications. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on a standard PC type personal computer with no limit on the number of copies that can be installed under the system license.
1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
 2. Manual Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
 3. System Configuration. The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password.
 4. On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
 5. Security. Each operator shall be required to log on to the system with user name and password in order to view, edit, add, or delete data.
 - a. Operator Access. The user name and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator. Users with system administrator rights shall be able to create new users and edit the privileges of all existing users. System administrators shall also be able to vary and deny each operator's privileges based on the geographic location, such as the ability to edit operating parameters in Building A, to view but not edit parameters in Building B, and to not even see equipment in Building C.
 - b. Password Policy Rules. System administrator shall invoke policies for minimum password strength, including number of characters, special characters and numbers, upper and lower case, etc.
 - c. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. This auto logoff time period shall be user-adjustable.
 - d. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.

6. System Diagnostics. The system shall automatically monitor the operation of all building management panels and controllers. The failure of any device shall be annunciated to the operator.
7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as required by sequences of operation. Alarms shall be BACnet alarm objects and shall use BACnet alarm services. BMS system shall be capable of assigning alarm sources to categories such as HVAC Critical, or HVAC General. The BMS shall include at a minimum HVAC and FDD categories. BMS system shall allow user to create custom alarm categories.
8. Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying on acronyms or mnemonics.
9. Alarm Reactions. Operator shall be able to configure (by object) what, if any actions are to be taken during an alarm. As a minimum, the workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send SMS text, and audibly annunciate.
10. Alarm and Event log. Operators shall be able to view all system alarms and changes of state from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and delete alarms, and archive closed alarms to the workstation or web server hard disk.
11. Trend Logs. The operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified by the sequences of operation. Trends shall be BACnet trend objects.
12. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object or property in the system. The status shall be available by menu, on graphics, or through custom programs.
13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
14. Audit and Security Detail. All users accessing the system shall have their actions recorded. Information recorded shall include:
 - a. Login/logout time and date
 - b. System modifications - with before and after values
 - c. Ability to report user activity based on individual and/or date and time.
15. Standard Reports. Furnish the following standard system reports:

- a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
 - b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
 - c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
 - 1) Alarm History.
 - 2) Trend Data. Operator shall be able to select trends to be logged.
 - 16. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface. Operator shall be able to schedule reports to automatically run and be emailed to recipients on a recurring basis from the BMS system.
- F. Workstation Application Editors. Each PC or browser workstation shall support editing of all system applications. The applications shall be downloaded and executed at one or more of the controller panels.
- 1. Controller. Provide a full-screen editor for each type of application that shall allow the operator to view and change the configuration, name, control parameters, and set points for all controllers.
 - 2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a method of selecting the desired schedule and schedule type. Exception schedules and holidays shall be shown clearly on the calendar. The start and stop times for each object shall be adjustable from this interface.
 - 3. Custom Application Programming. Provide the tools to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
 - a. Language. Language shall be graphically based or English oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. If English language oriented, language shall be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column-oriented or “fill-in-the-blanks.”
 - b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
 - c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.

- d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
- e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
- f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
- g. Variables. Operator shall be able to use variable values in program conditional statements and mathematical functions.
 - 1) Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
 - 2) System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.

2.5 CONTROLLER SOFTWARE

- A. All controller software applications shall reside and operate in the system controllers.
- B. All application software in controllers furnished by BMS manufacturer shall be editable through operator workstation, web browser interface, or workstation.
- C. Each controller furnished by BMS manufacturer shall have all of its local on board software applications backed up and saved to the BMS web server. In the event of a controller failure, the BMS server shall download backed up software applications to replacement controller. Controllers furnished by others and integrated into the BMS are not required to be backed up to BMS server.
- D. Furnish the following applications for building and energy management:
 - 1. System Security.
 - 2. Scheduling. Provide the capability to execute control functions according to a user created or edited schedule. Each schedule shall provide the following schedule options as a minimum:

- a. Weekly Schedule. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
 - b. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule has executed, the system shall discard and replace the exception schedule with the standard schedule for that day of the week.
 - c. Holiday Schedules. Provide the capability for the operator to define up to 24 special or holiday schedules. These schedules will be repeated each year. The operator shall be able to define the length of each holiday period.
3. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
4. Binary Alarms. Each binary object shall have the capability to be configured to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.
5. Analog Alarms. Each analog object shall have both high and low alarm limits. The operator shall be able to enable or disable these alarms.
6. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display on graphics.
7. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
8. Demand Limiting.
 - a. The demand-limiting program shall monitor building power consumption from a building power meter (provided by others) which generates pulse signals or a BACnet communications interface. An acceptable alternative is for the system to monitor a watt transducer or current transformer attached to the building feeder lines.
 - b. When power consumption exceeds adjustable levels, system shall automatically adjust setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified in in sequences of operation. When demand drops below adjustable levels, system shall restore loads as specified.
9. Maintenance Management. The system shall be capable of generating maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in sequences of operation.
10. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in sequences of operation.
11. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-

windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs. The calculation interval, PID gains, and other tuning parameters shall be adjustable by a user with the correct security level.

12. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
13. Energy Calculations.
 - a. The system shall accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.
 - b. The system shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.
14. Anti-Short Cycling. All binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
15. On and Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and a setpoint. The algorithm shall be direct-acting or reverse-acting.
16. Runtime Totalization. Provide software to totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as required by sequences of operation.

2.6 CONTROLLERS

- A. General. Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified by system performance. Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of communicating actuators, communicating sensors, BACnet Smart Actuators and BACnet Smart Sensors.
- B. BACnet.
 1. Building Controllers (BCs). Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.
 2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
 3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in

ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.

4. Smart Actuators (SAs). An actuator which is controlled by a network connection rather than a binary or analog signal (0-10v, 4-20mA, relay, etc.). Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.
5. Smart Sensors (SSs). A sensor which provides information to the BAS via network connection rather than a binary or analog signal (0-10000 ohm, 4-20mA, dry contact, etc.). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.
6. BACnet Communication.
 - a. Each controller residing on the ethernet data link shall be capable of providing BACnet/SC capability as described in the above Communication Section.
 - b. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP or BACnet/SC.
 - c. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
 - d. Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol using BACnet/IP or BACnet/SC, or it shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - e. Each ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - f. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - g. Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.

C. Security.

1. Provide BACnet firewall capability, as defined in the BACnet standard, for controllers that are IP capable.

D. Communication.

1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal.
2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.

4. Stand-Alone Operation. Each piece of equipment shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network such as outdoor air conditions, supply air or water temperature coming from source equipment, etc.
- E. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
 1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
 2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
 - F. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to a field-removable modular terminal strip or to a termination card connected by a ribbon cable. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
 - G. Real-time Clock. Controller shall have a real-time clock to keep track of time in the event of a power failure for up to three (3) days.
 - H. Memory.
 1. Controller memory shall support operating system, database, and programming requirements.
 2. Each controller shall use volatile memory with battery backed up memory or nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
 - I. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.
 - J. Transformer. Power supply shall be fused or current limiting and shall be rated at a minimum of 125% of controller power consumption.

2.7 INPUT AND OUTPUT INTERFACE

- A. General. Hard-wire input and output points to BCs, AACs, or ASCs.
- B. Protection. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground shall cause no damage to the

controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no controller damage.

- C. Binary Inputs. Binary inputs shall allow the monitoring of ON/OFF signals from remote devices. Binary inputs shall sense dry contact closure without application of power external to the controller.
- D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall also accumulate up to 10 pulses per second.
- E. Analog Inputs. Analog inputs shall monitor low-voltage (0–10 Vdc), current (4–20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary Outputs. Binary outputs shall provide for ON/OFF operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on Building Controllers shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- G. Analog Outputs. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0–10 Vdc or a 4–20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- I. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.8 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
 - 1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.

- a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
 - b. Line voltage units shall be UL recognized and CSA listed.
- B. Power Line Filtering.
 - 1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
 - a. Dielectric strength of 1000 V minimum
 - b. Response time of 10 nanoseconds or less
 - c. Transverse mode noise attenuation of 65 dB or greater
 - d. Common mode noise attenuation of 150 dB or greater at 40–100 Hz

2.9 LOCAL CONTROL PANELS

- A. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels.
- B. Interconnections between internal and face-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
- C. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

2.10 WIRING AND RACEWAYS

- A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
- B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service
- C. Alarm Management
 - 1. The software shall be capable of accepting alarms directly from NSCs or controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.
 - 2. Alarm management features shall include:

- a. A minimum of 1,000 alarm notification levels at the NSC, workstation, and webstation levels. At the Enterprise level the minimum number of active and viewable alarms shall be 10,000. Each notification level will establish a unique set of parameters for controlling alarm display, distribution, acknowledgment, keyboard annunciation, and record keeping.
- b. Automatic logging in the database of the alarm message, point name, point value, source device, timestamp of alarm, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement).
- c. Playing an audible sound on alarm initiation or return to normal.
- d. Sending an email page to anyone specifically listed on the initial occurrence of an alarm. The ability to utilize email paging of alarms shall be a standard feature of the software using Simple Mail Transfer Protocol (SMTP) with support for secure email using Simple Mail Transfer Protocol Secure (SMTPS) No special software interfaces shall be required and no email client software shall be running in order for email to be distributed. The email notification shall be able to be sent to an individual user or a user group.
- e. Individual alarms shall be able to be re-routed to a user at user-specified times and dates. For example, a critical high temp alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-6pm, Mon-Fri) and to a Central Alarming workstation at all other times.
- f. An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.
- g. The active alarm viewer can be configured such that an operator shall type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms.
- h. The active alarm viewer can be configured such that an operator shall type in text in an alarm entry and/or pick from a drop-down list of causes for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.
- i. The active alarm viewer can be configured such that an operator shall confirm that all of the steps in a check list have been accomplished prior to acknowledging the alarm.
- j. The active alarm viewer shall, if filtered, show the quantity of visible and total number of alarms that are not equal to 'normal' and the quantity of disabled and hidden alarms.
- k. The alarm viewer can be configured to auto hide alarms when triggered.
- l. An operator shall have the capability to assign an alarm to another user of the system.
- m. Time schedules shall be able to be used to set control notifications to users.
- n. An operator shall have the capability to save and apply alarm favorites.

- o. Alarm notifications shall support multiple distribution methods within one notification.

D. Report Generation

1. The Reports Server shall be able to process large amounts of data and produce meaningful reports to facilitate analysis and optimization of each installation.
2. Reports shall be possible to generate and view from the operator Workstation, and/or Webstation, and/or directly from a reports-only web interface.
3. A library of predefined automatically generated reports that prompt users for input prior to generation shall be available. The properties and configurations made to these reports shall be possible to save as Dashboard reports, so that the configurations are saved for future use.
4. It shall be possible to create reports standard tools, such as Microsoft Report Builder 2.0 or Visual Studio, shall be used for customized reports.
5. Additional reports or sets of reports shall be downloadable, transferrable, and importable
6. All reports shall be able to be set up to automatically run or be generated on demand.
7. Each report shall be capable of being automatically emailed to a recipient in Microsoft Word, Excel, and/or Adobe .pdf format.
8. Reports can be of any length and contain any point attributes from any controller on the network.
9. Image management functionality shall be possible to enable the system administrators to easily upload new logos or images to the system.
10. It shall be possible to run other executable programs whenever a report is initiated.
11. Report Generator activity can be tied to the alarm management system, so that any of the configured reports can be displayed in response to an alarm condition.
12. Minimum supplied reports shall include:
 - a. Activities Per Server Report
 - b. Activities Per User Report
 - c. Alarm Amount by Category Report
 - d. Alarm Amount by Type Report
 - e. Alarms Per Server Report
 - f. Current Alarm Report
 - g. Most Active Alarm Report
 - h. System Errors Per Server Report
 - i. Top Activities Report
 - j. Top Alarms Report
 - k. Top System Errors Report
 - l. Trend Log Comparison Report
 - m. User Logins Report
 - n. Users and Groups Reports
13. Minimum Energy Reports shall include:

- a. Energy Monitoring Calendar Consumption Report: Shall provide an interactive report that shows the energy usage on one or multiple selected days.
 - b. Energy Monitoring Consumption Breakdown Report: Shall provide a report on energy consumption broken down using sub-metering.
 - c. Energy Monitoring Consumption Report: Shall show the energy consumption against a specified target value.
- 14. Reports Server Hardware Requirements
 - a. Processor
 - 1) 2.0 GHz or higher
 - b. Memory
 - 1) 8GB or higher
 - c. Hard Disk: 1 TB
- 15. Reports Server Software Requirements
 - a. Operating System:
 - 1) Microsoft Windows 10 64-bit (Pro or Enterprise)
 - 2) Microsoft Windows Server 2019 64-bit (Standard, Datacenter, Essentials)
 - b. SQL Versions:
 - 1) PostgreSQL 11.0 or later
 - 2) TimescaleDB 1.2 and later
 - c. Additional required software”
 - 1) Microsoft .Net 4.7.2 and later

E. Scheduling

- 1. From the workstation or webstation, it shall be possible to configure and download schedules for any of the controllers on the network.
- 2. Time of day schedules shall be in a calendar style and viewable in both a graphical and tabular view.
- 3. Schedules shall be programmable for a minimum of one year in advance.
- 4. To change the schedule for a particular day, a user shall simply select the day and make the desired modifications.
- 5. Additionally, from the operator webstations, each schedule will appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.
- 6. Schedules will be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation will be automatically updated to the corresponding schedule in the controller.
- 7. It shall be possible to assign a lead schedule such that shadow/local schedules are updated based upon changes in the Lead.
- 8. It shall be possible to assign a list(s) of exception event days, dates, date ranges to a schedule.
- 9. It shall be possible to view combined views showing the calendar and all prioritized exemptions on one screen.
- 10. It should accommodate a minimum of 16 priority levels.

11. Values should be able to be controlled directly from a schedule, without the need for special program logic.

F. Programmer's Environment

1. Programming in the NSC shall be either in graphical block format or line-programming format or both.
2. Programming of the NSC shall be available offline from system prior to deployment into the field. All engineering tasks shall be possible, except, of course, the viewing of live tasks or values.
3. The programmer's environment will include access to a superset of the same programming language supported in the SDCUs.
4. NSC devices will support both script programming language as well as the graphical function block programming language. For both languages, the programmer will be able to configure application software for custom program development, and write global control programs. Both languages will have debugging capabilities in their editors.
5. It shall be possible to save custom programs as libraries for reuse throughout the system. A wizard tool shall be available for loading programs from a library file in the program editor.
6. It shall be possible to view graphical programming live and real-time from the Workstation.
7. The system shall be capable of creating 'binding templates' allowing the user to bind multiple points to multiple objects all at once.
8. Key terms should appear when typing (IntelliType).
9. Applications should be able to be assigned different priorities and cycle times for a prioritized execution of different function.
10. The system shall be able to create objects that allow common objects such as power meters, VFD drives, etc. to be integrated into the system with simple import actions without the need of complicated programming or configuration setups.

G. Saving/Reloading

1. The workstation software shall have an application to save and restore NSC and field controller memory files.
2. For the NSC, this application shall not be limited to saving and reloading an entire controller – it shall also be able to save/reload individual objects in the controller. This allows off-line debugging of control programs, for example, and then reloading of just the modified information.

H. Audit Trail

1. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.

2. It shall be possible to view a history of alarms, user actions, and commands for any system object individually or at least the last 5,000 records of all events for the entire system from Workstation.
 3. The Enterprise server shall be able to store up to 5 million events.
 4. The event view shall support viewing of up to 100,000 events.
 5. It shall be possible to save custom filtered views of event information that are viewable and configurable in Workstation.
 6. It shall be capable to search and view all forced values within the system.
- I. Fault Tolerant Enterprise Server Operation (Top level NSC)
1. A single component failure in the system shall not cause the entire system to fail. All system users shall be informed of any detectable component failure via an alarm event. System users shall not be logged off as a result of a system failure or switchover.
- J. Web-based Operator Software
1. General:
 - a. Day-to-day operation of the system shall be accessible through a standard web browser interface, allowing technicians and operators to view any part of the system from anywhere on the network.
 - b. The system shall be able to be accessed on site via a mobile device environment with, at a minimum, access to overwrite and view system values.
 2. Graphic Displays
 - a. The browser-based interface shall share the same graphical displays as the Administration and Programming Workstations, presenting dynamic data on site layouts, floor plans, and equipment graphics. The browser's graphics shall support commands to change setpoints, enable/disable equipment and start/stop equipment.
 - b. Through the browser-based interface, operators shall be able to navigate through the entire system, and change the value or status of any point in any controller. Changes are effective immediately to the controller, with a record of the change stored in the system database.
 3. Alarm Management
 - a. Systems requiring additional client software to be installed on a PC for viewing the webstation from that PC will not be considered.
 - b. Through the browser interface, a live alarm viewer identical to the alarm viewer on the Administration and Programming workstation shall be presented, if the user's password allows it. Users shall be able to receive alarms, silence alarms, and acknowledge alarms through a browser. If desired, specific operator text shall be able to be added to the alarm record before acknowledgement, attachments shall be viewable, and alarm checklists shall be available.
- K. Groups and Schedules
1. Through the browser interface, operators shall be able to view pre-defined groups of points, with their values updated automatically.

2. Through the browser interface, operators shall be able to change schedules – change start and stop times, add new times to a schedule, and modify calendars.
- L. User Accounts and Audit Trail
1. The same user accounts shall be used for the browser interface and for the operator workstations. Operators shall not be forced to memorize multiple passwords.
 2. All commands and user activity through the browser interface shall be recorded in the system’s activity log, which can be later searched and retrieved by user, date, or both.
- M. Web Services
1. The installed system shall be able to use web services to “consume” information within the Network Server/Controllers (NSCs) with other products and systems. Inability to perform web services within the NSCs will be unacceptable.
 - a. Shall be able to “consume” data into the system via SOAP and REST web services

2.11 NETWORK SERVER CONTROLLERS (NSC)

- A. Network Server Controllers shall combine both network routing functions, control functions, and server functions into a single unit.
- B. The BACnet NSC shall be classified as a “native” BACnet device, supporting the BACnet Network Server Controller (B-BC) profile. Controllers that support a lesser profile such as B-SA are not acceptable. NSCs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Network Server Controllers (B-BC).
- C. The Network Server Controller shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NRS.
- D. The NSCs shall be capable of whitelisting IPs to restrict access to a pre-defined list of hosts or devices.
- E. Whitelisting of file extensions for documents shall be capable.
- F. Encrypted and authenticated communication shall be configurable for non-open protocol communications using TLS 1.2.
- G. The NSCs shall support Simple Network Management Protocol version 3 (SNMPv3) for monitoring of the NSCs using a Network Management Tool.
- H. The NSCs shall support remote system logging for used by System Information and Event Monitoring (SIEM) software.

- I. They shall also be responsible for monitoring and controlling their own HVAC equipment.
- J. They shall also contain graphics, trends, trend charts, alarm views, and other similar presentation objects that can be served to workstations or web-based interfaces. A sufficient number of NSCs shall be supplied to fully meet the requirements of this specification and the attached point list.
- K. It shall be capable of executing application control programs to provide:
 - 1. Calendar functions
 - 2. Scheduling
 - 3. Trending
 - 4. Alarm monitoring and routing
 - 5. Time synchronization by means of an Internet site including automatic synchronization
 - 6. Native integration of LonWorks controller data and Modbus controller data or BACnet controller data and Modbus controller data
 - 7. Network Management functions for all LonWorks based devices
- L. Hardware Specifications
 - 1. Memory:
 - a. The operating system of the controller, application programs, and all other portions of the configuration database, shall be stored in non-volatile, FLASH memory. Servers/Controllers shall contain enough memory for the current application, plus required history logging, plus a minimum of 20% additional free memory.
 - 2. Each NRC shall provide the following on-board hardware for communication:
 - a. Two 10/100b Ethernet for communication to Workstations, other NRCs, IP field bus controllers, other SDCUs, and onto the internet.
 - 1) The two Ethernet ports shall support active switch and BACnet/IP communication protocols.
 - 2) Support IPv4 addressing
 - 3) Ethernet port 1 shall support static or DHCP client configuration for communication to Workstation or other NSCs
 - 4) Ethernet port 2 shall support switch mode or DHCP server to set addressing of DHCP client devices
 - 5) It shall be possible to disable Ethernet port 2
 - 6) In DHCP server mode, the Ethernet port 2 shall support 50 BACnet/IP field controllers in daisy chain configuration directly from the port
 - 7) Each NSC shall be able to support a total of 250 IP SDCUs in daisy chain configuration (5 sub networks via switch)
 - 8) If using RSTP (Rapid Spanning Tree Protocol) with a managed switch (with IEEE 802.1W or IEEE 802.1Q-2014 support), Ethernet port 2 shall support up to 39 devices
 - 9) Each NSC shall be able to support a total of 234 IP SDCUs in RSTP configuration (6 sub networks via managed switch)

- 10) Where a switch is needed, use an EtherWAN EX63402-01B, or other equal and approved equivalent.
- b. Two RS-485 ports for communication to BACnet MSTP bus or serial Modbus (software configurable)
- c. One TP/FT port for communication to LonWorks devices.
- d. One device USB port
- e. One host USB port
3. The NSC shall conform to a small footprint no larger than 4" W x 5" H x 3" D.

M. Modular Expandability:

1. The system shall employ a modular I/O design to allow expansion. Input and output capacity is to be provided through plug-in modules of various types. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications.
2. One shall be able to "hot-change" (hot-swap) the I/O modules preserving the system on-line without any intervention on the software; addressing and configuration shall be automatic.
3. If for any reason the backplane of the modular I/O system were to fail, I/O module addresses will be protected.

N. Hardware Override Switches:

1. All digital outputs shall, optionally, include three position manual override switches to allow selection of the ON, OFF, or AUTO output state. These switches shall be built into the unit and shall provide feedback to the controller so that the position of the override switch can be obtained through software. In addition each analog output shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.

O. Universal Input Temperatures

1. All universal inputs directly connected to the NSC via modular expansion shall be capable of using the following thermistors for use in the system without any external converters needed.
 - a. 10 kohm Type I (Continuum)
 - b. 10 kohm Type II (I/NET)
 - c. 10 kohm Type III (Satchwell)
 - d. 10 kohm Type IV (FD)
 - e. Linearized 10 kohm Type V (FD w/11k shunt)
 - f. Linearized 10 kohm (Satchwell)
 - g. 1.8 kohm (Xenta)
 - h. 1 kohm (Balco)
 - i. 20 kohm (Honeywell)
 - j. 2.2 kohm (Johnson)

2. In addition to the above, the system shall be capable of using the below RTD sensors, however it is not required that all universal inputs be compatible with them.
 - a. PT100 (Siemens)
 - b. PT1000 (Sauter)
 - c. Ni1000 (Danfoss)
- P. Local Status Indicator Lamps:
1. The NSC shall provide as a minimum LED indication of CPU status, Ethernet LAN status, and field bus status. For each input or output, provide LED indication of the value of the point (On/Off). The LED indication shall support software configuration to set whether the illumination of the LED corresponds to On or Off or whether the color when illuminated is Red or Green.
- Q. Real Time Clock (RTC):
1. Each NSC shall include a real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. Each NSC will allow for its own UTC offset, depending upon the time zone. When the time zone is set, the NSC will also store the appropriate times for daylight savings time.
 2. The RTC date and time shall also be accurate, up to 30 days, when the NSC is powerless.
 3. No batteries may be used to for the backup of the RTC.
- R. Power Supply:
1. The 24 VDC power supply for the NSCs shall provide 30 watts of available power for the NSC and associated IO modules. The system shall support the use of more than one power supply if heavily power consuming modules are required.
 2. The power supply, NSC, and I/O modules shall connect power wise and communication wise via the separate terminal base allowing for ease of replacement and no separate or loose wiring.
- S. Automatic Restart After Power Failure:
1. Upon restoration of power after an outage, the NSC shall automatically and without human intervention update all monitored functions, resume operation based on current, synchronize time and status, and implement special start-up strategies as required.
- T. Data Retention:
1. During a power failure, the NSC shall retain all programs, configuration data, historical data, and all other data that is configured to be retained. There shall be no time restriction for this retention and it shall not use batteries to achieve it.
- U. Software Specifications

1. The operating system of the controller, application programs, and all other portions of the configuration database such as graphics, trends, alarms, views, etc., shall be stored in non-volatile, FLASH memory. There will be no restrictions placed on the type of application programs in the system. Each NSC shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage, etc.
2. Each NSC shall have an available capacity of 4 GB of memory. This shall represent 2 GB for application and historical data and 2 GB dedicated for backup storage.

V. User Programming Language:

1. The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be either a script-based structured text or graphical function block based and fully programmable by the user. The language shall be structured to allow for the configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, and histories. Users shall be able to place comments anywhere in the body of either script or function block programs.
2. Network Server Controllers that use a “canned” program method will not be accepted.

W. Control Software:

1. The NSC shall have the ability to perform the following pre-tested control algorithms:
 - a. Proportional, Integral plus Derivative Control (PID)
 - b. Two Position Control
 - c. Digital Filter
 - d. Ratio Calculator
 - e. Equipment Cycling Protection

X. Mathematical Functions:

1. Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These shall be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

Y. NSCs shall have the ability to perform any or all of the following energy management routines:

1. Time of Day Scheduling
2. Calendar Based Scheduling

3. Holiday Scheduling
4. Temporary Schedule Overrides
5. Optimal Start
6. Optimal Stop
7. Night Setback Control
8. Peak Demand Limiting
9. Temperature Compensated Duty Cycling
10. CFM Tracking
11. Heating/Cooling Interlock

Z. History Logging:

1. Each NSC controller shall be capable of LOCALLY logging any input, output, calculated value or other system variable either over user defined time intervals ranging from 1 second to 1,440 minutes or based upon a user configurable change of value. A minimum of 1,000 logs, with a minimum of 100,000 records, shall be stored. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logged data shall be downloadable to a higher level NSC long term archiving based upon user-defined time intervals, or manual command.
2. For extended trend logging a minimum of 1,500 trends shall be capable, with a minimum number of 600,000 records within.
3. Management of a power meter replacement to ensure meter log data is accurate shall be possible in the NSC.
4. Every hardware input and output point, hosted within the NSC and attached I/O modules, shall be trended automatically without the requirement for manual creation, and each of these logs shall log values based upon a change of value and store at least 500 trend samples before replacing the oldest sample with new data.
5. The presentation of logged data shall be built into the server capabilities of the NSC. Presentation can be in time stamped list formats or in a chart format with fully configurable pen colors, weights, scales and time spans.
6. Tooltips shall be present, magnetic, and visible based on users preference.
7. Comments shall be visible whenever viewing the trend log list.
8. System shall give indication of memory usage and be able to alert the user if too many logs are allocated.

AA. Alarm Management:

1. For each system point, alarms can be created based on high/low limits or in comparison to other point values. All alarms will be tested each scan of the NSC and can result in the display of one or more alarm messages or reports.
2. There is no limit to the number of alarms that can be created for any point
3. Alarms can be configured to be generated based upon a single system condition or multiple system conditions.
4. Alarms will be generated based on an evaluation of the alarm conditions and can be presented to the user in a fully configurable order, by priority, by time, by category, etc. These configurable alarm views will be presented to a user

upon logging into the system regardless of whether the log in takes place at a WorkStation or a Webstation.

5. The alarm management system shall support the ability to create and select cause and action notes to be selected and associated with an alarm event. Checklists shall also be possible in order to present to an operator a suggested mode of troubleshooting. When acknowledging an alarm, it shall be possible to assign it to a user of the system such that the user is notified of the assignment and is made responsible for the alarm resolution.
6. Alarms shall be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.

BB. Embedded Web Server

1. Each NSC shall have the ability to serve out web pages containing the same information that is available from the WorkStation. The development of the screens to accomplish shall not require any additional engineering labor over that required to show them at the WorkStation itself.
2. The NSC shall be configurable to logging all Embedded Web Server access attempts
3. The NSC shall have the option to redirect HTTP based Embedded Web Server connections to secure, HTTPS connections.
4. The NSC shall authenticate and authorize all users connecting to the Embedded Web Server
5. The NSC shall provide to ability to configure an automatic logoff for Embedded Web Server users that have not had any activity for an adjustable time period.

2.12 BACNET IP FIELDBUS CONTROLLERS

A. Controllers – BACnet/IP Protocol

1. All BACnet/IP Fieldbus controllers shall be BACnet Testing Laboratory listed (v12 or later) as specified BACnet Advanced Application Controller (B-AAC)
2. All BACnet/IP Fieldbus controllers shall use the following communication specifications and achieve performance as specified herein:
 - a. All controllers shall be able to communicate peer-to-peer without the need for a NSC
 - b. Any BACnet/IP Fieldbus controllers on the Ethernet Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.

B. The BACnet/IP Fieldbus controllers shall be equipped with 2x 10/100bT Ethernet communication ports with active switch and will support BACnet/IP communication protocols with the following configurations:

1. Supporting IPv4 addressing
2. Supporting Static IP setting, DHCP client and Auto-IP address acquisition
3. It shall be possible to disable Ethernet port 2

C. Topologies

1. BACnet/IP Fieldbus controllers shall support daisy chain topology of up to 50 controllers. In case of any disruption to the communication, a system alarm shall notify the NSC/HMCS of the point disruption has occurred.
2. BACnet/IP Fieldbus Controllers shall support RSTP loop whereby up to 39 controllers are supported.
 - a. In case of any disruption there shall be no communication interruption
 - b. In case of any disruption there shall be system alarms that will inform the operator of the disruption

D. Performance

1. Each BACnet/IP Fieldbus Controllers shall have a 32-bit microprocessor operating at 500 MHz and support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135 and the BACnet Device Profile supported.
2. They shall be multi-tasking, real-time digital control processors consisting of communication controllers, controls processing, power supplies with built-in inputs and outputs.

E. Programmability

1. The BACnet/IP Fieldbus controllers shall support both script programming language and graphical that will be consistent with the NSC.
2. The control program will reside within the same enclosure as the input/output circuitry, that reads inputs and controls outputs
3. All control sequences programmed into the BACnet/IP Fieldbus Controllers shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
4. BACnet/IP Fieldbus controllers shall communicate with the Network Server Controller (NSC) via a BACnet/IP connection at a baud rate of not less than 100 Mbps
5. BACnet/IP Fieldbus controllers shall support a dedicated communications port for connecting and supplying power to a matching room temperature and/or humidity sensor and/or CO2 and/or presence detector that does not utilize any of the I/O points of the controller.
6. BACnet/IP Fieldbus controllers (Excluding VAV) shall support an add-on display to supply and provide access in real-time for monitoring inputs and overriding of outputs
7. The override functionality shall be supported by a dedicated processor to assure reliable operation (overriding of output)
8. Each BACnet/IP Fieldbus controller shall have sufficient memory, to support its own operating system and databases, including:
 - a. Control processes
 - b. Energy management applications
 - c. Alarm management
 - d. Historical/trend data
 - e. Maintenance support applications
 - f. Custom processes

- g. Manual override monitoring
- 9. Each BACnet/IP Fieldbus controller shall support local trend data up to 2x the built-in I/O and at a minimum be capable of holding 5 days @ 15 min intervals locally.
- 10. The BACnet/IP Fieldbus controller analog or universal input shall use a 16 bit A/D converter.
- 11. The BACnet/IP Fieldbus controller analog or universal output shall use a 10 bit D/A converter.
- 12. Built-in I/O: each BACnet/IP Fieldbus controllers shall support:
 - a. At minimum 8 and up to 20 configurable IO channels to monitor and to control the following types of inputs and outputs without the addition of equipment inside or outside the DDC Controller cabinet.
 - 1) Universal Inputs – the following thermistors for use in the system without any external converters needed.
 - a) 10 kohm Type I (Continuum)
 - b) 10 kohm Type II (I/NET)
 - c) 10 kohm Type III (Satchwell)
 - d) 10 kohm Type IV (FD)
 - e) Linearized 10 kohm Type V (FD w/11k shunt)
 - f) Linearized 10 kohm (Satchwell)
 - g) 1.8 kohm (Xenta)
 - h) 1 kohm (Balco)
 - i) 20 kohm (Honeywell)
 - j) 2.2 kohm (Johnson)
 - k) PT100 (Siemens)
 - l) PT1000 (Sauter)
 - m) Ni1000 (Danfoss)
 - 2) Analog inputs
 - a) Current Input - 0-20 mA
 - b) Voltage Input 0-10 Vdc
 - 3) Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
 - 4) Digital outputs
 - 5) Analog outputs of 4-20 mA and/or 0-10 Vdc
- 13. Real Time Clock (RTC):
 - a. Each BACnet/IP Fieldbus controller shall include a real time clock, accurate to +/-1 minute per month. The RTC shall provide the following: time of day, day, month, year, and day of week.
 - b. The RTC date and time shall also be accurate, up to 7 days, when the BACnet/IP Fieldbus controller is powerless.
 - c. No batteries may be used to for the backup of the RTC.
- 14. The BACnet/IP Fieldbus controller for Variable Air Volume (VAV) applications
 - a. The BACnet/IP Fieldbus controller for VAV applications shall include a built-in 'flow thru' differential pressure transducer

- b. The VAV differential pressure transducer shall have a measurement range of 0 to 1 in. W.C. and measurement accuracy of $\pm 5\%$ at 0.001 to 1 in. W.C. and a minimum resolution of 0.001 in. W.C., insuring primary air flow conditions shall be controlled and maintained to within $\pm 5\%$ of setpoint at the specified minimum and maximum air flow parameters
 - c. The BACnet/IP Fieldbus controller for VAV applications shall support a dedicated commissioning tool for air flow balancing
 - d. The BACnet/IP Fieldbus controller for VAV applications shall require no programming for air balancing algorithm
 - e. All balancing parameters shall be synchronized in NSC
 - 15. Each BACnet/IP Fieldbus controller shall have a minimum of 10% spare capacity for each point type represented on the controller for future point connection
 - 16. Power Requirements.: 24VDC (21 to 33 VDC) and 24 VAC $\pm 20\%$ with local transformer power
- F. Commissioning Tool - The BACnet/IP Fieldbus controller shall be supported via a dedicate mobile based commissioning tool for configuration, programming, air balancing and I/O checkout
- 1. The Commissioning Tool shall be supported across: iOS, Android and Windows 10 platforms
 - 2. The Commissioning Tool shall be available for download on App Store, Google Store and Windows Store
 - 3. Commissioning Tool Interface to BACnet/IP Fieldbus controllers shall be via a Bluetooth adapter interface through the Intelligent Space Sensor or via a Wi-Fi access point on the LAN
 - 4. Functionality
 - a. Device Configuration – the Commissioning Tool shall be able to set or edit all Network configurations associated with the BACnet/IP Fieldbus controller
 - b. Programming – The Commissioning Tool shall be able to load offline engineered applications directly in to the controller directly
 - c. Air Balancing
 - 1) The Commissioning Tool shall allow the air balancer to manually control the action of the actuator including the following function: open VAV damper, close VAV damper, open all VAV dampers, and close all VAV dampers.
 - 2) The Commissioning Tool shall be able to generate Air Balancing report
 - d. IO Checkout
 - 1) The Commissioning Tool shall be able to support overriding of the outputs and reading value of inputs live
 - 2) The Commissioning Tool shall be able to support generation of I/O checkout report
 - e. There shall be no limit to the number of Commissioning Tools that can be used on a network segment, however, one connection per controller is recommended

- G. Intelligent Space Sensors - The BACnet/IP Fieldbus controller shall support a dedicated RJ45 communication port to communicate and power up to 4 intelligent wall mount sensors without the use of on board inputs or outputs
1. The Intelligent Space Sensor shall communicate with the BACnet/IP Fieldbus controller through the sensor port and via category 5 or category 6 cable
 2. The Intelligent Space Sensor shall provide 2 RJ45 communication ports that will allow communication with parent BACnet/IP Field controller upstream and additional Intelligent Space Sensors downstream
 3. The Intelligent Space Sensor shall provide ambient space condition sensing without the use of hardware I/O
- H. Each Intelligent Space Sensor shall provide a color touch display with:
1. Minimum 2.4" x 2.4" display
 2. Backlit
- I. The Intelligent Space Sensor shall be capable of displaying measured space temperature from 32 to 122 °F with accuracy of ± 0.4 °F selectable for 0.1 or 1 degree display resolution of °F
1. Sensing Element: 10k Type 3 Thermistor
 2. Accuracy of ± 0.4 °F
 3. Resolution: 0.1 or 1 degree display resolution
 4. Range: 32 to 122 °F
- J. The Intelligent Space Sensor shall have the option for humidity sensor support sensing humidity from 0 % RH to 100 % RH Digital humidity indication (selectable for 0.1 or 1% RH with selectable display resolution of 0.1 or 1 % RH
1. Accuracy: ± 2 % RH
 2. Resolution: 0.1 or 1 % RH
 3. Range: 0 % RH to 100 % RH
- K. The Intelligent Space Sensor shall have the option for support of CO2 sensor with display resolution with 0 to 2000 ppm resolution
1. Accuracy: ± 30 ppm $\pm 2\%$ of measured value
 2. Range: 0 to 2,000 ppm
 3. Operating elevation: 0 to 16,000 ft.
 4. Temperature dependence: 0.11% FS per °F
 5. Stability: $< 2\%$ of FS over life of sensor (15 years)
 6. Sensing method: Non-dispersive infrared (NDIR), diffusion sampling
- L. The Intelligent Space Sensor shall have the option for motion sensor
- M. Display options: The Intelligent Space Sensor shall be capable of displaying the following elements:
1. Space temperature
 2. Cooling space temperature set point
 3. Heating space temperature set point
 4. Current heating or cooling mode

5. Current occupancy mode
6. Fan speed
7. Current time

2.13 SENSORS (INDUSTRIAL PROCESS AREAS)

- A. Provide sensors and instrumentation required to provide the Sequence of Operations described under Part 3, constructed and rated for the location in which they are installed.
- B. Not all sensors and control devices required to provide the sequence of operations are explicitly described in this Article but shall be provided to meet the functional requirements of the Work.
- C. Sensors and control devices specified below shall be used in both electrically classified and electrically non-classified areas. NEMA 4X rated control devices maybe used in non-classified areas provided they have similar rugged industrial construction to those devices specified herein.
- D. Provide rugged industrial grade sensors and transmitters from one of the following manufacturers:
 1. Dwyer Instruments.
 2. Foxboro.
 3. Rosemont.
 4. Or Equal
- E. Temperature Transmitter
 1. Temperature Sensor: Pt1000, 0.00385 DIN.
 2. Output Temperature Ranges: User selectable - any range between -30 to 250°F with a minimum span of 40°F.
 3. Temperature Limits: Ambient: 0 to 158°F (-18 to 70°C); Process: -30 to 250°F (-34.4 to 121.1°C).
 4. Accuracy: Transmitter: $\pm 0.1\%$ F.S.; Probe: $\pm 0.3\%$ F.S.
 5. Thermal Drift Effects: $\pm 0.02\%/^{\circ}\text{C}$ max.
 6. Response Time: 250 ms.
 7. Wetted Materials: 316 Stainless Steel.
 8. Process Connection: 1/2" male NPT.
 9. Conduit Connection: 1/2" female NPT.
 10. Probe Length: 2" to 18" (as required to suit application).
 11. Pressure Limits: 2000 psi (137.9 bar).
 12. Power Requirements: 10 to 35 VDC.
 13. Output Signal: 4-20 mA (two wire loop powered).
 14. Display: 2 Lines X 8 Character LCD.
 15. Enclosure Rating: Weatherproof and Explosion-proof for Class I, Groups B, C, D; Class II, Groups E, F, G; Class III.
 16. Weight: 2 lb 8 oz (1134 g).
 17. Agency Approvals: FM, CE.

18. Mounting Bracket: Type 316 SS.
19. Dwyer Series TTE, or approved equal.

F. Humidity Transmitter

1. Relative Humidity Range: 0 to 100% RH.
2. Temperature Range: -40 to 140°F (-40 to 60°C).
3. Accuracy: $\pm 2\%$ 10-90% RH, $\pm 0.9^\circ\text{F}$ at 72°F ($\pm 0.3^\circ\text{C}$ at 25°C).
4. Hysteresis: $\pm 1\%$.
5. Repeatability: $\pm 0.1\%$ typical.
6. Temperature Limits: -40 to 140°F (-40 to 60°C).
7. Storage Temperature: -40 to 176°F (-40 to 80°C).
8. Compensated Temperature: -40 to 140°F (-40 to 60°C).
9. Power Requirements: For intrinsically safe models HHT-IX, 9.5 to 28 VDC. For explosion-proof models HHT-EX, 16.5 to 28 VDC.
10. Output Signal: 4-20 mA, 2 channels for humidity/temperature models (loop power on RH).
11. Response Time: 15 seconds.
12. Electrical Connections: Screw terminal block.
13. Conduit Connection: 1/2" female NPT.
14. Drift: $<1\%$ RH/year.
15. RH Sensor: Capacitance polymer.
16. Temperature Sensor: Solid state band gap.
17. Housing Material: Aluminum.
18. Display: 2 line alpha numeric, 8 characters/line. Temperature display is $^\circ\text{F}/^\circ\text{C}$ selectable.
19. Display Resolution: RH: 0.1%: Temperature 0.1°F (0.1°C).
20. Weight: 2 lb 8 oz (1134 g).
21. Enclosure Rating: NEMA 4X (IP66). Models HHT-EX: FM Explosion-proof, Class I Div. 1 Group B, C, D, Class II Div. 1 Group E, F, G, Class III Div. 1; Models HHT-IX: FM Intrinsically Safe, Class I Div. 1 Group A, B, C, D, Class II Div. 1 Group E, F, G, Class III Div. 1 T4.
22. Agency Approvals: FM, CE.
23. Mounting Bracket: Type 316 SS.
24. Dwyer Series HHT or approved equal.

G. Differential Pressure Transmitter

1. Service: Compatible gases, steam, liquids or vapors.
2. Wetted Materials: 316L SS.
3. Accuracy: $\pm 0.075\%$ FS (@ 20°C).
4. Rangeability: 100:1 turn down.
5. Stability: $\pm 0.125\%$ FSO/yr.
6. Temperature Limits: Process: -40 to 248°F (-40 to 120°C); Ambient (without LCD): -40 to 185°F (-40 to 85°C); Ambient (with LCD): -22 to 176°F (-30 to 80°C).
7. Pressure Limits: Max. pressure: Range: -14.5 to 2000 psi; Burst pressure: 10000 psi.
8. Thermal Effect: $\pm 0.125\%$ span/32°C.

9. Power Requirements: 11.9 to 45 VDC.
10. Output Signal: 4 to 20 mA/HART® Communication.
11. Response Time: 0.12 seconds.
12. Damping Time: 0.25-60 seconds.
13. Loop Resistance: Operation: 0 to 1500 Ohm; HART® Communication: 250 to 500 Ohm.
14. Electrical Connection: Two 1/2" female NPT conduit, screw terminal.
15. Process Connection: 1/4" female NPT.
16. Display: Optional 5 digit LCD.
17. Enclosure Rating: NEMA 4X (IP66) and explosion-proof for Class I, Div I, Groups A, B, C and D.
18. Weight: 8.6 lb (3.9 kg).
19. Agency Approvals: CE, FM, ATEX.
20. Mounting Bracket: Type 316 SS.
21. Dwyer Series 3100D or approved equal.

H. Vane Operated Air Flow Switch

1. Service: Gases or liquids compatible with wetted materials.
2. Wetted Materials: Vane: 316 SS; Body: 316 SS standard; Magnet Keeper: 316 SS optional.
3. Temperature Limit: -4 to 275°F (-20 to 135°C) standard.
4. Pressure Limit: 316 SS body 2000 psig (138 bar).
5. Enclosure Rating: Weatherproof [meets NEMA 4 (IP65)] and Explosion-proof. Listed with UL and CSA for Class I, Groups C and D; Class II, Groups E, F, and G. ATEX CE 0344 EX II 2 G EEx d IIB T6 -20°C≤T_{amb}≤75°C, EC-Type Certificate No.: KEMA 03ATEX 2383. SAA: Exd C T6 (T_{amb}=60°C), Zone I. Also FM approved.
6. Switch Type: SPDT snap switch or DPDT as required for application.
7. Electrical Rating: UL, FM ATEX and SAA models 10A @ 125/250 VAC. CSA models: 5A @ 125/250 VAC; 5A res., 3A ind. @ 30 VDC.
8. Electrical Connections: UL and CSA models: 16 AWG, 6" (152 mm) long. ATEX and SAA unit: Terminal block.
9. Conduit Connection: 3/4" female NPT.
10. Process Connection: 1-1/2" male NPT.
11. Mounting Orientation: Within 5° of vertical for proper operation as standard or horizontal installation available.
12. Set Point Adjustment: For universal vane: five vane combinations.
13. Weight: 4 lb 8 oz (1.9 kg).
14. Agency Approvals: UL, CSA, CE, FM, SAA and ATEX.
15. Mounting Bracket: Type 316 SS.
16. Dwyer Series V4 or approved equal.

I. Thermal Dispersion Air Flow Switch

1. Service: Gases or liquids compatible with wetted materials.
2. Accuracy: +/- 10% of setpoint.
3. Repeatability: +/- 1% of setpoint.
4. Power Supply: 85 to 240 Vac or 24 Vdc

5. Wetted Materials: 316 SS.
6. Temperature Limit (Process): -4 to 176°F.
7. Pressure Limit: 4,351 psi.
8. Enclosure Rating: NEMA 4 (IP65).
9. Enclosure Materials: Glass filled nylon. Aluminum die cast optional.
10. Switch Type: 250 Vac SPDT 5 amp.
11. Switch Point Adjustment: Potentiometer.
12. Bargraph:
 - a. Green LED: Flow rate above setpoint.
 - b. Yellow LED: Flow is at setpoint.
 - c. Red LED: Flow is below setpoint.
13. Switch Point Status:
 - a. Red LED: No flow.
 - b. Green LED: Flow.
14. Switching Range:
 - a. Liquid: 0.09 to 9.84 ft/sec.
 - b. Air: 0.16 to 49 ft/sec.
15. Conduit Connection: 3/4" NPT.
16. Weight: 1.5 Lbs.
17. Omega FSW-6000/7000 Series or approved equal.

2.14 SENSORS (COMMERCIAL AREAS)

- A. Provide sensors and instrumentation required to provide the Sequence of Operations described under Part 3, constructed and rated for the location in which they are installed.
- B. Not all sensors and control devices required to provide the sequence of operations are explicitly described in this Article but shall be provided to meet the functional requirements of the Work.
- C. Temperature Sensors
 1. General:
 - a. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of -30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.
 2. Room Sensor:
 - a. Acceptable Manufacturers:
 - 1) Veris Industries TW Series.
 - 2) ACI Room Series or TUC2.
 - 3) Or Equal.
 - b. Standard space sensors shall be available in an [off white][black] enclosure made of ABS plastic for mounting on a standard electrical box.
 - 1) Where manual overrides are required, the sensor housing shall feature both an optional sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.

- 2) Where a local display is specified, the sensor shall incorporate an LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons, operators shall be able to adjust setpoints directly from the sensor.
3. Duct Probe Sensor
 - a. Acceptable Manufacturers:
 - 1) Veris Industries TD/TF/TG Series.
 - 2) ACI Duct or Duct Without Box Series.
 - 3) Or Equal.
 - b. Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Useable in air handling applications where the coil or duct area is less than 14 square feet.
4. Duct Averaging Sensor
 - a. Acceptable Manufacturers:
 - 1) Veris Industries TA Series.
 - 2) ACI Copper Averaging Series.
 - 3) Or Equal.
 - b. Averaging sensors shall be employed in ducts which are larger than 14 square feet. The averaging sensor tube shall contain at least one thermistor for every 3 feet, with a minimum tube length of 6 feet. The averaging sensor shall be constructed of rigid or flexible copper tubing.
5. Pipe Immersion Sensor
 - a. Acceptable Manufacturers:
 - 1) Veris Industries TI Series.
 - 2) ACI Immersion Series.
 - 3) Or Equal.
 - b. Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Provide sensor probe length suitable for application. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel for non-corrosive fluids below 250 degrees F and 300 series stainless steel for all other applications.
6. Outside Air Sensor
 - a. Acceptable Manufacturers:
 - 1) Veris Industries TO Series.
 - 2) ACI Outdoor Series.
 - 3) Or Equal.
 - b. Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure. Operating range -40 to 122 F.

D. Humidity Wall Transmitter

1. Acceptable Manufacturers:
 - a. Veris Industries HW2 Series.
 - b. ACI A/RH2 or TUCH2 Series.
 - c. Or Equal.

2. Transmitters shall be accurate to $\pm 2\%$ at full scale.
3. Transmitter shall have replaceable sensing element.
4. Sensor type shall be thin-film capacitive.
5. Sensor shall have single point field calibration.
6. Operating range shall be 0 - 95% RH noncondensing, 35 to 122 F.
7. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC.
8. Transmitter shall accept 20-30 VDC or 24 VAC supply power.
9. Transmitter shall be available in an off white enclosure made of ABS plastic for mounting on a standard electrical box.
10. Where a local display is specified, transmitter shall be provided with an LCD display.
11. Transmitter shall have option of being NIST certified.
12. Transmitter shall have option of an integrated temperature sensor.

E. Humidity Duct Transmitter

1. Acceptable Manufacturers:
 - a. Veris Industries HD Series.
 - b. ACI A/RH2 Series.
 - c. Or Equal.
2. Transmitters shall be accurate to $\pm 2\%$ at full scale.
3. Sensor type shall be thin-film capacitive.
4. Sensor shall have a single point calibration.
5. Operating range shall be 0 - 95% RH noncondensing, -40 to 122 F.
6. Output shall be 4-20 mA or 0-5/0-10 VDC.
7. Transmitter shall accept 20-30 VDC or 24 VAC supply power.
8. Transmitter shall have option of being NIST certified.
9. Transmitter shall have option of an integrated temperature sensor.

F. Humidity Outdoor Transmitter

1. Acceptable Manufacturers:
 - a. Veris Industries HO Series.
 - b. ACI A/RH2 Series.
 - c. Or Equal.
2. Transmitters shall be accurate to $\pm 2\%$ at full scale.
3. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure.
4. Sensor type shall be thin-film capacitive.
5. Sensor shall have a single point calibration.
6. Operating range shall be 0 - 95% RH noncondensing, -40 to 122 F.
7. Output shall be 4-20 mA or 0-5/0-10 VDC.
8. Transmitter shall accept 20-30 VDC or 24 VAC supply power.
9. Transmitter shall have option of being NIST certified.
10. Transmitter shall have option of an integrated temperature sensor.

G. Air Pressure Transmitters.

1. Acceptable Manufacturers:
 - a. Veris Industries PXU or PX3 Series.

- b. ACI A/DLP Series.
- c. Or Equal.
- 2. Sensor shall be microprocessor profiled ceramic capacitive or piezoresistive silicon sensing element.
- 3. Transmitter shall have 8 selectable ranges from 0.1 – 10” WC or 0.1-1.0” WC or 1.0-10” WC.
- 4. Transmitter shall be +/- 1% accurate in each selected range including linearity, repeatability, hysteresis, stability, and temperature compensation.
- 5. Transmitter shall be field configurable to mount on wall or duct with static probe.
- 6. Transmitter shall be field selectable for Unidirectional or Bidirectional.
- 7. Maximum operating pressure shall be 200% of design pressure.
- 8. Outputs shall be field selectable 4-20 mA or 0-5/0-10 VDC linear.
- 9. Transmitter shall accept 16-30 VDC or 24 VAC supply power.
- 10. Response time shall be minimum of 4 seconds.
- 11. Where a local display is specified, transmitter shall be provided with LCD display.
- 12. Units shall be field selectable for WC or PA.
- 13. Transmitter shall have provision for zeroing by pushbutton or digital input.
- 14. Transmitter shall be available with a certification of NIST calibration.

H. Liquid Differential Pressure Transmitters:

- 1. Acceptable Manufacturers:
 - a. Veris Industries PW or PWR Series.
 - b. ACI WPR2 Series.
 - c. Or Equal.
- 2. Transmitter shall be microprocessor based.
- 3. Transmitter shall use two independent gauges or remote pressure sensors to measure and calculate differential pressure.
- 4. Transmitter shall have 4 switch selectable ranges.
- 5. Transmitter shall have provision for zeroing by pushbutton or digital input.
- 6. Transmitter shall have field selectable outputs of 0-5V, 0-10V, and 4-20mA.
- 7. Transmitter shall accept 18-30 VDC or 24 VAC supply power.
- 8. Sensor shall be 17-4 PH or 304 stainless steel where it contacts the working fluid.
- 9. Performance:
 - a. Accuracy shall be $\pm 1\%$ F.S. and $\pm 2\%$ F.S. for lowest selectable range.
 - b. Long term stability shall be $\pm 0.25\%$.
 - c. Sensor temperature operating range shall be -4° to 185°F .
 - d. Operating environment shall be 32° to 122°F ; 10-90% RH noncondensing.
 - e. Proof pressure shall be 2x max. F.S. range.
 - f. Burst pressure shall be 5x max. F.S. range.
- 10. Transmitter shall be encased in a NEMA 4 enclosure.

I. Current Sensors

- 1. Acceptable Manufacturers:

- a. Veris Industries H921 Series.
 - b. ACI SCTA Series.
 - c. Or Equal.
 - 2. Current status sensors shall be used to monitor fans, pumps, motors and electrical loads. Current sensors shall be available in split core models with analog signal to the automation system.
 - 3. Loop powered.
 - 4. Three adjustable ranges with a full scale output of 20 mA.
 - 5. Accuracy to be +/- 2.0% of the reading over a temperature range of 5 to 104°F.
 - 6. Isolated to 600 VAC RMS.
- J. Current Status Switches for Constant Load Devices
- 1. Acceptable Manufacturers:
 - a. Veris Industries H608 Series.
 - b. ACI MSCS Series.
 - c. Or Equal.
 - 2. General: Factory programmed current sensor to detect motor undercurrent situations such as belt or coupling loss on constant loads.
 - 3. Visual LED indicator for status.
 - 4. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 0.5 A to 175 A.
 - 5. Normally open current sensor output. 0.1A at 30 VAC/DC.
- K. Current Status Switches for Constant Load Devices (Auto Calibration)
- 1. Acceptable Manufacturers:
 - a. Veris Industries H11D Series.
 - b. Or Equal.
 - 2. General: Microprocessor based, self-learning, self-calibrating current switch. Calibration-free status for both under and overcurrent, LCD display, and slide-switch selectable trip point limits. At initial power-up automatically learns average current on the line with no action required by the installer.
 - 3. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 2.5 A to 200 A.
 - 4. Display: Backlit LCD; illuminates when monitored current exceeds 4.5A.
 - 5. Nominal Trip Point: ±40%, ±60%, or on/off (user selectable).
 - 6. Normally open current sensor output. 0.1A at 30 VAC/DC.
- L. Current Status Switches for Variable Frequency Drive Application
- 1. Acceptable Manufacturers:
 - a. Veris Industries H614 Series.
 - b. Or Equal.
 - 2. General: Microprocessor controlled, self-learning, self-calibrating current sensor to detect motor undercurrent and overcurrent situations such as belt loss, coupling shear, and mechanical failure on variable loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory and relearn.
 - 3. Visual LED indicator for status.

2.15 AIR FLOW STATIONS

A. Airflow Measurement Devices (AMD) with Temperature Output and Airflow Alarming Capability:

1. General
 - a. Provide one AMD for each measurement location to determine the average airflow rate and temperature at each measurement location.
 - b. Each AMD shall be provided with a microprocessor-based transmitter and one or more sensor probes.
 - 1) Devices that have electronic signal processing components on or in the sensor probe are not acceptable.
 - c. Airflow measurement shall be field configurable to determine the average Actual or Standard mass airflow rate.
 - 1) Actual airflow rate calculations shall have the capability of being corrected by the transmitter for altitudes other than sea level.
 - d. Temperature measurement shall be field configurable with velocity weighted average as the default, or manual selection of arithmetic average temperature.
2. Sensor Probes
 - a. Sensor probes and mounting brackets shall be constructed of 316 stainless steel.
 - b. Probe internal wiring between the connecting cable and sensor nodes shall be Kynar coated copper.
 - 1) PVC jacketed internal wiring is not acceptable.
 - c. Probe internal wiring connections shall consist of solder joints and spot welds.
 - 1) Internal wiring connections shall be sealed and protected from the elements. They shall be capable of direct exposure to water without affecting instrument operation.
 - 2) Connectors of any type within the probe are not acceptable.
 - 3) Printed circuit boards within the probe are not acceptable.
 - d. Each sensor probe shall be provided with an integral, FEP jacket, plenum rated CMP/CL2P, UL/cUL Listed cable rated for exposures from -67° F to 392° F and continuous and direct UV exposure.
 - 1) Plenum rated PVC jacket cables are not acceptable.
 - e. Each sensor probe cable shall be provided with a connector plug with gold plated pins for connection to the transmitter.
 - f. Each sensor probe shall contain one or more independently wired sensing nodes.
 - g. Sensor node airflow and temperature calibration data shall be stored in a serial memory chip in the cable connecting plug and not require matching or adjustments to the transmitter in the field.
 - h. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy with sensor housings constructed of glass-filled polypropylene. Upon request, the manufacture shall provide a written independent laboratory test result of 100% survival rate in a 30 day saltwater and acid vapor test.

- 1) Devices that use epoxy or glass encapsulated chip thermistors are not acceptable.
- 2) Devices with exposed leads are not acceptable.
- i. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.
- j. Each sensor node shall be individually calibrated at 16 measurement points to airflow standards directly calibrated at NIST to the NIST Laser Doppler Anemometer (LDA) primary velocity standard and have an accuracy of $\pm 2\%$ of reading over the entire calibrated airflow range of 0 to 5,000 FPM.
 - 1) Upon request the manufacture shall submit for AMD approval a copy of the NIST report of calibration used for the reference standard used.
 - a) Devices claiming NIST traceability to third party laboratories and not directly to NIST are not acceptable
 - b) Devices calibrated against standards other than the NIST LDA are not acceptable.
- k. Accuracy shall include the combined uncertainty of the sensor nodes and transmitter.
- l. The installed airflow accuracy shall be:
 - 1) Ducts - $\pm 3\%$ of reading when installed in accordance with the manufactures recommended placement guidelines.
 - 2) Non-ducted Outdoor Air intakes – better than or equal to $\pm 5\%$ of reading when installed in accordance with the manufactures recommended placement guidelines.
- m. Devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter shall demonstrate compliance with this requirement over the entire operating range.
- n. Each sensing node shall have a temperature accuracy of $\pm 0.15^\circ \text{F}$ over an operating range of -20°F to 160°F and humidity range of 0 to 100% RH.
- o. The number of independent sensor nodes provided shall be as follows:

<u>Area ft²</u>	<u># Sensor Nodes</u>
≤ 0.5	1
$> 0.5 \text{ \& } \leq 1$	2
$> 1 \text{ \& } \leq 2$	4
$> 2 \text{ \& } \leq 4$	6
$> 4 \text{ \& } \leq 8$	8
$> 8 \text{ \& } \leq 12$	12
$> 12 \text{ \& } \leq 14$	14
> 14	16

- 1) A total of 4 probes shall be required for openings with an aspect ratio ≤ 1.5 and with an area $\geq 25 \text{ ft}^2$.
3. Transmitter

- a. A remotely located microprocessor-based transmitter shall be provided for each measurement location.
- b. The transmitter shall be comprised of a main circuit board and interchangeable interface card.
- c. All printed circuit board interconnects, edge fingers, receptacle plug pins and PCB test points shall be gold plated.
- d. All printed circuit boards shall be electroless nickel immersion gold (ENIG) plated.
- e. All integrated circuitry shall be temperature rated as 'industrial-grade'. Submissions containing 'commercial-grade' integrated circuitry are not acceptable.
- f. The transmitter shall be capable of determining the airflow rate and temperature average of all connected sensor nodes in an array for a single location.
 - 1) Separate integration buffers shall be provided for display airflow output, airflow signal output (analog and network) and individual sensor output (IR-interface).
- g. The transmitter shall be capable of providing a high and/or low airflow alarm with user-defined set point and % of set point tolerance. Alarm shall be capable of being manually or automatically reset and low-limit cutoff value may be selected to disable the alarm. An alarm delay function shall also be field defined.
- h. The transmitter shall be capable of identifying an AMD malfunction via the system status alarm and ignore any sensor node that is in a fault condition.
- i. The transmitter shall be capable of field configuration, diagnostics and include Field Output Adjustment Wizard that allows for a one or two point field adjustment to factory calibration for installations that require adjustment.
- j. The transmitter shall be provided with a 16-character, alpha-numeric, LCD display.
- k. The transmitter shall be provided with two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals (AO1=airflow, AO2=temperature or alarm), in combination with the following:
 - 1) One of the two options shall be selected by the CONTRACTOR and coordinated with the HMCS.
 - a) one isolated RS-485 (field selectable BACnet MS/TP or Modbus RTU) network connection, or
 - b) one isolated Ethernet (simultaneously supported BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) network connection.
- l. The analog signal capability shall include two output terminals: the first (AO1), shall provide the total airflow rate and the second output (AO2) shall be field configurable to provide one of the following:
 - 1) temperature

- 2) low and/or high airflow user-defined set point alarm, or
- 3) system status alarm
- m. The transmitter shall also be available with a single isolated LonWorks Free Topology network interface. Transmitters shall be available alternatively with one USB connection for thumb-drive data logging of sensor data. Neither of these options shall include analog output signals.
- n. The network communications shall provide: the average airflow rate, temperature, hi and/or low airflow set point alarm, system status alarm, individual sensor node airflow rates and individual sensor node temperatures.
- o. The transmitter shall have an on-off power switch. Isolation transformers shall not be required.
- p. The transmitter shall be powered by 24 VAC (22.8 to 26.4 under load) @20 V-A maximum and use a switching power supply that is over-current and over-voltage protected.
- q. The transmitter shall use a “watchdog” timer circuit to ensure automatic reset after power disruption, transients and brown-outs.
- r. Each transmitter shall have an operating temperature range of -20° F to 120° F and humidity range of 5 to 95% RH.
- 4. Listings and Certifications
 - a. The AMD shall be UL/cUL 873 Listed as an assembly.
 - 1) Devices claiming compliance with the UL Listing based on individual UL component listing are not acceptable.
 - b. All network-capable AMD models supplied with RS-485 interface and BACnet protocol shall be BTL Listed.
 - c. The AMD shall be tested for compliance with the EMC Directive’s requirements and be certified to carry the CE Mark for European Union Shipments.

B. Manufacturers: Provide products of one of the following:

- 1. Ebtron Inc.
- 2. Or equal.

2.16 DAMPER ACTUATORS

- A. Type: Electric, Direct Coupled (over the shaft):
 - 1. Proportional and two position as indicated in the Sequence of Operations.
 - 2. Spring return where specified.
 - 3. V-bolt and V-shaped cradle shaft attachment.
 - 4. Electronic overload or digital rotation sensing circuitry to prevent damage to actuator throughout the rotation of actuator.
 - 5. Spring return actuators shall be capable of either clockwise or counterclockwise spring return operation by changing mounting orientation.
 - 6. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mADC control input and provide a 2 to 10 VDC or 4 to 20 mADC operating range. Proportional control through a pulse width modulating signal is acceptable. Proportional control through floating (Tri-state) control is not acceptable.

Actuators shall be capable of providing 2 to 10 VDC position feedback signals.

7. 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 watts for DC applications. Actuators operating on 120 VAC power shall not require more than 10 VA.
8. Modulating actuators shall have an external, built in switch to allow the reversing of direction of rotation.
9. External manual gear release with manual crank to allow manual positioning of shaft.
10. Factory-mounted electrical cable and conduit fitting for connection to junction box.
11. Conforming to UL 873.
12. Actuator shall be provided with sufficient torque to open and close the device. Provide a minimum torque of 133-in-lb.
13. 120VAC or 24VDC.
14. NEMA Type 2 housing.
15. Accessories:
 - a. Linkage kit.
 - b. Mounting bracket.
 - c. Auxiliary switches.
 - d. NEMA Type 4X enclosure in all corrosive atmospheres.
 - e. NFPA Class 1, Division 1, enclosure where located in Class 1, Division 1 areas.
16. Manufacturers: Provide products of one of the following:
 - a. Belimo.
 - b. Schneider Electric
 - c. Or equal.

2.17 PANELS AND ENCLOSURES

A. General Construction Requirements

1. CONTRACTOR shall provide all electrical components and devices, support hardware, fasteners, and interconnecting wiring required to make the control panels and/or enclosures complete and operational.
2. CONTRACTOR shall locate and install all devices and components so that connections can be easily made and that there is ample room for servicing each item.
3. Components for installation on panel exterior shall be submitted for approval.
4. CONTRACTOR shall adequately support and restrain all devices and components mounted on or within the panel to prevent any movement.
5. All wiring to panel connections from field instruments, devices, and other panels shall be terminated at master numbered terminal strips, unless otherwise specified.
6. CONTRACTOR shall provide copper grounding studs for all panel equipment.
7. CONTRACTOR shall provide the following convenience accessories inside of each control panel:

- a. One 120 VAC, 20A duplex, grounding type receptacle.
- 8. No device shall be mounted less than 36-inches above the operating floor level, unless otherwise specified.

B. Identification:

- 1. CONTRACTOR shall provide laminated plastic nameplates for identification of panels and components mounted thereon as follows:
 - a. Nameplates shall be of 3/32-inch thick laminated phenolic type with white matte finish surface and black letter engraving.
 - b. Panel identification nameplates to have 1/2-inch high letter engravings.
 - c. Panel mounted component (e.g., control devices, indicating lights, selector switches, etc.) identification nameplates to have 1/4-inch high letter engravings.
 - d. Nameplates shall be attached to the panel face with two stainless steel self-tapping screws.
 - e. Nameplate engravings shall include the instrument or equipment tag number and descriptive title.
 - f. Tag all internally mounted instruments in accordance with the following requirements:
 - 1) The identifying tag number shall be permanently etched or embossed onto a stainless steel tag which shall be fastened to the device housing with stainless steel rivets or self tapping screws of appropriate size.
 - 2) Where neither of the above fastenings can be accomplished, tags shall be permanently attached to the device by a circlet of 1/16-inch diameter stainless steel wire rope.
 - 3) Identification tag shall be installed so that the numbers are easily visible to service personnel.
 - 4) Front of panel mounted instruments shall have the tag attached to rear of device.
 - g. Tagging of the following items shall be accomplished with the use of adhesive plastic Brady USA, Inc. labels, or equal.
 - 1) Tag all electrical devices (e.g., relays, timers, power supplies) mounted within control panels and enclosures.
 - 2) Numerically tag all terminal blocks.
 - 3) Color code and numerically tag wiring at each end.

C. Panels and Enclosures:

- 1. General:
 - a. Panels and enclosures shall meet the NEMA requirements for the type specified.
 - b. Sizes shown are estimates. CONTRACTOR shall furnish panels and enclosures amply sized to house all equipment, instruments, front panel mounted devices, power supplies, power distribution panels, wiring, and other components installed within.
- 2. General Construction Features:

- a. Fabricate enclosures using minimum 14-gauge steel for wall-mounted enclosures. Steel shall be free of pitting and surface blemishes.
- b. CONTRACTOR shall continuously weld all exterior seams and grind smooth. Also, surface grind complete removal of corrosion, burrs, sharp edges and mill scale.
- c. Reinforce sheet steel with steel angles where necessary to adequately support equipment and ensure rigidity and to preclude resonant vibrations.
- d. Panel shall be flat within 1/16-inch over a 24-inch by 24-inch area, or flat within 1/8-inch for a larger surface. Flatness shall be checked by using a 72-inch long straight edge. Out-of-flatness shall be gradual, in one direction only, and shall not consist of obvious depressions or a series of wavy sections.
- e. Panel shall use pan type construction for doors.
- f. Doors shall be mounted with full length heavy-duty piano hinges with stainless steel hinge pins.
- g. CONTRACTOR shall provide oil-resistant gasket completely around each door or opening.
- h. CONTRACTOR shall provide handle-operated, oil-tight, key-lockable three point stainless steel latching system with rollers on latch-rods for easy door closing.
- i. CONTRACTOR shall use stainless steel fasteners throughout.
- j. CONTRACTOR shall provide steel print pocket with white enamel finish.
- k. CONTRACTOR shall provide enclosure mounting supports as required for wall mounting.
- l. CONTRACTOR shall provide all holes and cutouts for installation of conduit and equipment. All conduit and piping openings and all conduits shall be sealed watertight.
- m. CONTRACTOR shall completely clean all interior and exterior surfaces so they are free of corrosive residue, oil, grease and dirt. Zinc phosphatize for corrosion protection.
- n. One coat of primer shall be applied to all interior and exterior surfaces immediately after corrosion protection has been applied. Exterior surfaces shall then be given sufficient coats of primer surfacer, applied with sanding and cleaning between coats, until a Grade 1 finish can be produced on the finish coat.
- o. All interior surfaces shall be painted with two coats of semi-gloss white polyurethane enamel.
- p. All exterior surfaces shall be painted with a minimum of three finish coats of polyurethane enamel to ultimately produce a Grade 1 finish (super smooth; completely free of imperfections). Color to be selected by ENGINEER from complete selection of standard and custom color charts furnished by the manufacturer.

- q. Primer and finish paint shall be compatible and shall be a low VOC, high solids polyurethane enamel, Hi-Solids Polyurethane B65 W300 Series as manufactured by Sherwin-Williams, Inc. or equal.
- r. Provide one extra quart of touch-up paint for each exterior finish color.
- 3. Control panels located in non-corrosive areas shall be NEMA 12 rated.
- 4. Control panels located in corrosive areas shall be NEMA 4X rated:
 - a. Panels shall be Type 316 stainless steel construction with a minimum thickness of 12-gauge for all surfaces (except those areas requiring reinforcement) having a smooth brushed finish.
 - b. Panel shall be furnished with stainless steel screw clamp assemblies on three sides of each door.
 - c. Panels shall be furnished with rolled lip around three sides of door and along top of enclosure opening.
 - d. Panels shall be furnished with hasp and staple for padlocking.
 - e. Panels shall be provided with a clear plastic, gasketed lockable hinged door to encompass all non-NEMA 4X front of panel instruments, where NEMA 4X panel instruments are not available.
- 5. Control Panels located in electrically classified areas shall be NEMA 7:
 - a. General: Explosion-proof control enclosures shall be used to house devices in hazardous environments. Enclosures shall be suitable for use in NEC Class 1, Groups C&D or Class II, Groups E, F & G applications and comply with UL and CSA standards.
 - b. Required Features:
 - 1) Light-weight and corrosion resistant copper-free aluminum.
 - 2) Integral, cast-on mounting lugs.
 - 3) Left side door hinges.
 - 4) Viewing windows sized to suit internally mounted components.
 - 5) Stainless steel cover bolts.
 - 6) Cad-plated steel mounting pans.
- 6. Electrical Systems:
 - a. Control of Environment:
 - 1) Panels shall be furnished with adequately sized, automatically controlled 120 VAC strip heaters to maintain temperature 10°F above ambient for condensation prevention inside panels.
 - 2) Panels shall be provided with automatically controlled closed loop ventilation fans or closed loop air conditioners with filtered air louvers if required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure.
 - b. Internal Power Distribution:
 - 1) Panels shall be provided with an internal 120 VAC power distribution panel with number of circuits and separate circuit breakers sized as required to distribute power to the panel components. Distribution panel shall contain two spare breakers minimum.
 - c. Wiring:

- 1) Internal wiring shall be Type MTW stranded copper wire with thermoplastic insulation rated for 600 V at 85°C for single conductors, color coded and labeled with wire identification.
- 2) For DC panel signal wiring, use No. 18 minimum AWG shielded.
- 3) For AC power wiring, use No. 12 minimum AWG. For AC signal and control wiring, use No. 16 minimum AWG. For wiring carrying more than 15 Amps, use sizes required by NEC and NFPA 79 Standards.
- 4) Low voltage signal wiring and shielded wiring shall be separated from power and control wiring by a minimum of 6-inches.
- 5) Parallel runs of wire shall be grouped or bundled using covered troughs. Maximum bundle size to be 1-inch. Troughs shall have 40 percent spare capacity.
- 6) Wire troughs along horizontal or vertical routes shall be installed to present a neat appearance. Angled runs are not acceptable.
- 7) CONTRACTOR shall adequately support and restrain all wiring runs to prevent sagging or other movement.
- 8) CONTRACTOR shall terminate all field wiring using forked, insulated, crimp-on connectors (soldered type not acceptable) at 600 V rated barrier type terminal strips with screwed connections and permanently affixed numeric identifiers beside each connection. Identifiers to be self-stick plastic tape strips with permanent type, machine printed numbers. For DC field signal wiring, terminal strips shall be capable of handling No. 12 wiring (minimum).
Manufacturers: Provide products of one of the following:
 - a) Phoenix Contact.
 - b) Entrelec Swartwout.
 - c) Allen Bradley.
 - d) Or equal.
- 9) All wiring shall be installed such that if wires are removed from any one device, power will not be disrupted to any other device.
- 10) For internal component to component wiring only, compression type terminal blocks are acceptable.
- 11) CONTRACTOR shall provide spare terminals equal in number to 20 percent of the terminals used for each type of wiring (e.g., DC signal and AC power).
- 12) CONTRACTOR shall provide a separate terminal for grounding each shielded cable.
- 13) CONTRACTOR shall use separate 5/16-inch diameter copper grounding studs for instrument signal cable shields and AC power.
- 14) Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.
- 15) When DC power and/or low voltage AC power is required, provide and install the necessary power supplies and transformers in the panel.

- 16) CONTRACTOR shall provide circuit breakers to protect each circuit, with no more than six instruments on a single circuit.
 - 17) CONTRACTOR shall provide complete wiring diagram showing "as-built" circuitry. Diagram shall be enclosed in transparent plastic and placed in easily accessible pocket built into panel door.
- d. Surge Protection:
- 1) General: Surge protection shall be provided to protect the electronic instrumentation system from surges propagating along the signal and power supply lines. The protection systems shall be such that the protection level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. Instruments shall be housed in suitable metallic cases, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground and where practical each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate junction box (compatible with the area designation) coupled to the enclosure.
 - 2) Manufacturers: Provide products of one of the following:
 - a) Telecommunication Industries.
 - b) Joslyn.
 - c) Or equal.
7. Common, push-to-test circuitry shall be provided for each panel to simultaneously test all indicating lights, horn, and strobe on the panel using a single pushbutton.
 8. Common, push-to-silence circuitry shall be provided for each panel to silence the alarm horn using a single pushbutton. Alarms strobe and alarm lights shall remain energized until the alarm is cleared from the system.

2.18 CONTROL RELAYS

- A. Type: General purpose, plug-in type rated for continuous duty.
- B. Coil Voltages: 24 VDC and 120 VAC as required.
- C. Contacts:
 1. Silver cadmium oxide rated not less than five amperes resistive at 120 VAC or 28 VDC continuous.
 2. For switching low energy circuits (less than 200 mADC) fine silver, gold flashed contacts rated not less than three amperes resistive at 120 VAC or 28 VDC continuous shall be provided.
- D. Relays to have clear plastic dust cover.
- E. Relays to be UL recognized.

F. Manufacturers: Provide products of one of the following:

1. IDEC.
2. Potter & Brumfield.
3. Allen-Bradley.
4. Or equal.

2.19 SELECTOR SWITCHES, PUSHBUTTONS AND INDICATING LIGHTS

A. General:

1. Selector switches, pushbuttons and indicating lights shall be provided by one manufacturer and is of the same series or model type.
2. Type: Heavy-duty, oil-tight.
3. Provide legend plate for indication of switch, pushbutton or light function (e.g. "OPEN/CLOSED", "HAND/OFF/AUTOMATIC").
4. Mounting: Flush mounted on control panel front, unless otherwise noted.
5. NEMA rated to match panel in which mounted.

B. Selector Switches:

1. Type: Provide selector switches with number of positions as required to perform intended functions.
2. Contacts:
 - a. Provide number and arrangement of contacts as required to perform intended functions specified but not less than one single pole, double throw contact.
 - b. Type: Double break, silver contacts with movable contact blade providing scrubbing action.
 - c. Rating: Compatible with AC or DC current with devices simultaneously operated by the switch contacts, but not less than ten amperes resistive at 120 VAC or DC continuous.
 - d. Switch Operator: Standard black knob.

C. Pushbuttons:

1. Type: Provide momentary, dual type pushbuttons as required to perform intended functions specified and shown.
2. Contacts: Comply with the requirements specified for selector switches.

D. Indicating Lights:

1. Type: Compact, integral transformer type.
2. Lamps: Six-volt, long life (20,000 hours minimum).
3. Indicating lights shall be provided with labeled escutcheon plates identifying the light function. (e.g. "RUN", "STOP", "ALARM", "POWER")

E. Button and Lens Colors:

1. Green for indication of closed, off (ready), stopped.
2. Red for indication of open, on, running.
3. Amber for indication of equipment malfunction, trouble and alarms (e.g. motor overload, etc.).

4. Blue for indication of electrical control power on.
- F. Rotary Cam Switches:
1. Provide rotary cam switches with number of positions and poles as required to perform the required signal switching function specified and shown.
 2. Contacts:
 - a. Gold-flashed contacts housed in mechanical contact blocks with number and arrangement of contacts as required to perform intended functions.
 - b. Contact Rating: Compatible with AC or DC through-put current of signals and devices simultaneously operated by the switch contacts, but not less than 20 amperes at 600 VAC or 250 VDC continuous.
 - c. Switch Operator: Standard black knob.

2.20 STROBE AND HORN

- A. General: Strobe light with horn shall be a pulsating, illuminating, multi-tone audible device used to indicate common alarm at HMCS panels.
- B. Service:
1. Corrosive and Non-Corrosive Areas: NEMA 4X construction.
 2. Electrically Classified Areas: NEMA 7 construction.
- C. Required Features:
1. Power Required: 120 VAC, 60 Hz.
 2. Strobe Light: Minimum 250 candlepower; 360 degree pattern.
 3. Flashing Mechanism: 72 to 75 flashes per minute.
 4. Base Materials of Construction: Polycarbonate
 5. Color: Amber/Red/Blue.
 6. Base Materials of Construction: Aluminum (NEMA 4X Rated)/Cast Aluminum (NEMA 7 Rated).
 7. Mounting: Mount on wall above HMCS panel. Provide appropriate mounting bracket and hardware.
 8. Decibel Output: 100 at ten feet minimum with manual volume control.
- D. Products and Manufacturers: Provide one of the following:
1. NEMA 4X Rated: 400 ST/350; NEMA 7 Rated: 27X ST/31x as manufactured by Federal Signal.
 2. Or equal.

2.21 CONDUIT, WIRE AND ACCESSORIES

- A. Provide conduit and conduit supports in accordance with Section 26 05 33.13, Rigid Conduit, and Section 26 05 33.16, Flexible Conduits, and Section 26 05 29, Hangers and Supports for Electrical Systems.
- B. Provide wire in accordance with Section 26 05 19, Low Voltage Electrical Power Conductors and Cables.

- C. Provide conduit, boxes and accessories in accordance with Section 26 05 33.33, Pull, Junction and Terminal Boxes.
- D. Provide identification in accordance with Section 26 05 53, Identification for Electrical Systems.

2.22 LABELING

- A. Labeling of all equipment shall be in conformance with requirements specified herein.

2.23 FACTORY TEST

- A. CONTRACTOR shall submit information on factory testing procedures to verify that testing shall fulfill the requirements as specified herein. Submittal shall be made at least two months in advance of any scheduled testing and shall include dates of scheduled tests.
- B. CONTRACTOR shall notify ENGINEER, in writing, at least 4 weeks before expected initiation of tests. OWNER and ENGINEER shall be present at factory during operational test of system equipment, either for individual units or as an integrated system.
- C. All input/output devices and components shall be tested to verify operability and basic calibration.
- D. All system hardware components equipment shall be tested to verify proper operation of the equipment as stand alone units. Test shall include, but not be limited to, the following:
 - 1. AC/DC power checks.
 - 2. Power fail/restart tests.
 - 3. Diagnostics checks.
 - 4. Test demonstrating that all specified equipment functional capabilities are working properly.
- E. All system components shall be tested to verify that communication between units is working properly.
- F. An integrated system test with all system equipment connected (excluding field sensors and instruments) shall be performed to verify that all equipment is performing properly as an integrated system.
- G. CONTRACTOR shall demonstrate all system software utility and security programs incorporated into the system to illustrate the various functions and capabilities specified.
- H. CONTRACTOR shall demonstrate the operation and display of all software based on a simulation of five percent of total input/output count, both analog and

discrete, as selected by the manufacturer. In addition, OWNER/ENGINEER shall randomly select, at the time of the test, additional inputs and outputs to be simulated in an amount approximately equal to five percent of total input/output count. Demonstration shall show that the monitoring and control application software associated with the input/output points performs the functions intended.

- I. System performance shall be tested using a fully integrated system, including all software and hardware if applicable. To achieve this, the entire control system, including all the peripheral devices and all interconnecting cables, shall be assembled on the factory test floor and simulated inputs applied. CONTRACTOR shall carry out a full system test, during which the entire system shall operate continuously without failure in accordance with the requirements of the Contract Documents. CONTRACTOR shall provide a control I/O simulation panel prior to the test with the following applicable devices:
 - 1. Toggle switches to simulate field or other input contacts.
 - 2. Indicating lights to simulate outputs from tested panels.
 - 3. Control relays to simulate motor control center coil inputs.
 - 4. Time relays to simulate position switches.
 - 5. Indications (mADC) to indicate every 4 to 20 mADC output from tested panel.
 - 6. Potentiometers to simulate 4 to 20 mADC inputs to tested panel.
- J. Every device shall have nameplate with description and device's tag number. Nameplates shall be removable and interchangeable for multiple use of panel during the test.
- K. Demonstration of communication between controllers or to remote I/O's shall be included in the Test Procedure, where applicable.
- L. Human Machine Interface (HMI): Prior to the staging and testing of the system, the display environments shall have been configured in accordance with the agreed upon display structure, loaded and data base parameters linked to the specified fields. During this phase of the factory acceptance test, the overall display structure shall be demonstrated, including environment configurations, passwords, security, etc. The display contents shall be reviewed to demonstrate how an operator navigates within the overall display structure. Each graphic display shall be reviewed for correctness in terms of the layout, symbols, color scheme, etc. The operation of standard alarm management displays (Current Alarm Display, Alarm History, etc.) shall also be demonstrated. A demonstration of each type of report specified shall be performed. Printing shall be an integral part of the report demonstration.
- M. When the factory tests have been successfully completed, a report shall be submitted to the ENGINEER. The equipment shall not be shipped until Notice of Acceptance of the test is received by CONTRACTOR.

2.24 MISCELLANEOUS

- A. Provide additional controls and appurtenances as required to meet the intent of the HMCS and functional descriptions as specified in Article 3.4, Sequence of Operations.
- B. Provide all mounting accessories, as required.
- C. Tubing, static pressure tips, mounting hardware, fasteners, and appurtenances shall be constructed of Type 316 stainless steel.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Building openings and penetrations shall be capped to protect the building from outside conditions.

3.3 INSTALLATION

- A. General:
 - 1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from ENGINEER in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 2. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.
 - 3. Install in accordance with Laws and Regulations.
 - 4. Do not modify structures to facilitate installation of equipment, unless approved in writing by ENGINEER.
 - 5. Installation to conform to requirements of all local and state codes.
 - 6. All the Work described in this Section shall be installed, wired, circuit tested and calibrated by manufacturers trained and certified electricians, technicians and mechanics qualified for the Work.
 - 7. CONTRACTOR shall be responsible for the proper operation and installation of all control systems herein specified. CONTRACTOR shall be responsible for coordination of all interfaces with other equipment and contractors to achieve the required control operation.

8. Anchorage shall be provided in accordance with structural criteria on construction documents.

B. Sensors:

1. Wall sensors shall be installed five feet above finished floor unless otherwise noted.
2. Where sensors are located on exterior walls provide an insulated mounting subbase.
3. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized. Provide sunshield enclosures.
4. Space humidity or temperature sensors will be mounted away from machinery generating heat, direct light and diffuser air streams.
5. Provide all mounting accessories including but not limited to junction boxes, wall boxes, wall plates and mounting hardware as required for a complete installation.

C. Hardware Installation Practices for Wiring

1. All controllers are to be mounted vertically and per the manufacturer's installation documentation.
2. The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
3. A true earth ground shall be available in the building. Do not use a corroded or galvanized pipe, or structural steel.
4. All wiring shall be enclosed in conduit.
5. Conduit in finished areas will be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction.
6. Exposed conduit will run parallel to or at right angles to the building structure.
7. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.
8. Provide fire caulking at all rated penetrations.

D. Installation Practices for Field Devices

1. Well-mounted sensors will include thermal conducting compound within the well to insure good heat transfer to the sensor.
2. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
3. Relay outputs will include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.
4. For building static pressure sensors, the high pressure port shall be inserted into the space via a metal tube. Pipe the low pressure port to the outside of the building.

E. Wiring, Conduit, and Cable

1. All wire will be copper and meet the minimum wire size and insulation class listed below:
 - a. Power - 12 Gauge - 600 Volt
 - b. Class One - 14 Gauge Std. - 600 Volt
 - c. Class Two - 18 Gauge Std. - 300 Volt
 - d. Class Three - 18 Gauge Std. - 300 Volt
 - e. Communications - Per Mfr.
2. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.
3. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.
4. Conduit shall be type EMT minimum size 3/4 inch galvanized. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.
5. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.
6. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.
7. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire management system shall be in conduit.

F. Enclosures

1. For all I/O requiring field interface devices, these devices where practical will be mounted in a field interface panel (FIP). The CONTRACTOR shall provide an enclosure which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.
2. FIPs shall contain power supplies for sensors, interface relays and contactors, and safety circuits.
3. The FIP enclosure shall meet the requirements specified under Panels and Enclosures.

G. Identification

1. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
2. All field enclosures shall be identified as specified under Panels and Enclosures.

3. Junction box covers will be marked to indicate that they are a part of the HMCS system.
4. All I/O field devices (except space sensors located in finished administration areas) that are not mounted within FIP's shall be identified with name plates.
5. All I/O field devices inside FIP's shall be labeled.

H. Software Installation

1. The CONTRACTOR shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

3.4 SEQUENCES OF OPERATION

- A. Sequence of Operation document will be provided during the construction phase. This document will outline the operational logic, control strategies, and sequences for all HVAC equipment and systems.

3.5 SYSTEM CHECKOUT AND START-UP

- A. CONTRACTOR, under the supervision of the Supplier, and other component suppliers, as applicable, shall perform the following:
1. Check and approve the installation of all HMCS components and all cable and wiring connections between the system components prior to placing the system into operation.
 2. Conduct a complete system checkout and adjustment, including calibration of all instruments, tuning of control loops, checking operation functions, and testing of final control actions. When there are future operational functions included in the Work, they should be included in the system checkout. All problems encountered shall be promptly corrected to prevent any delays in start-up of the system.
- B. CONTRACTOR and the Supplier shall be responsible for initial operation of monitoring and control system and shall make all necessary modifications or replacements to ensure that the operation, monitoring and control of the HVAC systems function in the manner intended by these Specifications.
- C. CONTRACTOR shall submit to the ENGINEER certified calibration reports for field instruments and devices and panel mounted devices upon completion of calibration.
- D. CONTRACTOR shall submit to the ENGINEER an installation inspection report certifying that all system components have been installed correctly and are operating in the manner intended. The report shall be signed by authorized representatives of CONTRACTOR and the Supplier.

3.6 INTEGRATED SYSTEM FIELD TEST

- A. Following checkout of the HMCS, CONTRACTOR, under the supervision of the Supplier shall perform an Integrated System Field Test to verify that all components and programmed software are operating properly as a fully integrated system, and that the intended monitoring and control functions are fully implemented and operational.
- B. The HMCS shall be fully operational and pretested by the CONTRACTOR prior to conducting the Integrated System Field Test.
- C. CONTRACTOR shall demonstrate all Sequence of Operations in the presence of the ENGINEER.
- D. Deficiencies found during the Integrated System Field Test shall be immediately corrected by CONTRACTOR and the system retested to demonstrate proper operation.

3.7 MANUFACTURER SERVICES

- A. Manufacturer's Field Services: CONTRACTOR shall provide the following services in addition to other services specified herein, and required by these Specifications.
 - 1. A factory trained manufacturer's representative shall be provided for minimum of three trips for a minimum of eight hour, on-Site, each day. The first trip shall be to provide installation supervision. Subsequent trips shall be for start-up services and training services. The installation services shall be coordinated between CONTRACTOR and the manufacturer. The startup and field testing services, and the training services shall be coordinated with the OWNER.
 - 2. After installation supervision and field testing services by the manufacturer, CONTRACTOR shall submit to the ENGINEER, a certification letter on the manufacturer's letterhead and signed by the manufacturer certifying that the equipment was installed in accordance with the manufacturer's recommendations and requirements and shall furnish all field test data, as required.
- B. Manufacturer's Training: CONTRACTOR shall retain the services of the System Supplier to provide operation, and maintenance training for the entire HMCS. For equipment items not manufactured by the System Supplier, the System Supplier shall provide for on-Site training by an authorized representative of the equipment manufacturer. Training shall be as follows:
 - 1. The Supplier shall perform standardized, structured training courses on-Site. Training shall be conducted by the Supplier's regular full time training instructors covering both operation and maintenance of the system equipment furnished by the Supplier.
 - 2. All training shall be scheduled so that it has been completed prior to Start-up and Acceptance by the OWNER.

3. The OWNER shall determine the exact number of personnel that will attend training.
4. Provide a training course covering the following topics.
 - a. The structure and the functions of the HMCS components and devices. The course shall familiarize the OWNER'S personnel with the procedures for applying the control system. As a minimum, the course shall cover the following topics:
 - 1) Overview of systems functional capabilities.
 - 2) Equipment overview including system component functions, operating principals and proper use.
 - 3) Start-up of the system hardware components.
 - b. Preventive and troubleshooting maintenance for the system components. The course shall familiarize the OWNER'S personnel with diagnostic capabilities of the system, both software and hardware, and also the routine maintenance procedures on the system and the common peripheral devices. As a minimum, the course shall cover the following topics:
 - 1) System overview description, including the power subsystems and logic components of the processor bus.
 - 2) Description of the maintenance and troubleshooting aids of the system including software diagnostic programs.
 - 3) Description of all bus operations.
 - 4) Description of peripheral and process interface devices.
 - 5) The use of hardware diagnostic routines, test equipment and test procedures as required enabling The OWNER'S personnel to detect and isolate system faults to the circuit board or module level and to implement repairs by replacing failed circuit boards or modules.
 - c. Training in the use and configuration of the specified HMI software. An instructor certified by the software manufacturer to furnish such training shall perform this training. The level of training shall be sufficient to familiarize the OWNER'S personnel with the configuration and application of all system programs. All essential system operating procedures shall be described as required to enable the OWNER'S personnel to operate the system via the work station and local control panels. As a minimum, the course shall cover the following topics:
 - 1) System overview and capabilities.
 - 2) Database configuration.
 - 3) Graphic display configuration, including linking of data to displays.
 - 4) Historical data configuration (collection, manipulation, and display).
 - 5) Real-time and historical trending.
 - 6) Report configuration, generation, printing, and customization.
 - 7) Alarm configuration and management.
 - 8) System security.
 - 9) I/O driver use and configuration.
 - 10) System backup and recovery.
 - 11) System command language.

- 12) Troubleshooting.
 - 13) System optimization.
 - 14) System startup and shutdown procedures.
 - 15) LAN and WAN communications, as appropriate
5. Provide instruction covering use and operation of the equipment to perform the intended functions.
- 1) Provide instruction covering procedures for routine, preventive and troubleshooting maintenance including equipment calibration.
 - 2) Explain procedures for placing the equipment in and out of operation and explain necessary actions and precautions to be taken regarding the overall HMCS.
- C. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

3.8 ADJUSTING

- A. Adjust the HMCS for proper settings and to achieve proper control.

3.9 CLEANING

- A. Thoroughly clean all equipment and accessories prior to installation and at substantial completion.
- B. Remove all dirt, rust, dust, etc. from equipment and accessories.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

3.10 PROTECTION OF EXECUTED WORK

- A. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.
- B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.

+ + END OF SECTION + +

SECTION 23 23 00

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install refrigerant piping complete and operational with accessories.
2. The Work shall comply with seismic, and wind control requirements indicated on structural criteria on construction drawings.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the refrigerant piping Work.
2. Notify other contractors in advance of the installation of the refrigerant piping to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the refrigerant piping Work.

C. Related Sections:

1. Section 09 91 00, Painting.
2. Section 10 14 00, Signage.
3. Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.

1.2 REFERENCES

A. American National Standards Institute (ANSI).

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

1. ASHRAE Standard 15 – Safety Standard for Refrigeration Systems.

C. American Society of Mechanical Engineers (ASME).

1. ASME/ANSI B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME/ANSI B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
3. ASME B40.100 – Pressure Gauges and Gauge Attachments.

D. American Society for Testing and Materials (ASTM).

1. ASTM B32 – Standard Specification for Solder Metal.
2. ASTM B280 – Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
3. ASTM B813 – Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
4. ASTM B828 – Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

E. American Welding Society (AWS).

1. AWS A5.8/A5.8M – Specification for Filler Metals for Brazing and Braze Welding.
2. AWS A5.31 – Specification for Fluxes and Braze Welding.
3. AWS B2.2 – Specification for Brazing Procedure and Performance Qualification.
4. AWS B2.3 – Specification for Soldering Procedure and Performance Qualification.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Minimum of five years of experience producing substantially similar material and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
 - b. Material shall be manufactured in the United States.
2. Installer:
 - a. Engage an experienced installer to perform the work of this Section who has specialized in installing refrigerant piping similar to that required for this Project and who is acceptable to manufacturer.
 - b. Submit name and qualifications to Engineer along with the following information on a minimum of three successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for projects.
 - 2) Approximate contract cost of the refrigerant piping.
 - 3) Amount of area installed.
3. Brazing and Soldering:
 - a. Qualify processes and operators in accordance with AWS B2.2 and B2.3 as appropriate for material to be brazed or soldered.

- b. Provide certification that operators employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.

B. Regulatory Requirements:

- 1. National Electrical Code (NEC).
- 2. National Fire Protection Association (NFPA).
- 3. Underwriters Laboratories Inc. (UL).
- 4. Local and State Building Codes and Ordinances.
- 5. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

- 1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, and installation details, including supports, expansion joints, guides and anchors.
 - b. 1/4-inch scale piping layouts, dimensioned to show length of runs, sizes, support spacing and expansion provisions.
 - c. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
- 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.
 - c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - f. Other technical data related to specified material and equipment as requested by Engineer.
- 3. Testing Plans, Procedures, and Testing Limitations:
 - a. Plan for performing required field testing.

B. Informational Submittals: Submit the following:

1. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 - c. Instructions for handling, start-up, and troubleshooting.
 2. Field Quality Control Submittals:
 - a. Written report presenting results of required field testing.
 3. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service personnel, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
 4. Qualifications Statements:
 - a. Manufacturer, when requested by Engineer.
 - b. Installer, when requested by Engineer.
 - c. Brazing and Soldering, when requested by Engineer.
- C. Closeout Submittals: Submit the following:
1. Record Documentation:
 - a. During progress of the Work keep an up-to-date set of the Drawings showing field and Shop Drawing modifications. Immediately upon completion of the Work, submit "pdf" of CADD drawings showing the actual in place installation of all refrigerant piping and equipment installed under this Section at a scale satisfactory to the Owner. The drawings shall show all piping on plans and in sections, with all reference dimensions and elevations required for complete Record Drawings of the systems. Two paper prints shall also be furnished. The prints and electronic copies of the CADD files shall be furnished no later than 30 days after completion of the Contract and prior to final payment.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
- B. Storage and Protection:
1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 SITE CONDITIONS

A. Existing Conditions:

1. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
2. The Drawings are intended as an indication of the arrangement of equipment and piping and are as nearly correct as can be determined in advance of the actual construction of the Work. Equipment, piping and appurtenances found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.

PART 2 - PRODUCTS

2.1 DETAILS OF MATERIALS

A. Tubing:

1. Tubing shall be seamless copper tube of Type ACR, hard or annealed, complying with ASTM B280.
2. Tubing shall be clean, dehydrated, and supplied with a nitrogen charge and pressure tight plugs for each length.

B. Fittings:

1. Fittings shall be in long pattern and shall be wrought copper or copper alloy conforming to the requirements of ASME/ANSI 16.22 or cast copper alloy conforming to the requirements of ASME/ANSI 16.18.
2. Unions shall be wrought or cast copper with a 300 psig working pressure, female pattern, brass to brass seat, and ground joint.
3. Gaskets shall be of a material suitable for the refrigerant, temperature and pressure for which they will be used.

C. Joints:

1. Joints shall be brazed using alloys meeting the requirements of AWS A5.8/A5.8M with BCuP or BAg designation.
2. Joints between dissimilar metals shall be fabricated using an approved brazing flux conforming to the requirements of AWS A5.31, Types FB3A or FB3C, and an appropriate brazing filler metal with BCuP or BAg designation.
3. The outside of the copper tube and the inside of the fitting where brazing rod will be applied, shall be cleaned and burnished with fine crocus cloth until all dirt and oxide is removed. A light coat of non-corrosive brazing flux shall be applied to both pipe and fittings (Acid flux shall not be used). Joint shall be uniformly heated to proper brazing temperature and the brazing material shall be fed to the joint until a uniform line of brazing material appears around the pipe at the end of the fitting. Brazing shall be done only by mechanics that are qualified for brazing refrigerant piping.
4. Fittings for copper tubing for refrigerant use shall be wrought copper with brazed type ends as applicable. Forged brass fittings are also acceptable for this purpose. Fittings shall be suitable for working pressure up to 250 psi. The use of cast brass fittings for this service will not be approved.

2.2 ACCESSORIES

A. Mechanical Link Seals:

1. Manufacturer: Provide product of one of the following:
 - a. Pipeline Seal and Insulator, Inc.
 - b. Thunderline Corporation.
 - c. Calpico, Inc.
 - d. Or equal.
2. Provide mechanical link seals through walls or floors with adjusting bolts suitable for 20 psig of pressure where shown or specified.
3. Details of Construction:
 - a. Non-Fire Rated Seals:
 - 1) Pressure Plates: Glass reinforced nylon composite.
 - 2) Bolts and Nuts: Type 316 stainless steel.
 - 3) Sealing Element: EPDM.
 - b. Fire Rated Seals:
 - 1) Pressure Plates: Zinc dichromate steel.
 - 2) Bolts and Nuts: Two part zinc dichromate steel with corrosion inhibiting coating.
 - 3) Sealing Element: Silicone.

4) 1-1/2-hour fire rating.

B. Sleeves and Wall Pipes:

1. General:

- a. Wall pipes and wall sleeves shall be provided in accordance with the following schedule when passing through new or existing concrete or masonry structures, except where noted otherwise:

<u>From</u>	<u>To</u>	<u>Fitting</u>
Dry area	Wet area	Wall Pipe
Dry area	Earth Exterior	Wall Pipe
Dry area	Dry area	Plain Sleeve
Earth	Earth	Plain Sleeve
Exterior	Exterior	Plain Sleeve

- b. Material of construction shall be Type 316 [304] stainless steel where located in corrosive areas and G90 hot dipped galvanized steel in non-corrosive areas. Refer to the Corrosive and Non-Corrosive Area Designation Table on the Drawings for a list of these areas.

2. Sleeves:

- a. Wall sleeves shall be Schedule 40.
- b. Shall be of sufficient size to pass the pipe and the insulation covering the pipe.
- c. Shall extend 2-inches above the finished floor.
- d. Shall be provided with split type escutcheon plates at the floor and wall openings.
- e. Shall terminate flush with walls and ceilings.
- f. Shall not be required in existing concrete walls where walls are core drilled and the resulting hole has a smooth inside surface.
- g. Shall be caulked with a fire retardant caulking compound at firewalls and a gas tight caulking compound at gas tight walls.

3. Wall Pipes:

- a. Wall pipes shall be equipped with a waterstop.
- b. Shall be of sufficient length to pass through the wall and provide adequate clearance for fastening.
- c. The end of the wall pipes shall be of a type consistent with the piping to be connected to them and shall conform to their standards and specifications.

- d. All wall pipes shall have the same interior protection as specified for the connecting piping. Exterior protection shall be as specified for the yard piping.

C. Structural Supports:

1. Contractor shall provide and install all hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances as required to mount all refrigerant piping.
2. All hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances shall conform to Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.

2.3 IDENTIFICATION

- A. All piping and equipment identification shall be provided in accordance with Section 10 14 00, Signage.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Protection of Surrounding Areas/Surfaces:
 1. Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.3 INSTALLATION

- A. General:
 1. Install the piping and equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 2. Install in accordance with Laws and Regulations.
 3. Do not modify structures to facilitate installation of piping, unless specifically approved by Engineer.
 4. Installation shall conform to requirements of all local and state codes.

- B. All refrigerant piping installations shall conform to ANSI/ASHRAE Standard 15.
- C. All pipes, whether insulated or not, shall be identified with pipe labels and the direction of flow indicated.
- D. Install oil traps and oil return line tubing in refrigerant piping, as required.
- E. All valves shall be manually opened and closed before installation to check their operation, and the interior of the valves shall be cleaned. Joints shall be made as specified.
- F. Install the valves so that they can be conveniently operated.
- G. Valves shall be supported as integral components of the piping systems.
- H. For systems containing more than 6.6 pounds of a refrigerant in systems using positive-displacement compressors, isolation valves shall be installed:
 - 1. At the inlet of each compressor, compressor unit or condensing unit.
 - 2. At the discharge outlet of each compressor, compressor unit or condensing unit and each liquid receiver.
- I. Before setting wall sleeves, pipes, castings and pipes to be cast-in-place, Contractor shall coordinate with the Drawings and Figures, which may have a direct bearing on the pipe locations. Contractor shall be responsible for coordinating the proper location of the pipes and appurtenances during the construction with all trades.
- J. Field coordinate for exact pipe penetrations and routing of all piping.
- K. Provide mechanical link seals with sleeves or wall pipes at all piping penetrations through wall, roof and floor slabs.
- L. Escutcheon plates shall be provided for all exposed piping penetrations.
- M. Contractor shall coordinate accessories included in packaged and split air conditioning equipment. Any accessories not included shall be provided by Contractor.

3.4 CONTRACTOR SHALL FURNISH AND INSTALL A COMPLETE CHARGE OF REFRIGERANT. FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Remove and plug the connection points of any controls or relief valves that could be damaged by test pressure.
 - 2. Remove all expansion valves and install temporary bypasses.
 - 3. Front seat both the compressor suction and discharge valves.
 - 4. Open the liquid line shutoff valve at the condenser, and any auxiliary valves in the hot gas and liquid lines.

5. Apply control power to open all solenoid valves.
6. Connect a cylinder of oil free dry nitrogen to the front seat port of the compressor discharge valve.
7. Introduce dry nitrogen into the system to a design test pressure listed on the condensing unit, compressor or compressor unit nameplate, as required by ANSI/ASHRAE Standard 15.
8. Test all piping for leaks by observing system pressure drop and applying a bubble test to all joints and connections.
9. After testing is completed, bleed the test pressure and repair any leaks found.
10. After the system is assumed to be free of leaks, charge enough refrigerant through the liquid line charging valve to raise the pressure to 15 psig. Remove the refrigerant connection and charge enough dry nitrogen into the system to raise the system pressure to the listed design test pressure.
11. Test all joints with an electronic leak detection meter. Record all test results.
12. After the results of the pressure tests have been approved, release test pressure and mechanically evacuate the system to a minimum of 22-inches Hg vacuum and maintain for 24 hours with no leaks. Disconnect the vacuum pump prior to vacuum leak test.
13. Record and report the test results.
14. After test results have been approved by Engineer, remove plugs and temporary bypass, and fully charge the system with the specified refrigerant.
15. All leaking joints shall be disassembled and remade using new materials. Retesting shall be conducted on all portions failing the tests.

B. Inspection:

1. Examine areas to receive piping and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances.
 - c. Start the Work only when conditions are satisfactory.
2. The Engineer reserves the right to reject or authorize replacement of piping and accessories found to be defective or deviated from allowable tolerances.

3.5 ADJUSTING

- A. Adjust all controls for proper settings.
- B. While system is operable, balance all equipment to achieve design conditions.

3.6 CLEANING

- A. Remove all dirt, rust, dust, etc. from refrigerant piping after installation.
- B. Remove and dispose of all debris and waste from the Site resulting from installation.

3.7 SCHEDULES

- A. All refrigerant piping shall be sized in accordance with manufacturer's recommendation.

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SECTION 23 31 13

METAL DUCTWORK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install metal ductwork complete and operational with accessories.
- B. Coordination:
 - 1. Notify other Contractors in advance of the installation of metal ductwork to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed with, or before, the metal ductwork Work.
- C. Related Sections:
 - 1. Section 10 14 00, Signage.
 - 2. Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.
 - 3. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
 - 4. Section 23 09 00, Instrumentation and Control for HVAC.

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc. (AMCA).
 - 1. AMCA Standard 500-D – Laboratory Methods of Testing Dampers for Rating.
 - 2. AMCA Publication 511 – Certified Ratings Program - Product Rating Manual for Air Control Devices.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
 - 1. ASHRAE Standard 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- C. American Society for Testing and Materials (ASTM).
 - 1. ASTM E84 – Standard Test Method for Burning Characteristics of Building Materials.
 - 2. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 3. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- D. American Welding Society (AWS).

1. AWS B2.1 – Specification for Welding Procedure and Performance Qualification.
- E. National Fire Protection Association (NFPA).
1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
 2. NFPA 90B – Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 3. NFPA 701 – Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
- F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
1. Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems.
 2. HVAC Duct Construction Standards – Metal and Flexible.
- G. Underwriters Laboratories Inc. (UL).
1. UL 181 – Factory-Made Air Ducts and Air Connectors.
 2. UL 181A – Closure Systems for Use With Rigid Air Ducts.
 3. UL 181B – Closure Systems for Use With Flexible Air Ducts and Air Connectors.
 4. UL 555 – Fire Dampers.
 5. UL 555S – Smoke Dampers.
 6. UL 900 – Air Filter Units.

1.3 QUALITY ASSURANCE

- A. Qualifications:
1. Installer:
 - a. Engage an experienced installer to perform the work of this Section who has specialized in installing metal ductwork similar to that required for this Project and who is acceptable to manufacturer.
 2. Welding:
 - a. Qualify processes and operators in accordance with AWS B2.1 as appropriate for material to be welded.
 - b. Provide certification that operators employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.
- B. Regulatory Requirements:
1. National Electrical Code (NEC).
 2. National Fire Protection Association (NFPA).
 3. Underwriters Laboratories Inc. (UL).
 4. Local and State Building Codes and Ordinances.
 5. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, and installation details.
 - b. 1/4-inch scale duct layouts, dimensioned to show length of runs, sizes, support spacing and expansion provisions.
 - c. Detailed installation drawing of each individual component showing:
 - 1) Mounting requirements.
 - 2) Locations.
 - d. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, wall thicknesses, design pressures, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.
 - c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - f. Other technical data related to specified material and equipment as requested by Engineer.
- B. Informational Submittals: Submit the following:
1. Certificates:
 - a. Certification that all stainless steel ductwork, accessories, and hardware are of the Type specified.
 2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 3. Source Quality Control Submittals:
 - a. Factory test reports.
 4. Field Quality Control Submittals:
 - a. Written report presenting results of required field testing.
 5. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service personnel, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
 6. Qualifications Statements:
 - a. Installer, when requested by Engineer.
 - b. Welding, when requested by Engineer.
- C. Closeout Submittals: Submit the following:
1. Record Documentation:
 - a. During progress of the Work keep an up-to-date set of the Drawings showing field and Shop Drawing modifications. Immediately upon completion of the Work, submit "pdf" of CADD drawings showing the

actual in place installation of all ductwork and equipment installed under this Section at a scale satisfactory to the Owner. The drawings shall show all ductwork on plans and in sections, with all reference dimensions and elevations required for complete Record Drawings of the systems. Two paper prints shall also be furnished. The prints and electronic copies of the CADD files shall be furnished no later than 30 days after completion of the Contract and prior to final payment.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of that Work.
 - 3. Comply with manufacturer's recommendations for rigging of equipment.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 SITE CONDITIONS

- A. Existing Conditions:
 - 1. The Contract Documents show the general arrangement and extent of the Work to be done. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work is governed by the general building plans and the actual building conditions.
 - 2. The Drawings are intended as an indication of the arrangement of equipment and ductwork and are as nearly correct as can be determined in advance of the actual construction of the Work. Equipment, ductwork, and appurtenances found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description:

1. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of the systems, Contractor, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval.
2. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each case and adequately provide for expansion and minimize the amount of space required for the same.
3. The Drawings do not show all offsets, fittings, accessories and details, which may be required. Contractor shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others," to complete the systems to the true extent of the Contract Documents.

B. Design Criteria:

1. All sheet metal construction shall be in accordance with the construction details and installation details in the latest edition of the SMACNA HVAC Duct Construction Standards. This Standard is hereinafter referred to as HVAC DS.
2. Sheet metal construction shall conform to the following minimum pressure classification (positive and negative pressure), unless otherwise shown or specified:
 - a. Ductwork serving administrative (office) and non-office spaces: 2-inch W.G.
 - b. Ductwork serving laboratory exhaust systems: Negative 6-inch W.G.

2.2 DETAILS OF MATERIALS

A. Material Type:

1. Galvanized steel ductwork shall be G90 hot dipped in accordance with ASTM A653/A653M.
 - a. All accessories for galvanized ductwork shall be G90 hot dipped galvanized steel, unless noted otherwise.
2. Stainless steel ductwork shall be Type 316.
 - a. All accessories for stainless steel ductwork shall be Type 316 stainless steel, unless noted otherwise.

B. Duct construction alternatives (duct gauge in relation to reinforcement spacing) selected by Contractor from HVAC DS Tables shall be identified by duct system and shall be submitted in schedule form to the Engineer prior to beginning installation of ductwork. Contractor shall construct ductwork to meet the requirements of the HVAC DS Tables in conjunction with the minimum duct thickness schedules in Article 3.10 except where noted below.

1. Laboratory exhaust ductwork shall be 18 gauge minimum.

- C. Rectangular ductwork longitudinal seams shall be Pittsburgh Lock type with permanently elastomeric sealant applied continuously within the seam.
- D. Round ductwork seams shall be spiral lock seam except for the laboratory exhaust system which shall be solid wall fully welded.
- E. Laboratory exhaust ductwork shall be joined using Vanstone flanges with chemical proof gasketing. The gasketing and flange seal shall be watertight to prevent potential condensate from leaking through joint.
- F. Duct reinforcement shall be made using external stiffener angles. Tie rods shall not be acceptable. Stiffener angles shall be constructed of the same material as the ductwork.
- G. Transverse Joints:
 - 1. Manufacturer: Provide product of one of the following:
 - a. Ductmate Industries, Inc.
 - b. Elgen Manufacturing Company, Inc.
 - c. Or equal.
 - 2. Ductwork shall be connected by a mechanical joining system, except where otherwise noted.
 - 3. Manufacturer's installation instructions will be followed, except where otherwise noted.
 - 4. SMACNA T-24 and other flange type connectors formed from the duct edge will NOT be allowed.
 - 5. All connectors shall meet or exceed the functional criteria outlined in the HVAC DS and shall be constructed of the same material as the ductwork.
- H. Turning Vanes:
 - 1. Manufacturer: Provide product of one of the following:
 - a. Ductmate Industries, Inc.
 - b. Elgen Manufacturing Company, Inc.
 - c. C.L. Ward & Family, Inc.
 - d. Or equal.
 - 2. Material: Same material as ductwork.
 - 3. Ducts 24-inches or shorter:
 - a. Vanes: Single thickness.
 - b. Runners: Type 2.
 - 4. Ducts taller than 24-inches:
 - a. Vanes: Double thickness.
 - b. Runners: Type 1.
- I. Splitter Dampers:
 - 1. Reference: HVAC DS.
 - 2. Material: Same material as ductwork.
- J. Transitions and Offsets:
 - 1. Reference: HVAC DS.
 - 2. Material: Same material as ductwork.

- K. Branch Take-Offs:
 - 1. Reference: HVAC DS.
 - 2. Material: Same material as ductwork.
 - 3. 45 degrees, NO straight taps, unless specifically shown.
- L. Rectangular Square Throat Elbows:
 - 1. Reference: HVAC DS.
 - 2. Material: Same material as ductwork.
 - 3. Provided with turning vanes.
- M. Rectangular Radius Elbows and Round Elbows:
 - 1. Reference: HVAC DS.
 - 2. Material: Same material as ductwork.
 - 3. Centerline Radius: $R=1.5W$, unless specifically shown otherwise.
- N. Round Converging Flow Fittings:
 - 1. Converging flow fittings shall be constructed with a radius entrance to all branch taps and with no excess material projecting from the body into the branch tap entrance.
 - 2. Branch entrances shall be by means of factory-fabricated fittings or factory fabricated duct tap assemblies.
- O. Seal Class:
 - 1. Class A – Ductwork constructed with a minimum pressure classification (positive and negative pressure) of 4-inch W.G. and up.
 - 2. Class B – Ductwork constructed with a minimum pressure classification (positive and negative pressure) less than 4-inch W.G.
- P. Leakage:
 - 1. Not to exceed five percent.
- Q. Flexible duct or duct constructed of fiberglass duct board shall not be permitted, except where specifically shown or indicated.

2.3 ACCESSORIES

A. Hangers and Supports:

1. Hangers and supports shall be provided in accordance with Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.

B. Motorized Control Dampers and Volume Dampers (for Rectangular Ductwork):

1. Commercial Type Dampers for Galvanized Steel Ductwork:
 - a. Design and Performance Criteria (based on 48-inch damper width):
 - 1) Dampers shall be performance rated and certified in accordance with AMCA Standard 500-D and AMCA Publication 511.
 - 2) Maximum Design Total Static Pressure: 5.2-inch W.G.
 - 3) Damper Leakage: Class 1 Leakage Rated – Not more than 8 cfm per square foot at 4-inch W.G. with blade seals.
 - 4) Certification: Manufacturer shall submit certified test data.
 - b. Product and Manufacturer: Provide one of the following:
 - 1) Model CD60, as manufactured by Ruskin.
 - 2) Or equal.
 - c. Details of Construction:
 - 1) Material: Galvanized steel.
 - 2) Frame: 16 gauge hat channel reinforced with corner braces for structural strength equal to 11 gauge channel frame with mounting flanges.
 - 3) Single Section Sizes:
 - a) Minimum: 8-inch wide by 10-inch high.
 - b) Maximum: 60-inch wide by 72-inch high.
 - 4) Blades:
 - a) 6-inch wide.
 - b) Opposed blades.
 - c) Airfoil shape with 14 gauge equivalent galvanized steel double skin construction.
 - d) EPDM edge seals for motorized control dampers only.
 - 5) Linkage: Concealed in frame outside the air stream.
 - 6) Axles: 1/2-inch plated steel hex.
 - 7) Bearings: Stainless steel sleeve.
 - 8) Jamb Seals: Flexible metal compressible type.
 - 9) Provide galvanized steel outside handle, quadrant with 2-inch standoff and approved position indicator with locking device for all volume dampers.

C. Motorized Control Dampers and Volume Dampers (for Round Ductwork):

1. Commercial Type Dampers for all Metal Ductwork:
 - a. Design and Performance Criteria (based on 48-inch damper diameter):
 - 1) Dampers shall be performance rated and certified in accordance with AMCA Standard 500-D and AMCA Publication 511.
 - 2) Maximum Design Total Static Pressure: 4.0-inch W.G.

- 3) Damper Leakage: Not more than 11.30 cfm total at 1-inch W.G. with blade seals.
- 4) Certification: Manufacturer shall submit certified test data.
- b. Product and Manufacturer: Provide one of the following:
 - 1) Model CDRS82, as manufactured by Ruskin.
 - 2) Or equal.
- c. Details of Construction:
 - 1) Material: Same as ductwork.
 - 2) Frame: Minimum 16 gauge frame with 12 gauge mounting flanges.
 - 3) Single Section Sizes:
 - a) Minimum: 4-inch diameter.
 - b) Maximum: 48-inch diameter.
 - 4) Blades:
 - a) Minimum 16 gauge double skin construction with material same as ductwork.
 - b) EPDM continuous edge seals with pin angle stops for motorized control dampers only.
 - 5) Axles: Minimum 1/2-inch with material same as ductwork.
 - 6) Bearings: Stainless steel sleeve.
 - 7) Provide outside handle, quadrant with 2-inch standoff and approved position indicator with locking device constructed from same material as ductwork for all volume dampers.

D. Gravity Backdraft Dampers (GBD):

1. Commercial Type GBD for Galvanized Steel
 - a. Provide gravity backdraft damper where specified on the Equipment Schedule or shown on the Drawings.
 - b. Design and Performance Criteria (based on 48-inch damper width):
 - 1) Dampers shall be performance rated and certified in accordance with AMCA Standard 500-D and AMCA Publication 511.
 - 2) Maximum Design Back Pressure: 4.0-inch W.G.
 - 3) Damper Leakage: Not more than 15 cfm per square foot at 1-inch W.G.
 - 4) Blades shall begin to open at approximately 0.12-inch W.G. and shall be kept fully open at 0.20-inch W.G.
 - 5) Certification: Manufacturer shall submit certified test data.
 - c. Product and Manufacturer: Provide one of the following:
 - 1) Model BD6, as manufactured by Ruskin.
 - 2) Model EM, as manufactured by Greenheck Fan Corporation.
 - 3) Or equal.
 - d. Details of Construction:
 - 1) Material: 6063-T5 aluminum.
 - 2) Frame: Minimum 0.125-inch thick extruded aluminum frame.
 - 3) Single Section Sizes:
 - a) Minimum: 6-inch wide by 6-inch high.
 - b) Maximum: 48-inch wide by 52-inch high.
 - 4) Blades:
 - a) Extruded 0.070-inch thick 6063-T5 aluminum construction.

- b) Extruded vinyl blade edge seals mechanically locked into extruded blade slots. Adhesive tape seals are not acceptable.
 - 5) Linkage: 1/2-inch tie bars with stainless steel pivot pins.
 - 6) Bearings: Molded synthetic.
 - 7) Provide a field-adjustable static pressure controller (SPC) to maintain static pressures in the ranges up to 0.25-inch W.G. for dampers up to 17.3 ft² and up to 0.75-inch W.G. for dampers up to 6 ft².
- E. Curtain Type Dynamic Fire Dampers (FD):
 - 1. FD for Galvanized Steel Ductwork:
 - a. Design and Performance Criteria:
 - 1) Dampers shall be certified and labeled to UL 555.
 - 2) Dampers shall have a minimum fire rating of 1-1/2 hours for less than 3-hour fire-resistance-rated assemblies and 3 hours for 3-hour or greater fire-resistance-rated assemblies.
 - 3) Dampers shall meet NFPA 90A and local building codes.
 - 4) Maximum Design Total Static Pressure: 4.0-inch W.G.
 - 5) Maximum Operating Velocity: 2000 fpm.
 - 6) Maximum Operating Temperature: 250 degrees F.
 - 7) Certification: Manufacturer shall submit certified test data.
 - b. Product and Manufacturer: Provide one of the following:
 - 1) Model DIBD2/DIBD23, as manufactured by Ruskin.
 - 2) Model DFD-150/DFD-350, as manufactured by Greenheck Fan Corporation.
 - 3) Or equal.
 - c. Details of Construction:
 - 1) Material: Galvanized steel.
 - 2) Frame: Minimum 20 gauge hat channel frame.
 - 3) Single Section Sizes:
 - a) Minimum: 4-inch wide by 4-inch high.
 - b) Maximum: 33-inch wide by 36-inch high.
 - 4) Blades:
 - a) Curtain type in airstream with minimum 24 gauge galvanized steel construction.
 - 5) Closure Springs: Type 301 stainless steel constant force or spring clip type.
 - 6) Control: 165 degrees F fusible link.
 - d. Damper installation shall conform to manufacturer's installation recommendations required to meet UL requirements.
 - e. Provide factory sleeves constructed from same material as damper to ensure field compliance with UL installation requirements.
 - f. Provide factory fabricated round duct connections constructed from same material as ductwork for round ductwork installation.
 - g. Provide firestopping at walls, floors, and ceilings where dampers are installed.
 - h. Provide a duct access door at each curtain type dynamic fire damper.

2. FD for Stainless Steel Ductwork:
 - a. Design and Performance Criteria:
 - 1) Dampers shall be certified and labeled to UL 555.
 - 2) Dampers shall have a minimum fire rating of 1-1/2 hours for less than 3-hour fire-resistance-rated assemblies and 3 hours for 3-hour or greater fire-resistance-rated assemblies.
 - 3) Dampers shall meet NFPA 90A and local building codes.
 - 4) Maximum Design Total Static Pressure: 4.0-inch W.G.
 - 5) Maximum Operating Velocity: 2000 fpm.
 - 6) Maximum Operating Temperature: 250 degrees F.
 - 7) Certification: Manufacturer shall submit certified test data.
 - b. Product and Manufacturer: Provide one of the following:
 - 1) Model DIBD2SS/DIBD23SS, as manufactured by Ruskin.
 - 2) Model SSDFD-150/SSDFD-350, as manufactured by Greenheck Fan Corporation.
 - 3) Or equal.
 - c. Details of Construction:
 - 1) Material: Type 316 stainless steel.
 - 2) Frame: Minimum 20 gauge hat channel frame.
 - 3) Single Section Sizes:
 - a) Minimum: 6-inch wide by 4-inch high.
 - b) Maximum: 24-inch wide by 21-inch high.
 - 4) Blades:
 - a) Curtain type in airstream with minimum 24 gauge Type 316 stainless steel construction.
 - 5) Closure Springs: Type 301 stainless steel constant force or spring clip type.
 - 6) Control: 165 degrees F fusible link.
 - d. Damper installation shall conform to manufacturer's installation recommendations required to meet UL requirements.
 - e. Provide factory sleeves constructed from same material as damper to ensure field compliance with UL installation requirements.
 - f. Provide factory fabricated round duct connections constructed from same material as ductwork for round ductwork installation.
 - g. Provide firestopping at walls, floors, and ceilings where dampers are installed.
 - h. Provide a duct access door at each curtain type dynamic fire damper.

F. Access Doors:

1. Provide access doors for all fire dampers, control dampers, and other duct mounted devices where required to be accessible.
2. Access doors for fire dampers shall not affect the integrity of fire-resistance-rated assemblies. The access openings shall not reduce the fire-resistance rating of the assembly.
3. Access doors for fire dampers shall be labeled "FIRE DAMPER ACCESS" with minimum 1/2-inch high letters.
4. Reference: HVAC DS.
5. Material: Same as ductwork.

6. For Rectangular Ductwork:
 - a. Type: Gasketed cam lock covers.
 - b. Unless otherwise specified rectangular access doors shall be:
 - 1) 12 by X-2-inches for ducts X-inches and smaller less than 14-inches.
 - 2) 24 by 12-inches for ducts between 14 and 36-inches.
 - 3) 24 by 24-inches for ducts between 36 and 60-inches.
 - 4) Two 24 by 24-inch doors for ducts larger than 61-inches.
7. For Round Ductwork:
 - a. Type: Industrial oval gasketed access door with locking hand wheels.
 - b. Unless otherwise specified oval access door sizes shall be:

<u>Duct Diameter:</u>	<u>Nominal Opening:</u>
8 thru 18-inches:	10 by 6-inches.
19 thru 48-inches:	16 by 12-inches.
49 thru 72-inches:	24 by 18-inches.

G. Flexible Connectors (FC):

1. Design and Performance Criteria:
 - a. Flexible connectors shall be tested in accordance with UL 181.
 - b. Flexible connectors shall be listed and labeled as Class 0 or Class 1 flexible connectors.
 - c. Flexible connectors shall meet NFPA 90A, NFPA 90B, NFPA 701, and local building codes.
 - d. Maximum Design Total Static Pressure: 10.0-inch W.G.
 - e. Temperature Range: -65 degrees F to 500 degrees F.
 - f. Width: Minimum 4 inches, but shall not exceed 14 inches.
2. Product and Manufacturer: Provide one of the following:
 - a. Model Thermafab, as manufactured by Duro Dyne Corporation.
 - b. Model PROflex, as manufactured by Ductmate Industries, Inc.
 - c. Or equal.
3. Details of Construction:
 - a. Base Fabric: Woven fiberglass.
 - b. Coating: Silicone rubber.
 - c. Weight: 17 ounce per square yard.
 - d. Tensile Strength: 200 lb by 250 lb.
 - e. Tear Strength: 50 lb by 40 lb.
 - f. Features:
 - 1) Excellent high temp resistance.
 - 2) Excellent low temp resistance.
 - 3) Excellent chemical resistance.
 - 4) Excellent low smoke emission.
 - 5) Excellent ozone resistance.
 - 6) Excellent weathering.
 - 7) Unaffected by mildew.
 - g. Metal connectors shall be of the same material and gauge as ductwork with double-lock fold.

H. Flexible Air Ducts:

1. Design and Performance Criteria:
 - a. Flexible air ducts shall be tested in accordance with UL 181.
 - b. Flexible air ducts shall be listed and labeled as Class 0 or Class 1 flexible air ducts.
 - c. Flexible air ducts including insulation and jacketing shall have the following Fire Hazard Classifications in accordance with ASTM E84:
 - 1) Flame Spread: 25 maximum.
 - 2) Smoke Developed: 50 maximum.
 - d. Flexible connectors shall meet NFPA 90A, NFPA 90B, and local building codes.
 - e. Maximum Design Total Static Pressure: 10.0-inch W.G.
 - f. Maximum Operating Velocity: 4000 fpm.
 - g. Maximum Water Vapor Transmission: 0.05 perm.
2. Product and Manufacturer: Provide one of the following:
 - a. Model M-KC, as manufactured by Thermaflex – A Division of Flexible Technologies, Inc.
 - b. Model F296, as manufactured by Hart & Cooley, Inc.
 - c. Or equal.
3. Details of Construction:
 - a. Flexible ductwork shall be limited to six feet and allowed only where shown or indicated on Drawings.
 - b. Inner liner shall be woven and coated fiberglass fabric permanently bonded to a coated spring steel wire helix.
 - c. Fiberglass insulation shall have a minimum thermal conductance R-value of 6.
 - d. Outer jacket shall be a fiberglass scrim reinforced aluminized polyester film vapor barrier.

I. Miscellaneous Duct Fittings:

1. Reference: HVAC DS.
2. Material: Same material as ductwork.

J. Sleeves:

1. Material: Same material as ductwork passing through opening.
2. Thickness: Minimum 24-gauge.
3. Calk airtight with fire resistant sealant between sleeve and ductwork.

K. Duct Gaskets:

1. Product and Manufacturer: Provide one of the following:
 - a. Model 440 Gasket Tape, as manufactured by Ductmate Industries, Inc.
 - b. Model 440 Butyl Gasket, as manufactured by Elgen Manufacturing Company, Inc.
 - c. Or equal.
2. Material: Non-hardening butyl.
3. Service Temperatures: -30 degrees F to 180 degrees F.
4. Service Life: 20 years minimum.

5. Gaskets shall have the following Fire Hazard Classifications in accordance with ASTM E84:
 - a. Flame Spread: 10 maximum.
 - b. Smoke Developed: 10 maximum.

L. Hardware and Fasteners:

1. All hardware and fasteners for aluminum and stainless steel ductwork shall be Type 316 stainless steel, unless noted otherwise.
2. All hardware and fasteners for galvanized ductwork shall be G90 hot dipped galvanized steel, unless noted otherwise.

M. Grilles and Diffusers:

1. General:
 - a. Grilles and diffusers mounted in hung ceilings shall have a baked enamel white finish.
 - b. Where registers are shown to be provided in lieu of grilles, include an integral opposed blade damper of the same construction as the grille.
2. Supply Grilles (SG):
 - a. Product and Manufacturer: Provide one of the following:
 - 1) Steel construction:
 - a) Model 20, as manufactured by Anemostat.
 - b) Model T54 as manufactured by Tuttle & Bailey.
 - c) Model 300RL- as manufactured by Titus.
 - d) Or equal.
 - b. Double deflection with horizontal face bars for horizontal duct and vertical face bars for vertical duct.
 - c. 3/4-inch blade spacing.
 - d. For surface mounting as shown or indicated on Drawings.
3. Return/Exhaust Grilles (RG/EG):
 - a. Product and Manufacturer: Provide one of the following:
 - 1) Steel construction:
 - a) Model 35, as manufactured by Anemostat.
 - b) Model T70, as manufactured by Tuttle & Bailey.
 - c) Model RL, as manufactured by Titus.
 - d) Or equal.
 - b. Single 0- or 45-degree deflection with horizontal face bars for horizontal duct and vertical face bars for vertical duct.
 - c. 3/4-inch blade spacing.
 - d. For surface mounting as shown or indicated on Drawings.

N. Drip Pans:

1. Provide 16-gauge Type 316 or 304 stainless steel drip pans under all ductwork installed over electrical equipment and motors.
2. Route drainage to nearest approved floor drain, gutter, or other drainage system with 3/4-inch pipe. All construction shall be liquid tight. Pitch the drain pan uniformly toward the drainpipe at a slope not less than 1/8-inch per lineal foot

2.4

2.4 IDENTIFICATION

- A. All equipment and component identification shall be provided in accordance with Section 10 14 00, Signage.

SOURCE QUALITY CONTROL

- A. Shop Tests:

1. Equipment shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
 - a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label or equal.
 - b. Factory test equipment to ensure that the entire package has been properly fabricated and assembled, that all the controls function as specified herein and that the package meets the specified performance requirements including manufacturer's data report.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Protection of Surrounding Areas/Surfaces:
 1. Openings and penetrations shall be capped to protect the building from outside conditions.
 2. Properly cap the open ends of all ductwork at the end of each day's Work or other stopping point throughout the construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.3 INSTALLATION

- A. General:
 1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 2. Install in accordance with Laws and Regulations.
 3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.

4. Installation to conform to requirements of all local and state codes.
- B. All ductwork shall conform accurately to the dimensions shown, the ducts shall be straight and smooth inside with joints neatly finished. Ductwork shall be installed so as to preclude the possibility of vibration under all operating conditions.
- C. Tape and seal all joints in accordance with HVAC DS. Tape shall not be used as the primary means of sealing. Tape used in sealing metallic ductwork shall be listed and labeled in accordance with UL 181A and shall be marked "181 A-P" for pressure-sensitive tape, "181 A-M" for mastic or "181 A-H" for heat-sensitive tape. Tape used in sealing flexible ductwork and connectors shall be listed and labeled in accordance with UL 181B and shall be marked "181 B-FX" for pressure-sensitive tape or "181 B-M" for mastic.
- D. Fire dampers shall be provided and installed where indicated and where required by UL and authorities having jurisdiction, and shall be approved by local building codes and in accordance with the requirements of the NFPA.
- E. Install all ductwork and accessories to provide a system free from buckling, warping, bellowing, or vibration.
- F. All ducts at flexible connections with fans shall be supported at free end within 12-inches of flexible connection.
- G. Provisions shall be made for supporting all ductwork, dampers, and other ductwork accessories, where necessary.
- H. Coordinate all air outlets for compatibility with ceiling system.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Services:
 1. Provide a qualified, factory-trained service person to perform the following:
 - a. Instruct Contractor in installing equipment.
 - b. After installation, inspect and adjust equipment, verify proper operation, and assist with field testing.
 - c. Instruct operations and maintenance personnel in operation and maintenance of the equipment.

3.5 ADJUSTING

- A. All duct systems shall be tested, adjusted, and balanced per Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
- B. Test openings shall be installed in the ductwork as directed by the testing, adjusting, and balancing Contractor. Test openings shall be sealed by a screw cap and gasket.

3.6 CLEANING

- A. Thoroughly clean all ductwork and accessories prior to installation.

- B. Remove all dirt, rust, dust, etc. from ductwork and accessories after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.
- D. Contractor to clean all existing ductwork

3.7 PROTECTION OF EXECUTED WORK

- A. Contractor to protect all occupied areas from working areas and clean-up/dispose of debris daily.

3.8 SCHEDULES

- A. Minimum Duct Thicknesses:
 - 1. Ductwork serving administrative (office) spaces: As recommended in the HVAC DS for the pressure classification, reinforcement and support spacing.
- B. All ductwork serving the following equipment shall be galvanized steel:
 - 1. All ductwork other than lab exhaust system.
- C. All ductwork serving the following equipment shall be Type 316 stainless steel welded:
 - 1. Lab exhaust system.

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SECTION 23 34 05

METALLIC HVAC FANS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install metallic HVAC fans complete and operational with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the metallic HVAC fans Work.
 - 2. Notify other Contractors in advance of the installation of metallic HVAC fans to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed with, or before, the metallic HVAC fans Work.
- C. Related Sections:
 - 1. Section 10 14 00, Signage.
 - 2. Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.
 - 3. Section 23 09 00, Instrumentation and Control for HVAC.
 - 4. Section 26 05 05, General Provisions for Electrical Systems.
 - 5. Section 26 05 53, Identification For Electrical Systems.
 - 6. Section 26 28 16.33, Disconnect Switches.

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc. (AMCA).
 - 1. AMCA Standard 99-2408 – Operating Limits for Centrifugal Fans.
 - 2. AMCA Standard 204 – Balance Quality and Vibration Levels for Fans.
 - 3. AMCA Standard 210 – Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
 - 4. AMCA Standard 301 – Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- B. American Society for Testing and Materials (ASTM).
 - 1. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
- C. Institute of Electrical and Electronic Engineers (IEEE).
- D. National Electrical Code (NEC).
- E. National Fire Protection Association (NFPA).

1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.

F. Underwriters Laboratories Inc. (UL).

1. UL 705 – Power Ventilators.

1.3 QUALITY ASSURANCE

A. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of the component manufacturer from a single metallic HVAC fan manufacturer.
2. Require the metallic HVAC fan manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the metallic HVAC fan manufacturer.

B. Regulatory Requirements:

1. National Electrical Code (NEC).
2. National Fire Protection Association (NFPA).
3. Underwriters Laboratories Inc. (UL).
4. Local and State Building Codes and Ordinances.
5. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

C. Certifications:

1. Metallic HVAC fans shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the National Electric Code.
2. Metallic HVAC fans shall be AMCA certified.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, installation details, and wiring diagrams.
 - b. Setting drawings, templates, and directions for the installation of roof/equipment curbs, anchor bolts, and other anchorages.
2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.
 - c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Fan performance curves with operating points.
 - f. Standard and custom color selection charts for finishing system.

- g. Lubricant Specification: Furnish lubricant specification for type and grade required for equipment furnished.
 - h. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - i. Other technical data related to specified material and equipment as requested by Engineer.
- 3. Testing Plans, Procedures, and Testing Limitations:
 - a. Plan for performing required field testing.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Certification of painting systems, in accordance with “Finishing” Article in this Section.
 - b. Independent certification reports:
 - 1) UL Label or equal.
 - 2) AMCA certification.
 - 2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 - c. Instructions for handling, start-up, and troubleshooting.
 - 3. Source Quality Control Submittals:
 - a. Written report presenting results of required shop testing.
 - b. Factory test reports.
 - 4. Field Quality Control Submittals:
 - a. Written report presenting results of required field testing.
- C. Closeout Submittals: Submit the following:
 - 1. Operations and Maintenance Data:
 - a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.
 - 2. Warranty Documentation:
 - a. General warranty.
 - b. Special warranties on materials and equipment.
- D. Maintenance Material Submittals: Furnish the following:
 - 1. Spare Parts:
 - a. Spare parts list and recommended quantities.
 - 2. Extra Stock Materials:
 - a. Touch up paint for each unit.
 - 3. Tools:
 - a. Two sets of special tools, if any, required for normal operation and maintenance.
 - 4. Spare parts, extra stock materials, and tools shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a

dry, warm location until transferred to the Owner at the conclusion of the Project.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of that Work.
 - 3. Comply with manufacturer's recommendations for rigging of equipment.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive Owner of other rights or remedies Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents. The obligations of Contractor under the Contract Documents shall not be limited in any way by the provisions of the specified special warranty.
- B. Special Warranty on Materials and Equipment:
 - 1. Provide manufacturer's written warranty, running to the benefit of Owner, agreeing to correct, or at option of Owner, remove or replace materials or equipment specified in this Section found to be defective during a period of 1 year after the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. Design Criteria:
 - 1. Design conditions shall be as indicated on the Equipment Schedule.
 - 2. Fans shall conform and be certified to UL 705.

3. Fan bearings shall be rated for a minimum L-10 life of 100,000 hours at the fan's maximum operating speed in accordance with ABMA 9 or 11.
4. Fans shall be balanced in accordance with AMCA Standard 204.

B. Performance Criteria:

1. Minimum performance data for each unit shall be as indicated on the Equipment Schedule. Provided equipment shall not exceed scheduled total power.
2. Fans shall be performance rated in accordance with AMCA Standards 210, 300, and 301.

2.2 DETAILS OF EQUIPMENT

A. Square Centrifugal Fans

1. Product and Manufacturer: Provide one of the following:
 - a. Model SQ , as manufactured by Greenheck
 - b. Model SQI, as manufactured by Loren Cook Company.
 - c. Or equal.
2. Housing:
 - a. Square design Minimum 18-gauge aluminum construction
 - b. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number
3. Fan Wheel:
 - a. Non-overloading, backward inclined centrifugal wheel
 - b. Constructed of Aluminum
 - c. Statically and dynamically balanced in accordance to AMCA Standard 204-05
 - d. The wheel cone and fan inlet shall be matched and shall have precise running tolerances for maximum performance and operating efficiency
 - e. Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone.
4. Motors:
 - a. Electronically Commutated Motor
 - b. Motor enclosure: Open drip proof
 - c. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors
 - d. Motors shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase
 - e. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
 - f. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal
 - g. Motor shall be a minimum of 85% efficient at all speeds.
5. Duct Collars:
 - a. Square design to provide a large discharge area

- b. Inlet and discharge collars provide easy duct connection
- 6. Access Panel:
 - a. Two sided access panels, permit easy access to all internal components
 - b. Located perpendicular to the motor mounting panel
- 7. Options/Accessories:
 - a. BD Damper, Inline balanced for minimal resistance to flow
- 8. Finishes:
 - a. Industrial Epoxy- thermosetting epoxy powder with chemical resistance to a wide variety of chemicals
- B. Direct Drive Roof Downblast Centrifugal Exhaust Fans
 - 1. Product and Manufacturer: Provide one of the following:
 - a. Model G, as manufactured by Greenheck.
 - b. Model ACE, as manufactured by Loren Cook Company.
 - c. Or equal.
 - 2. Housing:
 - a. Motor cover, shroud, curb cap, and lower windband shall be constructed of heavy gauge aluminum
 - b. Shroud shall have an integral rolled bead for extra strength
 - c. Shroud shall be drawn from a disc and direct air downward
 - d. Lower windband shall have a formed edge for added strength
 - e. Motor cover shall be drawn from a disc
 - f. All housing components shall have final thicknesses equal to or greater than preformed thickness
 - g. Curb cap shall have pre-punched mounting holes to ensure correct attachment
 - h. Rigid internal support structure
 - i. Leak proof
 - j. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number.
 - 3. Housing Supports and Drive Frame:
 - a. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators
 - 4. Vibration Isolation:
 - a. Rubber isolators, sized to match the weight of each fan.
 - 5. Wheel:
 - a. Constructed of Aluminum
 - b. Non-overloading, backward inclined centrifugal
 - c. Statically and dynamically balanced in accordance to AMCA Standard 204-05
 - d. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency
 - 6. Motors:
 - a. Electronically Commutated Motor
 - b. Motor enclosure: TENV
 - c. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole,

- Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors
- d. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase
 - e. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor
 - f. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal
 - g. Motor shall be a minimum of 85% efficient at all speeds

2.3 ACCESSORIES

A. Disconnects

- 1. Disconnects provided by Electrical contractor conforming to Section 26 28 16.33, Disconnect Switches.
- 2. Disconnects shall be constructed and rated for the location in which they are installed. Refer to Section 26 05 05, General Provisions for Electrical Systems, and the Electrical Drawings for area classifications and ratings.

B. Gravity Backdraft Dampers (GBD)

- 1. For fans where specified on the Equipment Schedule or shown on the Drawings.
- 2. End-pivoted, gravity backdraft damper constructed entirely of aluminum.
- 3. Multiple, interlocked blades.
- 4. Aluminum hinge pins.
- 5. EPDM blade edges.
- 6. Nylon bushings.
- 7. Contractor shall furnish gravity backdraft dampers from the unit manufacturer.

C. Prefabricated Roof Curbs

- 1. Where specified on the Equipment Schedule or shown on the Drawings.
- 2. Details of Construction:
 - a. Weatherproof, continuous welded, minimum 14-gauge (0.064-inch), aluminum construction with pressure treated wood nailer.
 - b. Insulated with minimum 1-1/2 inch thick, 3 lb/ft³ fiberglass sandwiched between inner and outer walls of curb.
 - c. 12 inches minimum height measured from top of finished roofing system to top of wood nailer. Contractor shall coordinate total height of curb with actual roofing system provided.
 - d. Provide wood blocking and wood cant as required.
 - e. Provide watertight flashing and counter flashing at curb.
 - f. Provide damper tray where backdraft damper is specified on the Equipment Schedule.
- 3. Curb Gasket: Minimum 1-inch wide by 1/2-inch thick EPDM gasket cemented to curb top to provide air and water seal between curb and housing. Neoprene is not acceptable.

4. Ventilator to Curb and Curb to Roof Deck Fasteners: Type 304 or 316 stainless steel hardware.
 5. Provide hinged base kit with Type 304 or 316 stainless steel latch cable and locking hasp for a hinged connection between roof fan and curb. Hinged base kit shall allow easy access to the wheel and inlet of the roof fan as well as the interior ductwork.
 6. Contractor shall furnish prefabricated roof curbs from the unit manufacturer.
- D. Companion Flanges
1. For all inline fans.
 2. Same material of construction as fan, predrilled to fit the flanges of the fan.
- E. Bird Screens
1. For all roof mounted fans.
 2. Type 304 or 316 stainless mesh screen securely anchored to housing, 80% free area.
- F. Mounting Hardware
1. Provide Type 304 or 316 stainless steel hardware for all fan installation.
- G. Structural Supports
1. Contractor shall provide and install all hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances as required to mount equipment where shown. All hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances shall conform to Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.

2.4 FINISHING

- A. All fans listed below shall have an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Coating shall be capable of withstanding at least 1,000 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B117 test procedure.
1. EF-2
- B. All surfaces shall be prepared, and coating systems applied and cured in strict accordance with the coating manufacturer's approved procedures. Primer coatings shall be selected for the specific material and application.
- C. Primer coat and finish coat dry film thickness shall be applied to the required thickness as recommended by the coating manufacturer to provide maximum corrosion protection.
- D. The equipment manufacturer shall furnish a written affidavit that the equipment has been prepared, primed, and coated in strict accordance with the coating manufacturer's procedures and at the coating manufacturer's facility.

- E. All gears, bearing surfaces, machined surfaces, and other surfaces that are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. Maintain coating during shipping and storage until equipment is placed into operation.

2.5 CONTROLS

- A. Refer to Section 23 09 00, Instrumentation and Control for HVAC, for sequence of operations.

2.6 IDENTIFICATION

- A. All equipment and component identification shall be provided in accordance with Section 10 14 00, Signage.
- B. All electrical wiring identification shall be provided in accordance with Section 26 05 53, Identification For Electrical Systems.
- C. All electrical wiring shall be color-coded and labeled for simplified identification. Power wiring shall be coded per Owner standards.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Protection of Surrounding Areas/Surfaces:
 - 1. Openings and penetrations shall be capped to protect the building from outside conditions.
 - 2. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.3 INSTALLATION

- A. General:
 - 1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 2. Install in accordance with Laws and Regulations.

3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
4. Installation to conform to requirements of all local and state codes.
5. Curb mounted fans shall be provided with enough electrical wiring and conduit slack to allow the fan to be removed from the curb without disconnecting the electrical wiring at the fan.

B. Install vibrator isolators.

3.4 FIELD QUALITY CONTROL

A. Field Tests:

1. After equipment installation is complete, Contractor and a qualified field service representative of unit manufacturer shall perform an operating test of each unit and associated controls, in presence of Engineer. Equipment will pass the test when each unit and its controls are demonstrated to function correctly.
2. Running Tests:
 - a. Field-test each equipment together with its controls and appurtenances. Tests shall demonstrate to Engineer that each part and all parts together function in accordance with the Contract Documents. Provide all necessary testing equipment, labor, and appurtenances.
 - b. Verify that equipment operates at design point as intended, that vibration limits are not excessive and beyond manufacturer's recommendations, and that equipment operates smoothly without excessive noise, temperature rise, or other defects, across entire range of operating curve. Verify that all controls work as intended in both manual and automatic mode.
 - c. If equipment does not comply with the Contract Documents and does not pass the tests, Contractor shall adjust, modify, and retest the equipment as often as necessary until tests are successfully passed.

3.5 ADJUSTING

- A. Adjust all controls for proper settings.
- B. While system is operable, balance all equipment to achieve design conditions.

3.6 CLEANING

- A. Thoroughly clean all equipment and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from equipment and accessories after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

+ + END OF SECTION + +

SECTION 23 34 06

NON-METALLIC HVAC FANS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install non-metallic HVAC fans complete and operational with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the non-metallic HVAC fans Work.
 - 2. Notify other Contractors in advance of the installation of non-metallic HVAC fans to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed with, or before, the non-metallic HVAC fans Work.
- C. Related Sections:
 - 1. Section 10 14 00, Signage.
 - 2. Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.
 - 3. Section 23 09 00, Instrumentation and Control for HVAC.
 - 4. Section 26 05 05, General Provisions for Electrical Systems.
 - 5. Section 26 05 53, Identification For Electrical Systems.
 - 6. Section 26 28 16.33, Disconnect Switches.

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc. (AMCA).
 - 1. AMCA Standard 204 – Balance Quality and Vibration Levels for Fans.
 - 2. AMCA Standard 210 – Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
 - 3. AMCA Standard 300 – Reverberant Room Method for Sound Testing of Fans.
 - 4. AMCA Standard 301 – Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- B. American Bearing Manufacturers Association (ABMA).
 - 1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 – Load Ratings and Fatigue Life for Roller Bearings.
- C. American Society for Testing and Materials (ASTM).
 - 1. ASTM E84 – Standard Test Method for Burning Characteristics of Building Materials.

2. ASTM D4167 – Standard Specification for Fiber-Reinforced Plastic Fans and Blowers.

D. National Electrical Code (NEC).

E. National Fire Protection Association (NFPA).

1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
2. NFPA 91 – Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids.

F. Underwriters Laboratories Inc. (UL).

1.3 QUALITY ASSURANCE

A. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of the component manufacturer from a single non-metallic HVAC fan manufacturer.
2. Require the non-metallic HVAC fan manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the non-metallic HVAC fan manufacturer.

B. Regulatory Requirements:

1. National Electrical Code (NEC).
2. National Fire Protection Association (NFPA).
3. Underwriters Laboratories Inc. (UL).
4. Local and State Building Codes and Ordinances.
5. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

C. Certifications:

1. Non-metallic HVAC fans shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the National Electric Code.
2. Non-metallic HVAC fans shall be AMCA certified.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, installation details, and wiring diagrams.
 - b. Setting drawings, templates, and directions for the installation of roof/equipment curbs, anchor bolts, and other anchorages.
2. Product Data:

- a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.
 - c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Fan performance curves with operating points.
 - f. Standard and custom color selection charts for finishing system.
 - g. Lubricant Specification: Furnish lubricant specification for type and grade required for equipment furnished.
 - h. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - i. Other technical data related to specified material and equipment as requested by Engineer.
 - 3. Testing Plans, Procedures, and Testing Limitations:
 - a. Plan for performing required shop testing.
 - b. Plan for performing required field testing.
- B. Informational Submittals: Submit the following:
- 1. Certificates:
 - a. Independent certification reports:
 - 1) UL Label or equal.
 - 2) AMCA certification.
 - 2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 - c. Instructions for handling, start-up, and troubleshooting.
 - 3. Source Quality Control Submittals:
 - a. Written report presenting results of required shop testing.
 - b. Factory test reports.
 - 4. Field Quality Control Submittals:
 - a. Written report presenting results of required field testing.
 - 5. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service personnel, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
 - 6. Qualifications Statements:
 - a. Manufacturer, when requested by Engineer.
- C. Closeout Submittals: Submit the following:
- 1. Operations and Maintenance Data:
 - a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.

- b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.
 - 2. Warranty Documentation:
 - a. General warranty.
 - b. Special warranties on materials and equipment.
- D. Maintenance Material Submittals: Furnish the following:
 - 1. Spare Parts:
 - a. Spare parts list and recommended quantities.
 - 2. Tools:
 - a. Two sets of special tools, if any, required for normal operation and maintenance.
 - 3. Spare parts, extra stock materials, and tools shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the Owner at the conclusion of the Project.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of that Work.
 - 3. Comply with manufacturer's recommendations for rigging of equipment.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 WARRANTY

- A. General Warranty: The special warranties specified in this Article shall not deprive Owner of other rights or remedies Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents. The obligations of Contractor under the Contract Documents shall not be limited in any way by the provisions of the specified special warranty.

- B. Special warranties on Materials and Equipment:
 - 1. Provide manufacturer's written warranty, running to the benefit of Owner, agreeing to correct, or at option of Owner, remove or replace materials or equipment specified in this Section found to be defective during a period of 1 year after the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. ANSI/AMCA Compliance: Applicable requirements to ANSI/AMCA Standards 99, 210, 300, and 301. Blowers must be tested in accordance with AMCA Publications 211 and 311 in an AMCA accredited laboratory and certified for air and sound performance. Blower shall be licensed to bear the AMCE rating seal for air performance (AMCA 210) and sound performance (AMCA 300). Manufacturers that are not licensed to bear the AMCA 210 ratings seal shall not be accepted.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Startup."
- D. ANSI/AMCA Compliance: Applicable requirements in latest Z9.5 Laboratory Ventilation.
- E. ASHRAE Compliance: Applicable requirements in Laboratory Design Guide.
- F. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.2 DETAILS OF EQUIPMENT

- A. FORWARD-CURVED CENTRIFUGAL CORROSION AND HAZARDOUS RESISTANT UTILITY BLOWER
 - 1. Product and Manufacturer: Provide one of the following:
 - a. Series P20, as manufactured by PLASTEC Ventilation, Inc.
 - b. Or equal.
 - 2. General
 - a. Fans used shall be capable of accommodating static pressure variations of plus and minus 10%.
 - b. Fans shall be suitable for highly corrosive and hazardous air applications such as laboratory exhaust for the chemical industry and other industries.
 - c. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas.
 - 3. Description
 - a. Factory-fabricated, -assembled, -tested, and -finished, direct-driven centrifugal corrosion and hazardous resistant utility blower, consisting of

- housing, impeller, motor shaft, bearings, motor, drive assembly, support structure, and accessories and other industries.
- b. Deliver utility blower as factory-assembled and tested unit, to the extent allowable by shipping limitations.
- 4. Housings and Internal/External Components:
 - a. Constructed of strong (min. 4-5mm thickness) high-density UV treated Polypropylene composite material for maximum corrosion and hazardous resistance.
 - b. Housing Assembly: Constructed of one single seamless, blow molded or injection molded, piece to prevent chemical gas/fume leakage. Split housing with baskets or welded housings are not acceptable. Metal in the housing air stream shall not be tolerated.
 - c. Plate and Housing Mounting: 316 Stainless-steel mounting hardware, supporting, and accessories.
- 5. Impeller
 - a. Impeller Configuration: Centrifugal forward-curved type.
 - b. Impeller Assembly: Constructed of strong (min. 4-5mm thickness) high-density UV treated uniformly injection molded Polypropylene composite material for maximum corrosion and hazardous resistance. Impeller shall be electronically and dynamically balanced. Utility blower impeller shall be supplied with a keyed motor hub bushing and O-ring sealed hubcap made of Polypropylene material to fully protect motor shaft end from corrosive gas/fume air contact. Impeller shall be suited for up to 3600 RPM.
- 6. Motor Base (Belt Drive Only):
 - a. Motor mounting plates shall be steel encapsulated with resin, mat, and cloth and mounted onto the housing.
 - b. Fully adjustable platform style.

2.3 ACCESSORIES

- A. Disconnects:
 - 1. Disconnects provided by Electrical contractor conforming to Section 26 28 16.33, Disconnect Switches.
 - 2. Disconnects shall be constructed and rated for the location in which they are installed. Refer to Section 26 05 05, General Provisions for Electrical Systems, and the Electrical Drawings for area classifications and ratings.
- B. Variable Frequency Drive:
 - 1. Manufacturer programmed variable frequency drive for plug and play application.
- C. Housing drain connection plug pipe coupling attached to lowest point of blower scroll housing.
- D. Inlet or Outlet Flexible PVC reducer / coupling with stainless steel compression clamps. Sized per blower series model inlet/outlet OD and duct pipe OD.

- E. Inlet or Outlet Exhaust Guard / Bird Screen: Corrosion resistant grid screen (9.5sq. mm opening) constructed of polypropylene material.
- F. Neoprene vibration rubber isolators with zinc plated threads and stainless-steel hardware.
- G. Adjustable Polypropylene butterfly damper with locking quadrants and stainless-steel hardware.
- H. Vertical Gravity Polypropylene Backdraft Damper.
- I. Polypropylene high-density UV treated weather stack system with beveled end socket and seamless construction, stack shall have zero pressure loss. Max height 1.52m (5ft) each stack, stackable capability.
- J. Polypropylene high-density UV treated velocity discharge exhaust nozzle. Beveled end socket and seamless construction, optimized for 3,000 fpm velocity discharge.
- K. Curb: Galvalume roof curb, 16-gauge, insulated, with nailers, designed for flat roof installation.
- L. Polypropylene high-density UV treated Roof Unit Kit for blower installation on existing or new roof curb. Includes roof curb cap, cap motor bracket, outlet exhaust guard / bird screen, motor cap cover, and stainless-steel hardware. Horizontal exhaust discharge application only. (Curb provided separately).
- M. Galvanized enamel pickled black coated support stand with stainless steel hardware.
- N. Stainless Steel (304L) support stand with stainless steel hardware.
- O. Polypropylene high-density UV treated Weather Hood/Pedestal enclosure. Constructed to support entire blower system structure, motor protection against weather elements, and protection against hazardous spray environments.
- P. Aluminum gray powder coated finish Weather Hood/Pedestal enclosure. Corrosion resistant 5052 H32 aluminum construction material, stainless-steel hardware, reversible (front to back and back to front opening) inspection access hood that is self-locking in open position. Hood and pedestal shall be rated for 400F.

2.4 CONTROLS

- A. Refer to Section 23 09 00, Instrumentation and Control for HVAC, for sequence of operations.

2.5 IDENTIFICATION

- A. All equipment and component identification shall be provided in accordance with Section 10 14 00, Signage.

- B. All electrical wiring identification shall be provided in accordance with Section 26 05 53, Identification For Electrical Systems.
- C. All electrical wiring shall be color-coded and labeled for simplified identification. Power wiring shall be coded per Owner standards.

2.6 SOURCE QUALITY CONTROL

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Protection of Surrounding Areas/Surfaces:
 - 1. Openings and penetrations shall be capped to protect the building from outside conditions.
 - 2. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.3 INSTALLATION

- A. General:
 - 1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 2. Install in accordance with Laws and Regulations.
 - 3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
 - 4. Installation to conform to requirements of all local and state codes.
 - 5. Roof curb mounted fans shall be provided with enough electrical wiring and conduit slack to allow the fan to be removed from the curb without disconnecting the electrical wiring at the fan.
 - 6. Install centrifugal utility blower level and plumb.
 - 7. Do not operate blowers for any purpose until ductwork is clean, bearings lubricated, and blower has been test run under observation.
 - 8. Disassemble and reassemble units, as required for moving to the final location, in accordance with manufacturer's written instructions.
 - 9. Lift and support units with manufacturer's designated lifting or supporting points.

10. Install units with clearances for service and maintenance.
11. To prevent the possibility of chemical and hazardous air entering the building, ensure that the installation of the utility blower systems are at least 6m (20ft) away from any other equipment, makeup air intake units, intake louvers, windows, and doors. If 6m (20ft) distance is not attainable, ensure that utility blowers are installed with minimum 3m (10ft) height corrosion resistant polypropylene stack systems and high velocity discharge nozzle.
12. Curb Support: Install roof curb on roof structure, level and secure, in accordance with "The NRCA Roofing and Waterproofing Manual," detail "Equipment Support Curb," number "SPF-9" and detail "Equipment Support Curb," number "SPF-9S". Install and secure centrifugal corrosion and hazardous resistant utility blowers with roof unit kit on curbs, and coordinate roof penetrations and flashing with roof construction. Secure units to curb support with 316 Stainless Steel anchor bolts (min. 12" O.C.).
13. Install flexible reducer/coupling connections specified in Section 23 31 13 - Metal Ductwork, between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch (25mm) flex between ductwork and fan while running.

B. Ductwork:

1. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible PVC connectors. Flexible PVC connectors are specified in Section 23 31 13 - Metal Ductwork.
2. Install ducts adjacent to fans to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

A. Field Tests:

1. After equipment installation is complete, Contractor and a qualified field service representative of unit manufacturer shall perform an operating test of each unit and associated controls, in presence of Engineer. Equipment will pass the test when each unit and its controls are demonstrated to function correctly.
2. Running Tests:
 - a. Field-test each equipment together with its controls and appurtenances. Tests shall demonstrate to Engineer that each part and all parts together function in accordance with the Contract Documents. Provide all necessary testing equipment, labor, and appurtenances.
 - b. Verify that equipment operates at design point as intended, that vibration limits are not excessive and beyond manufacturer's recommendations, and that equipment operates smoothly without excessive noise, temperature rise, or other defects, across entire range of operating curve. Verify that all controls work as intended in both manual and automatic mode.
 - c. If equipment does not comply with the Contract Documents and does not pass the tests, Contractor shall adjust, modify, and retest the equipment as often as necessary until tests are successfully passed.

3.5 ADJUSTING

- A. Adjust all controls for proper settings.
- B. While system is operable, balance all equipment to achieve design conditions.

3.6 CLEANING

- A. Thoroughly clean all equipment and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from equipment and accessories after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

+ + END OF SECTION + +

SECTION 23 74 13

PACKAGED OUTDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install packaged outdoor central-station air-handling units complete and operational with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the packaged outdoor central-station air-handling units Work.
 - 2. Notify other Contractors in advance of the installation of the packaged outdoor central-station air-handling units to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed with, or before, the packaged outdoor central-station air-handling units Work.
- C. Related Sections:
 - 1. Section 10 14 00, Signage.
 - 2. Section 23 09 00, Instrumentation and Control for HVAC.
 - 3. Section 26 05 53, Identification For Electrical Systems.
 - 4. Section 26 28 16.33, Disconnect Switches.

1.2 REFERENCES

- A. Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
 - 1. AHRI 210/240 – Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - 2. AHRI 340/360 – Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
 - 3. AHRI 410 – Forced-Circulation Air-Cooling and Air-Heating Coils.
- B. Air Movement and Control Association International, Inc. (AMCA).
 - 1. AMCA Standard 210 – Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
- C. American Bearing Manufacturers Association (ABMA).
 - 1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 – Load Ratings and Fatigue Life for Roller Bearings.
- D. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
 - 1. ASHRAE Standard 15 – Safety Standard for Refrigeration Systems.

2. ASHRAE Standard 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- E. American Society for Testing and Materials (ASTM).
 1. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
 2. ASTM D870 – Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.
 3. ASTM D2247 – Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
- F. National Electrical Code (NEC).
- G. National Electrical Manufacturers Association (NEMA).
 1. NEMA ICS 3.1 – Guide for the Application, Handling, Storage, Installation and Maintenance of Medium-Voltage AC Contactors, Controllers and Control Centers.
- H. Underwriters Laboratories Inc. (UL).
 1. UL 900 – Air Filter Units.
 2. UL 1995 – Heating and Cooling Equipment.

1.3 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single packaged outdoor central-station air-handling unit manufacturer.
 2. Require the packaged outdoor central-station air-handling unit manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the packaged outdoor central-station air-handling unit manufacturer.
- B. Regulatory Requirements:
 1. National Electrical Code (NEC).
 2. National Fire Protection Association (NFPA).
 3. Underwriters Laboratories Inc. (UL).
 4. Local and State Building Codes and Ordinances.
 5. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.
- C. Certifications:
 1. Packaged outdoor central-station air-handling units shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the National Electric Code.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, installation details, and wiring diagrams.
 - b. Detailed drawings of each individual component's wiring diagrams.
 - c. Detailed drawings of control panel layout.
 - d. Detailed installation drawing of each individual component showing:
 - 1) Mounting requirements including roof/equipment curbs.
 - 2) Locations (panel, field, etc.).
 - 3) Ductwork, piping, and wiring connections, labeled and coded.
 - e. Setting drawings, templates, and directions for the installation of roof/equipment curbs, anchor bolts, and other anchorages.
 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.
 - c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Fan performance curves with operating points.
 - f. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - g. Lubricant Specification: Furnish lubricant specification for type and grade required for equipment furnished.
 - h. Other technical data related to specified material and equipment as requested by Engineer.
- B. Informational Submittals: Submit the following:
1. Certificates:
 - a. Certification of unit painting systems in accordance with "Finishing" Article in this Section.
 - b. Independent certification reports:
 - 1) UL Label or equal.
 - 2) AHRI Label.
 2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 - c. Instructions for handling, start-up, and troubleshooting.
 3. Source Quality Control Submittals:
 - a. Written report presenting results of required shop testing.
 - b. Factory test reports.
 4. Field Quality Control Submittals:
 - a. Written report presenting results of required field testing.
 5. Supplier Reports:

- a. Submit written report of results of each visit to Site by Supplier's service personnel, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
- 6. Qualifications Statements:
 - a. Manufacturer, when requested by Engineer.
- C. Closeout Submittals: Submit the following:
 - 1. Operations and Maintenance Data:
 - a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.
 - 2. Warranty Documentation:
 - a. General warranty.
 - b. Special warranties on materials and equipment.
- D. Maintenance Material Submittals: Furnish the following:
 - 1. Spare Parts:
 - a. Spare parts list and recommended quantities.
 - b. One set of filters for each unit.
 - 2. Tools:
 - a. Two sets of fin combs for each fin spacing required.
 - 3. Spare parts, extra stock materials, and tools shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the Owner at the conclusion of the Project.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
 - 3. Comply with manufacturer's recommendations for rigging of equipment.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components

and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 WARRANTY

- A. General Warranty: The special warranties specified in this Article shall not deprive Owner of other rights or remedies Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents. The obligations of Contractor under the Contract Documents shall not be limited in any way by the provisions of the specified special warranties.
- B. Special Warranties on Materials and Equipment:
 - 1. Provide manufacturer's written warranty, running to the benefit of Owner, agreeing to correct, or at option of Owner, remove or replace materials or equipment specified in this Section found to be defective during a period of years as listed below after the date of Substantial Completion.
 - a. Compressors shall carry a 5 year non-prorated warranty.
 - b. All coil coatings shall carry a 5-year non-prorated warranty.
 - c. All other components not listed above shall carry a minimum 1 year non-prorated warranty.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. Equipment Description:
 - 1. RTU-1:
 - a. Unit furnished and installed shall be packaged outdoor air unit(s) as scheduled on contract documents and described in these specifications. Unit(s) shall be designed for cooling and heating and ventilation. Compressor controls shall modulate capacity to maintain evaporator leaving set point. Hot Gas Bypass shall not be used to control compressor capacity. Heating system Heat Pump and with electric auxiliary heating and modulating controls. Compressor on-off only or primary heating on-off only controls shall not be acceptable control strategies.
 - b. Unit discharge airflow configuration shall be: Horizontal discharge through side of unit.
 - 2. RTU-2:
 - a. Unit furnished and installed shall be packaged outdoor air unit as scheduled on contract documents and described in these specifications. Unit shall be designed for dehumidification, cooling and/or heating of 100% Outdoor Air. For dehumidification and cooling modes, the evaporator temperature shall be monitored, reported at unit controller. Compressor controls shall modulate capacity to maintain evaporator leaving set point. Hot Gas Bypass shall not be used to control compressor capacity. Compressor Hot Gas Reheat (HGRH) shall be factory installed. To prevent rehydration of evaporator condensate the reheat coil face shall

be located a minimum of 6" downstream from the leaving face of the evaporator coil. Heating system shall be electric and include modulating controls. Compressor on-off only or primary heating on-off only controls shall not be acceptable control strategies.

- b. Unit discharge airflow configuration shall be: Horizontal discharge through side of unit.
- 3. Units shall be completely factory assembled and tested, internally wired, and fully charged with refrigerant. Unit shall consist of insulated weatherproof cabinet with compressors, condenser coils, condenser fans, filters, cooling section, heating section, supply fans, motors and drives, outside air intake hood, and including all unit mounted controls, wiring and accessories.
- 4. Units shall be equipped with provisions for forklift or crane lifting and be designed structurally to withstand the stresses.
- 5. Factory fabricate and test units of sizes, capacities, and configuration as indicated and specified. Units shall be fully assembled on steel support members up to practical shipping limitations. On units not shipped fully assembled, manufacturer shall tag each section to indicate location and direction of airflow to facilitate assembly at the Site.

B. Design Criteria:

- 1. Design conditions shall be as indicated on the Equipment Schedule.
- 2. Units shall conform and be certified to the latest editions of ASHRAE Standard 15 and UL 1995.

C. Performance Criteria:

- 1. Minimum performance data for each unit shall be as indicated on the Equipment Schedule. Provided equipment shall not exceed scheduled total power.
- 2. Units shall meet or exceed the Energy Efficiency Ratio (EER) shown on the Equipment Schedule when tested in accordance to the latest editions of AHRI Standard 210/240 or 340/360.

2.2 MANUFACTURERS

A. Product and Manufacturer: Provide one of the following:

- 1. RTU-1:
 - a. Precedent Series, as manufactured by Trane.
 - b. Model DPS, as manufactured by Daikin.
 - c. Or equal.
- 2. RTU-2:
 - a. Horizon™ Model OAU, as manufactured by Trane.
 - b. Or equal.

2.3 DETAILS OF CONSTRUCTION

A. RTU-1

- 1. Cabinet:
 - a. Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a

- weather-resistant baked enamel finish. Unit's surface shall be tested 500 hours in a salt spray test in compliance with ASTM B117.
- b. Unit construction shall allow for all maintenance on one side of the unit. Access to filters, dampers, cooling sections, heating sections, supply fans, compressors, condensers, and electrical and controls components shall be through hinged access doors with rain break overhangs above doors and quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors. Removal of screwed wall panels shall not be acceptable.
 - c. All exposed vertical panels and top covers in the indoor air section shall be insulated with a cleanable foil-faced, fire-retardant permanent, odorless glass fiber material. The base of the unit shall be insulated with 1/8 inch, foil-faced, closed-cell insulation. All insulation edges shall be either captured or sealed. The unit's base pan shall have no penetrations within the perimeter of the curb to provide an added water integrity precaution, if the condensate drain backs up. The base of the unit shall have provisions for forklift and crane lifting, with forklift capabilities on three sides of the unit.
 - d. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Continuous sealing shall be included between panels and between access doors and openings. Refrigerant piping and electrical conduit through cabinet panels shall include sealing. Cabinet leakage shall not exceed 1 percent of total airflow when tested at three times the minimum external static pressure provided in AHRI Standards. Panel deflection shall not exceed L/240 ratio at 125 percent of design static pressure, at a maximum 8 inches of positive or negative static pressure. Deflection shall be measured at the midpoint of the panel height and width.
 - e. Unit shall be provided with factory fabricated filter section with filter guides or holding frames. Block-offs shall be provided as required to prevent air bypass around filters.
 - f. Unit shall provide an external location for mounting a disconnect device.
2. Fans and Motors
- a. Indoor fans shall be high efficiency forward curved impeller.
 - b. Indoor fans shall be direct drive with premium efficiency motors, statically and dynamically balanced, draw through.
 - c. Outdoor fans shall be direct drive with premium efficiency motors, statically and dynamically balanced, draw through in the vertical discharge position.
 - d. Provide shafts constructed of solid hot rolled steel, ground and polished, with keyway, and protectively coated with lubricating oil.
3. Air Filters
- a. The Evaporator Inlet shall include a full complement of pleated media air filters. Filters shall be as indicated in equipment schedule.
 - 1) 2" deep MERV 13.
4. Air Cooled Condenser Section:
- a. Condenser section shall be of similar construction to unit cabinet.

- b. Fans shall be direct drive, statically and dynamically balanced, for vertical discharge axial flow.
 - c. Fan motor shall be permanently lubricated and have built-in thermal overload protection.
 - d. Coils shall be copper tubes with aluminum fins mechanically bonded to the tubes.
 - e. Coils shall be leak tested to 450 psig and pressure tested to 600 psig at the factory.
 - f. Coils shall be designed for a minimum of 10 degrees F of refrigerant sub-cooling.
5. Refrigeration Systems:
- a. Refrigeration system shall be factory run and adjusted prior to shipment.
 - b. Compressors shall be hermetically sealed, scroll type with internal thermal overload protection and independently circuited.
 - c. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation.
 - d. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
 - e. Each refrigeration circuit shall be equipped with factory installed thermostatic expansion device, automatic reset low pressure and manual reset high pressure refrigerant controls, service pressure ports on both the high side and low pressure sides, and refrigerant line filter driers. An area shall be provided for replacement of suction line driers.
 - f. Each refrigeration circuit shall be equipped with factory installed liquid line sight glasses.
 - g. Each refrigeration circuit shall be equipped with suction and discharge compressor isolation valves.
 - h. Refrigeration system shall include a variable capacity scroll compressor on the lead [all] refrigeration circuit(s) which shall be capable of modulation from 10 to 100 percent of its capacity.
6. Unit shall be configured as an air-source heat pump. Each refrigeration circuit shall each be equipped with a factory installed liquid line filter drier with check valve, reversing valve, accumulator, and thermal expansion valves on both the indoor and outdoor coils. Reversing valve shall energize during the heat pump heating mode of operation.
7. Outside Air Options:
- a. Unit shall be adjustable for 0 to 50 percent outside air operation with a motor operated outside air damper assembly and return air connection.
 - b. Unit shall include outside air opening bird screen and outside air hood with rain lip.
8. Outside Air Dampers:
- a. Dampers shall be constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have leakage no more than 15 cfm/ft² of damper area when subjected to 2 inches w.g. air pressure differential across the damper.

- b. Damper assembly shall be controlled by spring return, two position actuator.
- 9. Electric Heating Section:
 - a. Low watt density.
 - b. Heavy duty nickel-chromium elements internally delta connected.
 - c. UL approved with disc-type automatic and manual reset-type thermal safety devices.
 - d. Air flow safety interlock.
 - e. Safety fuse located in the line of power to prevent power surge damage.
 - f. Automatic line break high limit controls.
 - g. Heater element shall be controlled by a 24 VAC normally opened magnetic contactor(s).
 - h. Heater shall be furnished with proper internal components to allow for a single point power connection.
 - i. Auxiliary electric heating capacity shall be sized to meet heating leaving air temperature setpoint when heat pump heating is in operation. Auxiliary heating capacity shall be available for operation when heat pump heating is in operation.

B. RTU-2

- 1. Cabinet:
 - a. Cabinet panels: 2" double-wall foamed panel with thermal break construction throughout the indoor section of unit to provide nonporous, cleanable interior surfaces. All interior seams exposed to airflow shall be sealed.
 - b. Insulation: 2" polyisocyanurate or 2" polyurethane injected foam metal encapsulated with no exposed edges. Initial R value of 6.6 per inch of thickness.
 - c. Cabinet base shall be double wall construction designed to prevent trapping or ponding of water within the unit base. Cabinet base pan shall be insulated with 2" thick polyisocyanurate foam. Foam insulation shall be fully enclosed with galvanized steel insulation cover. Insulation shall not be applied to underside of unit base.
 - d. Cabinet Base Rails: Side and end base rails shall include openings for forklift and tie-down access. To protect unit base from fork damage side rails shall include removable heavy gauge fork pockets.
 - e. Shipping anchors attach to and/or through unit base rails. Straps over unit shall not be used to secure unit for shipping.
 - f. Cabinet material interior and base rails: shall be G-90 zinc-coated galvanized steel. Material gauge shall be a minimum of 14-gauge for base rails, 16-gauge for structural members and 20-gauge for access doors and cabinet panels.
 - g. Exterior Corrosion Protection: Exterior cabinet panels shall be a base coat of G-90 galvanized steel with both exterior and interior surfaces cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be in compliance with ASTM B117 salt spray testing at a minimum of 672-hour duration.

- h. Cabinet construction shall provide hinged panels providing easy access for all parts requiring routine service.
 - i. Cabinet top cover shall be one piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.
 - j. Hinged Access Panels: Water- and air-tight hinged access panels shall provide access to all areas requiring routine service including air filters, heating section, electrical and control cabinet sections, supply air fan section, evaporator and reheat coil sections. Insulated doors shall be constructed to allow the hinges to be reversed in the field.
 - k. Hold-open devices shall be factory installed on all hinged front access doors. Chains shall not be used as hold-open devices.
 - l. Latches with locking hasps or tool operated closure devices shall be factory installed on all hinged access panels.
 - m. Drain Pan material shall be Type 304 Stainless steel drain and constructed to sloped in two directions to ensure positive drainage with corners exposed to standing water and drain fittings welded liquid tight to prevent leaks. Pan shall have a minimum depth of 2". Base of drain pan shall be insulated with 1" thick foam insulation.
 - n. Provide openings either on side of unit for power, control.
 - o. Cabinet shall include interior liner constructed of Type 304 stainless steel with sealed seams.
 - p. Unit shall be equipped with a 6" filter rack upstream of the evaporator. Frame shall be field-adjustable to match any filter combination specified in the following section.
 - q. Unit shall provide an external location for mounting a disconnect device.
2. Fans and Motors
- a. Indoor fans shall be high efficiency backward curved impeller.
 - b. Indoor fans shall be direct drive with premium efficiency motors, statically and dynamically balanced, draw through.
 - c. Outdoor fans shall be direct drive with premium efficiency motors, statically and dynamically balanced, draw through in the vertical discharge position.
 - d. Provide shafts constructed of solid hot rolled steel, ground and polished, with keyway, and protectively coated with lubricating oil.
3. Air Filters
- a. The Evaporator Inlet shall include a full complement of pleated media air filters. Filters shall be as indicated in equipment schedule.
 - 1) 2" deep MERV 8.
 - 2) 4" deep MERV 14.
 - 3) 6" deep (combinations of MERV 8 and 14 rated filters above.
4. Air Cooled Condenser Section:
- a. Outdoor Fans: Shall be direct drive vertical discharge design with low-noise corrosion resistant glass reinforced polypropylene props, powder coated wire discharge guards and electro-plated motor mounting brackets.
 - b. Fans shall be statically and dynamically balanced.
5. Dehumidification/Cooling
- a. Compressors

- 1) All units shall have direct drive, scroll type Digital Scroll Compressor compressors.
- 2) Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage.
- 3) Internal overloads shall be provided with the scroll compressors.
- 4) Each compressor shall have a crankcase heater to minimize the amount of liquid refrigerant present in the oil sump during off cycles.
- 5) Each compressor shall be mounted on rubber vibration isolators, to reduce the transmission of noise.
- 6) Provide each unit with hermetically sealed refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, liquid line charging port, suction and liquid line pressure ports, sight glass, and thermal expansion valve.
- 7) Provide each circuit with automatic reset high and low pressure and high temperature switches for safety control.
- b. Compressor Capacity Control
 - 1) Mechanical Control: shall be equipped with Refrigerant Capacity Control (RCC) on the lead circuit to modulate compressor capacity during Dehumidification or Cooling modes to maintain evaporator Dehumidification or Cooling setpoint and prevent evaporator frosting or freezing. RCC shall be electrical. Hot gas bypass shall not be an acceptable compressor capacity control strategy. The RCC setpoint is factory set, and field adjustable, to maintain desired suction pressure and compressor discharge pressure.
 - 2) Electronic Control: Compressor output capacity shall be controlled by the Main Control Module (refer to unit control and sequence sections of this specification).
6. Heating
 - a. Modulating Electric Resistance Heating System
 - 1) Completely assembled and factory installed electric heating system shall be fully modulating, SCR controlled and listed for use in roof top handler. The heating section will include open coil heating elements, automatic and manual cut-outs, low voltage controls, air proving switch, maximum 48 amps per circuit and fusing for heaters over 48 amps. Electric heater shall be located:
 - a) In the Primary heating position located downstream of the indoor fan assembly.
 - 2) Heater shall be UL or CSA listed and approved and provide single point power connection.
7. Electrical Ratings And Connections
 - a. All high voltage power components such as fuses, switches and contactors shall include a service personnel protection barrier or shall be a listed as touch-safe design.
 - b. Power wiring to be single point connection.
 - c. Wiring internal to the unit shall be colored and numbered for identification.
 - d. Unit shall be factory wired to field wiring terminal block mounted in isolated enclosure.

- e. Factory wired main power disconnect and overcurrent device shall be rated for total unit connected power.
 - f. Unit SCCR rating shall be a minimum of 5kA.
 - g. Optional unit SCCR rating shall be a minimum of 65kA.
 - h. Factory wired Voltage/Phase monitor shall be included as standard. In the event of any of the following, the units will be shut down and a fault code will be stored in the monitor for the most recent 25 faults. Upon correction of the fault condition the unit will reset and restart automatically.
 - 1) Phase Unbalance Protection: Factory set 2% with a maximum adjustment of 3% in the field.
 - 2) Over/Under/Brown Out Voltage Protection: +/-10% of nameplate voltage.
 - 3) Phase Loss/Reversal.
 - 4) Factory to mount 120-volt convenience outlet.
 - 5) All low voltage field wiring connections shall be made at factory installed low voltage terminal strip.
8. Coils:
- a. Evaporator, Condenser and Hot Gas Reheat coils shall be constructed with copper tubes mechanically bonded to configured aluminum plate fins.
 - b. Casings to be constructed with 14-gauge 304 L stainless steel.
 - c. Copper tube shall be C12200, ASTM B75, that is 050 light annealed tubing, with a minimum grain size of 0.015 to 0.035 mm. Tensile strength shall be a minimum of 34KSI, with a yield strength of 9-13KSI.
 - d. Aluminum fin shall be of the Series 1100, ASTM B209, with an H112 Temper.
 - e. Coils shall be factory leak tested in accordance ANSI/ASHRAE 15-1992 at a minimum pressure of 500 PSIG.
 - f. The condenser coil shall have a fin designed for ease of cleaning.
 - g. Evaporator coil shall include four rows of cooling interlaced for superior sensible and latent cooling with a maximum of 12 FPI for ease of cleaning.
 - h. Reheat coil shall be fully integrated into the supply airstream and be capable of delivering design supply air temperature.
 - i. To prevent re-hydration of condensate from evaporator coil, the evaporator coil face and the hot gas reheat coil face shall be separated by a minimum of six inches.
 - j. Coil Coating: Coil will have a flexible epoxy polymer e-coat uniformly applied to all coil surface areas with no material bridging between fins. The coating process will ensure complete coil encapsulation and a uniform dry film thickness from 0.6 – 1.2 mills on all surface areas including fin edges and meet 5b rating cross hatched adhesion per ASTM B3359- 93. Corrosion durability will be confirmed through testing with no less than 5,000 hours salt spray resistance per ASTM B117-90 using scribed aluminum test school coupons. The coil coating will meet the following test standards:
 - 1) MIL-C-46168 Chemical Agent Resistance – DS2, HCL Gas.

- 2) CIDA-A-52474-A (GSA).
- 3) MIL-STD810F, Method 509.4 (Sand and Dust).
- 4) MIL-P-53084 (ME)-TACOM Approval.
- 5) MIL-DTL-12468 Decontamination Agent (STB).
- 6) DPG (Dugway Proving Grounds) Soil & Water Exposure Tests.
- 7) GM9540P-97 Accelerated Corrosion Test (120 cycles).
- 8) ASTM B117-G85 Modified Salt Spray (Fog) Testing-2,000 hours (tested by ARL for Lockheed Martin).
- k. The unit(s) must comply per above - spray coatings not acceptable.
- l. Condenser coil hail guards shall be factory installed.
- 9. Outside Air Options:
 - a. Unit shall be configured for 100 percent outside air operation with a motor operated outside air damper assembly and no return air connection.
 - b. Unit shall include outside air opening bird screen and outside air hood with rain lip.
- 10. Outside Air Dampers:
 - a. Dampers shall be constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have leakage no more than 15 cfm/ft² of damper area when subjected to 2 inches w.g. air pressure differential across the damper.
 - b. Damper assembly shall be controlled by spring return, two position actuator.

2.4 ACCESSORIES

- A. Unit shall include factory installed, painted galvanized steel condenser coil guards on the face of the condenser coil.
- B. Disconnect switches provided by Electrical contractor. Disconnect shall conform to Section 26 28 16.33, Disconnect Switches.
- C. Units shall be provided with 120 VAC ground-fault-circuit-interrupter (GFCI) type service outlets unpowered. Electrical shall provide power to outlets.
- D. Unit shall include dirty filter switch for remote indication.
- E. Unit shall be provided with an UL 268A rated smoke detector(s) sensing the supply air (RTU-2) of the unit, wired to shut off the unit's control circuit.
- F. Unit shall be provided with a terminal block for field installation of a smoke detector which shuts off the unit's control circuit.
- G. Unit shall be provided with a firestat sensing the return and supply air of the unit, wired to shut off the unit's control circuit.
- H. Prefabricated Curb:
 - 1. Weatherproof, continuous welded, constructed of aluminum with pressure treated wood nailer.

2. Curb shall be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the unit to be mounted on the curb immediately before mounting of the unit.
3. Curb shall be 12-inches minimum height measured from top of finished roofing system to top of wood nailer. Contractor shall coordinate total height of curb with actual roofing system provided.
4. Curb shall be solid bottom type with factory lined 1 inch neoprene coated fiberglass insulation.
5. Provide flashing and counter flashing at curb as required to make watertight installation.
6. Unit to curb and curb to roof deck fasteners shall be Type 304 or Type 316 stainless steel.
7. Condensate drainage system shall be routed to nearest roof drain.

2.5 CONTROLS

- A. Refer to Section 23 09 00, Instrumentation and Control for HVAC, for additional information and sequence of operations. Provide provisions for interfacing with the instrumentation and control (IC) system. Components requiring remote monitoring and control shall be wired to a terminal block for interfacing with the IC system. Contractor shall coordinate operating system requirements with Section 23 09 00, Instrumentation and Control for HVAC, for a complete system.
- B. Unit shall be completely factory wired with the necessary controls, starters, contactors and terminal blocks for power and control wiring.
- C. Unit shall be provided with phase and brown-out protection to de-energize all motors in the unit if the phases are more than 10 percent out of balance on voltage, or the voltage is more than 10 percent under design voltage, or on phase reversal.
- D. Control panel shall be of similar construction to unit conforming to UL 1995 and shall be provided with a hinged latching cover and multiple concentric knockouts for field wiring.
- E. Control panel shall be provided with automatically controlled closed loop ventilation fans or closed loop air conditioners with filtered air louvers if required to maintain temperature inside below the maximum and above the minimum operating temperature ratings of the electrical components.
- F. A color-coded circuit diagram of the approved electrical drawing shall be provided with the unit.
- G. All electrical components shall bear the UL label.
- H. Unit shall be designed for single point electrical connection. All necessary power transformers shall be factory provided and installed.

- I. Units with ECM driven supply fan shall have factory installed potentiometer within control panel to allow for adjustment of airflow setpoint.
- J. Factory Provided Unit Controller:
 - 1. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested.
 - 2. Controller shall be capable of standalone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
 - 3. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
 - 4. Controller shall include non-volatile memory to retain all programmed values, without the use of an external battery, in the event of a power failure.
 - 5. Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a BACnet network.
- K. Unit shall be provided with a terminal block for field installation of controls provided by the IC contractor under Section 23 09 00, Instrumentation and Control for HVAC. Isolation relays shall be factory provided.
- L. Air-source heat pump shall include an optimized start defrost cycle to prevent frost accumulation on the outdoor coil during heat pump heating operation and to minimized defrost cycle energy usage. If the temperature of the outdoor heat exchanger and/or the suction line is less than a predetermined value, a deferred defrost cycle is initiated wherein the defrost cycle starts after a variable, continuously optimizing, time interval has elapsed. The defrost cycle is terminated when the relative temperatures of the outdoor heat exchanger and/or the suction line indicate that sufficient frost is melted from the heat exchanger to insure adequate time between successive defrost cycles for optimizing the efficiency and reliability of the system, or after a predetermined time interval has elapsed, whichever condition occurs first. During defrost cycle all compressors shall energize, reversing valves shall de-energize, and auxiliary heat, if specified, shall energize.]
- M. With modulating gas heat option, a field installed supply air temperature sensor shall be furnished to control the amount of heating. Supply air temperature setpoint shall be field adjustable.
- N. Electric heater shall have full modulation capacity controlled by a Silicon Controlled Rectifier (SCR). Supply air temperature sensor shall be factory

provided and field installed in the supply air ductwork. A setpoint adjustment potentiometer shall be factory provided.

- O. With the modulating hot gas reheat option, a space humidity sensor and supply air temperature sensor shall be furnished with the unit for field installation. Suction pressure sensor shall be factory installed. Supply air temperature and space humidity setpoints, for the dehumidification mode of operation, shall be adjustable.]
- P. Unit shall be provided with blower auxiliary contacts on the low voltage terminal block which close when the supply fans are energized.
- Q. Unit shall be provided with remote stop/start terminals which require contact closure for unit operation. When these contacts are open the low voltage circuit is broken and the unit will not operate.]
- R. Each refrigeration circuit shall be provided with an adjustable temperature sensor freeze stat which shuts down the cooling circuits when the evaporator coil tubing falls below the setpoint.

2.6 IDENTIFICATION

- A. All equipment and component identification shall be provided in accordance with Section 10 14 00, Signage.
- B. All electrical wiring identification shall be provided in accordance with Section 26 05 53, Identification For Electrical Systems.
- C. All electrical wiring shall be color-coded and labeled for simplified identification. Power wiring shall be coded per Owner standards.

2.7 SOURCE QUALITY CONTROL

- A. Shop Tests:
 - 1. Equipment shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
 - a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label or equal.
 - b. Factory test equipment to ensure that the entire package has been properly fabricated and assembled, that all the controls function as specified herein and that the package meets the specified performance requirements including manufacturer's data report.
 - c. Fan wheels and shafts shall be statically and dynamically balanced.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Protection of Surrounding Areas/Surfaces:
 - 1. Openings and penetrations shall be capped to protect the building from outside conditions.
 - 2. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.3 INSTALLATION

- A. General:
 - 1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 2. Install in accordance with Laws and Regulations.
 - 3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
 - 4. Installation to conform to requirements of all local and state codes.
- B. Equipment shall be anchored to the prefabricated curb and the curb anchored to the roof structure to transfer loads to the building structure or to the concrete curb and pad.

3.4 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. After equipment installation is complete, Contractor and a qualified field service representative of unit manufacturer shall perform an operating test and a sound test of each unit and associated controls, in presence of Engineer. Equipment will pass the test when each unit and its controls are demonstrated to function correctly, and sound levels do not exceed maximum limits.
 - 2. Running Tests:
 - a. Field-test each equipment together with its controls and appurtenances. Tests shall demonstrate to Engineer that each part and all parts together function in accordance with the Contract Documents. Provide all necessary testing equipment, labor, and appurtenances.
 - b. Verify that equipment operates at design point as intended, that vibration limits are not excessive and beyond manufacturer's recommendations, and that equipment operates smoothly without excessive noise, temperature rise, or other defects, across entire range of operating curve. Verify that

all controls work as intended in both manual and automatic mode.

Successfully test-operate each equipment for at least 120 hours.

- c. If equipment does not comply with the Contract Documents and does not pass the tests, Contractor shall adjust, modify, and retest the equipment as often as necessary until tests are successfully passed.

B. Manufacturer's Services:

- 1. Provide a qualified, factory-trained service person to perform the following:
 - a. Instruct Contractor in installing equipment.
 - b. After installation, inspect and adjust equipment, verify proper operation, and assist with field testing.
 - c. Instruct operations and maintenance personnel in operation and maintenance of the equipment.
- 2. Manufacturer's service person shall make visits to the Site as follows:
 - a. First visit shall be for instructing Contractor in proper equipment installation, and assisting in installing equipment. Minimum number of hours on-Site: 4 hours.
 - b. Second visit shall be for checking completed installation, start-up of system; and performing field testing. Minimum number of hours on-Site: 4 hours.
 - c. Third visit shall be to instruct operations and maintenance personnel.
 - 1) Furnish services of manufacturer's qualified, factory-trained specialists to instruct operations and maintenance personnel in recommended operation and maintenance of equipment.
 - 2) Training requirements, duration of instruction, and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
 - 3) Number of hours on-Site shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
 - d. Technician shall revisit the Site as often as necessary until installation is acceptable.
- 3. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.5 ADJUSTING

- A. Adjust all controls for proper settings.
- B. While system is operable, balance all equipment to achieve design conditions.

3.6 CLEANING

- A. Thoroughly clean all equipment and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from equipment and accessories after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

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SECTION 23 81 26

DUCTLESS SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to furnish and install ductless split-system air-conditioners complete and operational with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the ductless split-system air-conditioners Work.
 - 2. Notify other Contractors in advance of the installation of the ductless split-system air-conditioners to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed with, or before, the ductless split-system air-conditioners Work.
- C. Related Sections:
 - 1. Section 05 05 33, Anchor Systems.
 - 2. Section 10 14 00, Signage.
 - 3. Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.
 - 4. Section 23 09 00, Instrumentation and Control for HVAC.
 - 5. Section 26 28 16.33, Disconnect Switches.

1.2 REFERENCES

- A. Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
 - 1. AHRI 210/240 – Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
 - 1. ASHRAE Standard 15 – Safety Standard for Refrigeration Systems.
- C. American Society for Testing and Materials (ASTM).
 - 1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 3. ASTM B280 – Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- D. National Electrical Code (NEC).

- E. National Electrical Manufacturers Association (NEMA).
- F. Underwriters Laboratories Inc. (UL).
 - 1. UL 1995 – Heating and Cooling Equipment.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer:
 - a. Engage an experienced installer to perform the work of this Section who has specialized in installing ductless split-system air-conditioners similar to that required for this Project and who is acceptable to manufacturer.
- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single ductless split-system air-conditioner manufacturer.
 - 2. Require the ductless split-system air-conditioner manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the ductless split-system air-conditioner manufacturer.
- C. Regulatory Requirements:
 - 1. National Electrical Code (NEC).
 - 2. National Fire Protection Association (NFPA).
 - 3. Underwriters Laboratories Inc. (UL).
 - 4. Local and State Building Codes and Ordinances.
 - 5. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.
- D. Certifications:
 - 1. Ductless split-system air-conditioners shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the National Electric Code.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, installation details, and wiring diagrams.
 - b. Detailed drawings of each individual component's wiring diagrams.
 - c. Detailed drawings of control panel layout.
 - d. Detailed installation drawing of each individual component showing:
 - 1) Mounting requirements.
 - 2) Locations (panel, field, etc.).
 - 3) Piping, and wiring connections, labeled and coded.

- e. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
- 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.
 - c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - f. Other technical data related to specified material and equipment as requested by Engineer.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Independent certification reports:
 - 1) UL Label or equal.
 - 2) AHRI Label.
 - 2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 - c. Instructions for handling, start-up, and troubleshooting.
 - 3. Field Quality Control Submittals:
 - a. Written report presenting results of required field testing.
 - 4. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service personnel, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
 - 5. Qualifications Statements:
 - a. Installer, when requested by Engineer.
- C. Closeout Submittals: Submit the following:
 - 1. Operations and Maintenance Data:
 - a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.
 - 2. Warranty Documentation:
 - a. General warranty.
 - b. Special warranties on materials and equipment.
- D. Maintenance Material Submittals: Furnish the following:
 - 1. Spare Parts:

- a. Spare parts list and recommended quantities.
 - b. One set of filters for each unit.
2. Spare parts, extra stock materials, and tools shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the Owner at the conclusion of the Project.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
 3. Comply with manufacturer's recommendations for rigging of equipment.
- B. Storage and Protection:
 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 WARRANTY

- A. General Warranty: The special warranties specified in this Article shall not deprive Owner of other rights or remedies Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents. The obligations of Contractor under the Contract Documents shall not be limited in any way by the provisions of the specified special warranties.
- B. Special Warranties on Materials and Equipment:
 1. Provide manufacturer's written warranty, running to the benefit of Owner, agreeing to correct, or at option of Owner, remove or replace materials or equipment specified in this Section found to be defective during a period of years as listed below after the date of Substantial Completion.
 - a. Compressors shall carry a minimum 6 year non-prorated warranty.
 - b. All other components not listed above shall carry a minimum 5 year non-prorated warranty.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. Equipment Description:
 - 1. Units shall be completely factory assembled and tested, and internally piped and wired. Units shall consist of indoor air conditioners (indoor units) with filters, evaporator coils, supply fans, motors, and remotely located outdoor air-cooled heat pumps outdoor unit.
 - 2. Units shall include all unit mounted controls, wiring, and accessories.
 - 3. Indoor units and refrigerant pipes shall be purged with dry air before shipment from the factory.
 - 4. Outdoor units shall be pre-charged with refrigerant for a minimum of 70 feet of refrigerant tubing.
- B. Design Criteria:
 - 1. Design conditions shall be as indicated on the Equipment Schedule.
 - 2. Units shall conform and be certified to the latest editions of ASHRAE Standard 15 and UL 1995.
- C. Performance Criteria:
 - 1. Minimum performance data for each unit shall be as indicated on the Equipment Schedule. Provided equipment shall not exceed scheduled total power.
 - 2. Units shall meet or exceed the Energy Efficiency Ratio (EER) shown on the Equipment Schedule when tested in accordance to the latest editions of AHRI Standard 210/240.
 - 3. System shall be capable of operating up to a minimum refrigerant tubing length of 100 feet between indoor and outdoor units without the need for line size changes, traps or additional oil.

2.2 DETAILS OF EQUIPMENT

- A. Wall-Mounted / Floor Mounted Air Conditioners:
 - 1. Product and Manufacturer: Provide the following:
 - a. Wall Mounted: Model MSZ; Floor Mounted: Model NTXFKS, as manufactured by Trane / Mitsubishi Electric.
 - b. Or equal.
 - 2. Cabinet:
 - a. Cabinet shall be formed from high strength molded plastic with smooth white finish.
 - b. Cabinet shall have a flat front panel design with access for filter.
 - c. Unit shall be wall mounted by means of a factory supplied, pre-drilled, mounting plate.
 - 3. Evaporator Coil:
 - a. Coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. All tube joints shall be brazed with PhosCopper or silver alloy.
 - b. Coil shall be pressure tested at the factory.

- c. Coil shall be furnished with a condensate pan and drain.
- 4. Supply Fans:
 - a. Direct drive, high performance, double inlet, forward curve sirocco fan shall be driven by a single motor.
 - b. Multi-speed fan motor shall have permanently lubricated bearings.
 - c. Fan shall have a selectable AUTO fan setting that will adjust the fan speed based on the difference between controller setpoint and sensed space temperature.
- 5. Vanes:
 - a. Motorized horizontal vane shall be provided to automatically direct air flow in a horizontal and downward direction for uniform air distribution.
 - b. Horizontal vane shall close the outlet port when not operating.
 - c. A set of vertical vanes shall also be provided to allow for horizontal swing airflow movement.
- 6. Filter:
 - a. Return air shall be filtered by means of an easily removable, washable polypropylene honeycomb filter.

B. Outdoor Units:

- 1. Product and Manufacturer: Provide one of the following:
 - a. Model NTXMMX , as manufactured by Trane / Mitsubishi Electric.
 - b. Or equal.
- 2. Cabinet:
 - a. Casing shall be fabricated of galvanized steel.
 - b. Mounting feet shall be provided and shall be welded to the base of the cabinet.
 - c. Removable panel sections shall allow easy access to all serviceable parts.
 - d. Fan grill shall be constructed from ABS plastic.
 - e. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane condition areas.
- 3. Condenser Fans:
 - a. Direct drive fan and motor shall be configured for horizontal discharge airflow.
 - b. Fan blades shall be of aerodynamic design for quiet operation and the fan motor bearings shall be permanently lubricated.
 - c. Fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front.
 - d. Fan shall be provided with a raised guard to prevent external contact with moving parts.
- 4. Condenser Coil:
 - a. Coil shall be of copper tubing with flat aluminum fins.
 - b. Coil shall be protected with an integral metal guard.
- 5. Compressors:
 - a. Compressor shall be hermetically sealed, variable speed, rotary or scroll type. Compressor shall be equipped with an internal thermal overload.
 - b. Compressor shall be driven by inverter circuit to control compressor speed.

- c. In lieu of a crankcase heater, minimal amount of current shall be automatically and intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant during the off cycle to prevent liquid accumulation.
- d. Compressor shall be mounted so as to avoid transmission of vibration.
- 6. Refrigeration System:
 - a. Refrigerant flow from the condenser shall be controlled by means of an electronic linear expansion valve (LEV) metering device. The LEV shall be control by a microprocessor controlled step motor.
 - b. System shall include an accumulator, high pressure safety switch, refrigerant line filter driers (strainers), Schrader type service fittings (stop valves) for liquid and suction connections, and service ports.

2.3 ACCESSORIES

- A. Hangers and Supports:
 - 1. Hangers and supports shall be provided in accordance with Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.
- B. Outdoor and indoor units shall be provided by Electrical contractor conforming to Section 26 28 16.33, Disconnect Switches.
- C. Refrigerant Piping and Insulation:
 - 1. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, Type ACR, meeting ASTM B280 requirements.
 - 2. Refrigerant piping shall be individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material.
 - 3. Insulation shall have a maximum thermal conductivity of 0.27 Btu-in/hr-ft²-degree F at 75 degrees F and a maximum water vapor transmission of 0.08 perm-in.
 - 4. Insulation shall have a maximum Flame Spread Index of 25 and a maximum Smoke Developed Index of 50 when tested in accordance with ASTM E84.
- D. Indoor units shall be provided with a condensate mini-pump that is capable of lifting condensate 23 inches above the drain pan.

2.4 FINISHING

- A. Outdoor units shall be provided with Blue Fin anti-corrosion treatment

2.5 CONTROLS

- A. Refer to Section 23 09 00, Instrumentation and Control for HVAC, for additional information and sequence of operations. Provide provisions for interfacing with the instrumentation and control (IC) system. Components requiring remote monitoring and control shall be wired to a terminal block for interfacing with the

IC system. Contractor shall coordinate operating system requirements with Section 23 09 00, Instrumentation and Control for HVAC, for a complete system.

- B. Unit shall be completely factory wired with the necessary controls, starters, contactors and terminal blocks for power and control wiring.
- C. A color-coded circuit diagram of the approved electrical drawing shall be provided with the unit.
- D. All electrical components shall bear the UL label.
- E. Unit shall be designed for single point electrical connection. All necessary power transformers shall be factory provided and installed.
- F. The system shall be capable of satisfactory operation within voltage limits of 198 VAC to 253 VAC, 1 Phase, 60 Hz.
- G. The power to the indoor unit shall be supplied from the outdoor unit. A factory provided three AWG-14 wire conductors with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. The outdoor unit shall have Pulse Amplitude Modulation circuit to utilize 98 percent of input power supply.
- H. The control system shall consist of a minimum of two microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. The outdoor unit shall be controlled by the microprocessor located in the indoor unit using 24 VDC pulse control signal.
- I. The indoor unit control board shall have auxiliary control contact connectors to provide:
 - 1. Remote Switch.
 - 2. Central Control.
 - 3. IP Terminal.
- J. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from a wireless or wired controller, providing emergency operation and controlling the outdoor unit.
- K. The system shall include a 3-minute time delay mechanism, an automatic restart function when power is restored after power interruption, and a test run switch.
- L. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the controller panel.
- M. Remote Controllers:
 - 1. Wireless, Hand-Held:

- a. Controller shall consist of a hand held wireless remote controller and a wireless receiver. The wireless receiver shall be plug and fit compatible with the indoor unit.
- b. Controller shall perform input functions necessary to operate the system.
- c. Controller shall have a Power ON/OFF switch, Mode Selector (Cool, Dry, Heat, Auto, and Powerful Modes), Temperature Setting, Timer Control, Fan Speed Select, and Horizontal and Vertical Vane control selector.
- d. The indoor unit shall perform Self-diagnostic Function and Check Mode switching.
- e. Temperature changes shall be in 1 degree F (0.5 degree C) increments with a setting range of 61-88 degrees F (16-31 degrees C).

2.6 IDENTIFICATION

- A. All equipment and component identification shall be provided in accordance with Section 10 14 00, Signage.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Protection of Surrounding Areas/Surfaces:
 - 1. Openings and penetrations shall be capped to protect the building from outside conditions.
 - 2. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.3 INSTALLATION

- A. General:
 - 1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 2. Install in accordance with Laws and Regulations.
 - 3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
 - 4. Installation to conform to requirements of all local and state codes.

3.4 FIELD QUALITY CONTROL

A. Field Tests:

1. After equipment installation is complete, Contractor and a qualified field service representative of unit manufacturer shall perform an operating test and a sound test of each unit and associated controls, in presence of Engineer. Equipment will pass the test when each unit and its controls are demonstrated to function correctly, and sound levels do not exceed maximum limits.
2. Running Tests:
 - a. Field-test each equipment together with its controls and appurtenances. Tests shall demonstrate to Engineer that each part and all parts together function in accordance with the Contract Documents. Provide all necessary testing equipment, labor, and appurtenances.
 - b. Verify that equipment operates at design point as intended, that vibration limits are not excessive and beyond manufacturer's recommendations, and that equipment operates smoothly without excessive noise, temperature rise, or other defects, across entire range of operating curve. Verify that all controls work as intended in both manual and automatic mode.
 - c. If equipment does not comply with the Contract Documents and does not pass the tests, Contractor shall adjust, modify, and retest the equipment as often as necessary until tests are successfully passed.

3.5 ADJUSTING

- A. Adjust all controls for proper settings.
- B. While system is operable, balance all equipment to achieve design conditions.

3.6 CLEANING

- A. Thoroughly clean all equipment and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from equipment and accessories after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

+ + END OF SECTION + +

SECTION 23 82 39.13

CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install cabinet unit heaters complete and operational with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the cabinet unit heaters Work.
 - 2. Notify other Contractors in advance of the installation of cabinet unit heaters to provide other contractors with sufficient time for the installation of items included in their contracts that must be installed with, or before, the cabinet unit heaters Work.
- C. Related Sections:
 - 1. Section 10 14 00, Signage.
 - 2. Section 23 09 00 - Instrumentation and Control for HVAC

1.2 REFERENCES

- A. National Electrical Code (NEC).
- B. National Electrical Manufacturers Association (NEMA).
- C. Underwriters Laboratories Inc. (UL).
 - 1. UL 873 – Temperature-Indicating and -Regulating Equipment.

1.3 QUALITY ASSURANCE

- A. Qualifications:
- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single cabinet unit heater manufacturer.
 - 2. Require the cabinet unit heater manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the cabinet unit heater manufacturer.

- C. Regulatory Requirements:
 - 1. National Electrical Code (NEC).
 - 2. National Fire Protection Association (NFPA).
 - 3. Underwriters Laboratories Inc. (UL).
 - 4. Local and State Building Codes and Ordinances.
 - 5. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.
- D. Certifications:
 - 1. Cabinet unit heaters shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the National Electric Code.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, installation details, and wiring diagrams.
 - 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.
 - c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - f. Other technical data related to specified material and equipment as requested by Engineer.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Independent certification reports:
 - 1) UL Label or equal.
 - 2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 - c. Instructions for handling, start-up, and troubleshooting.
- C. Closeout Submittals: Submit the following:
 - 1. Operations and Maintenance Data:
 - a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

- D. Maintenance Material Submittals: Furnish the following:
1. Spare Parts:
 - a. Spare parts list and recommended quantities.
 2. Tools:
 - a. Two sets of special tools, if any, required for normal operation and maintenance.
 3. Spare parts and tools shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the Owner at the conclusion of the Project.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of that Work.
 3. Comply with manufacturer's recommendations for rigging of equipment.
- B. Storage and Protection:
1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. Design Criteria:
1. Design conditions shall be as indicated on the Equipment Schedule.
 2. All cabinet unit heaters shall be UL Listed.
- B. Performance Criteria:
1. Minimum performance data for each unit shall be as indicated on the Equipment Schedule. Provided equipment shall not exceed scheduled total power.

2.2 DETAILS OF EQUIPMENT

- A. Cabinet Console Blower Heaters (Non-Corrosive Environment)

1. Product and Manufacturer: Provide one of the following:
 - a. Model AWFA, as manufactured by STELPRO.
 - b. Or equal.
2. Casing:
 - a. Minimum 22 gauge steel cabinet.
 - b. Provided with integral mounting bracket and hardware for recessed, or surface mounting.
3. Heating Elements:
 - a. High-quality nichrome element .
4. Fan and Motor:
 - a. Totally enclosed fan motor shall be permanently lubricated with automatic reset thermal overload protection.
5. Grilles:
 - a. Extruded aluminum grille with a thickness equivalent to 13 gauge.
6. Controls:
 - a. Fan delay switch to activate fan after heating element reaches operating temperature and continue to operate until the element is cool.
 - b. Linear high temperature thermal cutout with automatic reset.
 - c. Built-in voltage relay kit for remote 24 VAC thermostat]
 - d. Thermostats:
 - 1) Refer to Equipment Schedule for type.

2.3 ACCESSORIES

- A. Units shall be provided with integral disconnect switch.
- B. Space Thermostats (Non-Corrosive Environment)
 1. Refer to Section 23 09 00 - Instrumentation and Control for HVAC

2.4 IDENTIFICATION

- A. All equipment and component identification shall be provided in accordance with Section 10 14 00, Signage.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 INSTALLATION

- A. General:

1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
2. Install in accordance with Laws and Regulations.
3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
4. Installation to conform to requirements of all local and state codes.

3.3 FIELD QUALITY CONTROL

A. Field Tests:

1. After equipment installation is complete, Contractor and a qualified field service representative of unit manufacturer shall perform an operating test of each unit and associated controls, in presence of Engineer. Equipment will pass the test when each unit and its controls are demonstrated to function correctly.

3.4 ADJUSTING

- A. Adjust all controls for proper settings.
- B. Position unit and adjust grilles.

3.5 CLEANING

- A. Thoroughly clean all equipment and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from equipment and accessories after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

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SECTION 26 05 05

GENERAL PROVISIONS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to complete the electrical Work, which includes:
 - a. Providing conduits, inserts and other electrical items to be embedded in concrete, built into walls, partitions, ceilings, and panels provided by others.
2. Temporary Utilities: CONTRACTOR shall provide temporary power and lighting in accordance with Section 01 51 05, Temporary Utilities
3. Demolition: Electrical demolition shall be in accordance with Section 02 41 00, Demolition.
3. Demolition: Responsibility for electrical demolition is indicated in Section 01 12 13, Summary of Work.

B. Coordination:

1. Review installation procedures and schedules under other contracts and coordinate with other contractors the installation of electrical items to be installed with or within formwork, walls, partitions, ceilings, and panels constructed by other contractors.
 - a. Furnish as required to other contractors detailed drawings or sketches of the locations of conduits and other built-in items.
 - b. Coordinate with other contractors regarding progress of construction where conduits and built-in items are will be installed. Install conduits and built-in items in manner that does not delay work of other contractors.
2. Coordination and Intent of Electrical Drawings:
 - a. Dimensions on Drawings related to equipment are based on equipment of certain manufacturers. Verify the dimensions of equipment furnished to space available at the Site and allocated to the equipment.
 - b. Drawings show the principal elements of the electrical Work, and are not intended as detailed working drawings for the electrical Work. Drawings supplement and complement the Specifications and other Contract Documents relative to principal features of electrical systems.
 - c. Equipment and devices provided under this Contract and other contracts shall be properly connected and interconnected with other equipment and devices for successful operation of complete systems, whether or not all connections and interconnections are specifically mentioned or shown in the Contract Documents.

- d. Drawings are provided for CONTRACTOR's guidance in fulfilling the intent of the Contract Documents CONTRACTOR shall comply with Laws and Regulations, including safety and electrical codes, and provide materials, equipment, appurtenances, and specialty items necessary for complete and operable systems.
- 3. Obtain from OWNER record drawings required to execute the Work.
- 4. Field Coordination:
 - a. Provide materials, equipment, and services to interface with existing circuits. Field-verify system and equipment requirements prior to modifying existing systems.
 - b. Coordinate the interface of equipment with OWNER's personnel and field conditions.
 - d. Field-trace existing circuits as required to interface the equipment provided.
- C. Related Sections:
 - 1. Section 01 12 13 Summary of Work
 - 2. Section 02 41 00, Demolition.
 - 3. Section 05 05 33, Anchor Systems.
 - 4. Section 09 91 00, Painting.
- D. Work Included in This Contract but Specified Elsewhere:
 - 1. Anchorage systems shall comply with Section 05 05 33, Anchor Systems.
 - 2. Shop painting and surface preparation shall comply with Section 09 91 00, Painting, unless otherwise specified in Division 26 Sections.
- F. Area Classifications:
 - 1. Materials, equipment, and incidentals shall be suitable for the area classification(s) shown, specified, and required.
 - 2. Wet Locations: Comply with NEC and NEMA requirements for wet locations. Enclosures in wet locations shall comply with NEMA 4 unless specified otherwise.
 - 3. Corrosive Locations: Comply with NEC and NEMA requirements for corrosive locations. Enclosures in corrosive locations shall conform to NEMA 4X requirements unless specified otherwise.
 - 4. Dusty Locations: Indoor areas not designated as hazardous, corrosive, or wet are dusty locations. Comply with NEC and NEMA 12 requirements unless specified otherwise.

1.2 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Materials and equipment similar to each other shall be from the same manufacturer for uniformity.
- B. Regulatory Requirements:

1. Permits: Refer to the General Conditions, Supplementary Conditions, and other parts of the Contract Documents for responsibilities relative to obtaining and paying for permits, licenses, and inspection fees.
2. Codes: Refer to Section 01 42 00, References, for indication of applicable codes.

1.3 SUBMITTALS

A. General:

1. To the extent practical, submit Shop Drawings and other CONTRACTOR submittals for each Specification Section into the smallest number of submittals possible. Do not furnish partial submittals.
2. Review of equipment submittals does not relieve CONTRACTOR of responsibility for providing complete and successfully operating systems.

B. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Internal wiring diagram and drawings indicating all connections to components and numbered terminals for external connections.
 - b. Dimensioned plan, section, elevations, and panel layouts showing means for mounting, conduit connection, and grounding.
 - c. List of components including manufacturer's name and catalog number (or part number) for each.
2. Product Data:
 - a. Manufacturer's name and product designation or catalog number.
 - b. Electrical ratings.
 - c. Manufacturer's technical data and specifications.
 - d. Manufacturer's indication of compliance with applicable reference standards.
 - e. Painting and coating systems proposed.
3. Test Procedures: Proposed testing procedures and testing limitations for source quality control testing and field quality control testing.

C. Informational Submittals: Submit the following:

1. Manufacturer's Instructions:
 - a. Installation data and instructions.
 - b. Instructions for handling, starting-up, and troubleshooting.
2. Source Quality Control Submittals: Results for required shop testing.
3. Field Quality Control Submittals: Results for required field testing.

D. Closeout Submittals: Submit the following:

1. Record Documentation:
 - a. System Record Drawings: Include the following:
 - 1) One-line wiring diagram of the electrical distribution system.
 - 2) Actual, in-place conduit and cable layouts with schedule of conduit sizes and number, and size of conductors.

- 3) Layouts of the power and lighting arrangements and the grounding system.
 - 4) Control schematic diagrams, with terminal numbers and control devices identified, for all equipment.
- b. Record documents shall indicate final equipment and field installation information.

PART 2 – PRODUCTS

- A. Performance Criteria:
1. Electrical equipment shall be capable of operating successfully at full-rated load, without failure, with ambient outside air temperature of -30- degrees F to 104 degrees F and an elevation of 2000 feet above mean sea level.
 2. Unless specified otherwise, electrical equipment shall have ratings based on 75 degrees C terminations.
- B. Testing Laboratory Labels: Electrical material and equipment shall bear the label of Underwriters' Laboratories, Inc. or other nationally recognized, independent testing laboratory, where standards have been established and label service applies.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which Work will be performed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. General:
1. Install materials and equipment in accordance with the Contract Documents, Laws and Regulations, approved (and accepted, as applicable) Shop Drawings and other CONTRACTOR submittals, and manufacturer's recommendations.
 2. Provide tools and equipment required to trace circuits necessary for proper execution of the Work.
 3. Define and identify all wiring, circuit terminations, and equipment to be modified to ensure proper interface of components. The Contract Price includes all costs associated with field services specified for a complete and functional system.
- B. Staging, Sequencing, and Coordination with Existing Facilities:
1. Schedule, sequence, and install materials and equipment in accordance with Section 01 14 16, Coordination with Owner's Operations

2. Perform the Work in a manner that will not interfere with the existing equipment and facilities or cause interruption of the functions of the Site, unless specified otherwise or otherwise allowed by OWNER.
3. When operation of existing facilities and Site is disrupted due to CONTRACTOR's operations, comply with Section 01 14 16, Coordination with Owner's Operations, unless otherwise allowed by OWNER.
4. Where the Work ties in with existing installations, take precautions and provide safeguards in connecting the Work to existing operating circuits to prevent interruption to existing circuits. Connection of Work to existing circuits shall be performed in the presence of OWNER and ENGINEER.
5. Interruptions of existing circuits, not addressed in Section 01 14 16, Coordination with Owner's Operations, shall be coordinated with the OWNER who will determine the length of time a circuit may be de-energized to maintain the OWNER's processes in dependable and safe operation.

3.3 FIELD QUALITY CONTROL

A. Field Quality Control – General:

1. Perform field quality control for electrical Work in accordance with the Contract Documents.

B. Site Tests:

1. Prior to requesting certificate of Substantial Completion, demonstrate to ENGINEER that electrical systems and electrically-operated equipment installed or modified under the Contract operates in accordance with the Contract Documents and operates as required
2. Perform the following operational tests on electrical systems:
 - a. Operate power circuits to verify proper operation and connection to electrical systems materials and equipment, including mechanical key-interlocks for circuit breakers.
 - b. Operate control circuits, including pushbuttons, indicating lights, and similar devices, to verify proper connection and function. Operate all devices, such as pressure switches, flow switches, and similar devices, to verify that shutdowns and control sequences operate as required.
 - c. Operate lighting systems and receptacle devices to verify proper operation and connections.
3. Prepare and submit report on the equipment demonstration and operating field quality control tests. Report shall include complete information on the tests performed and results.

C. Manufacturer's Services:

1. Furnish at the Site qualified, factory-trained representative(s) of equipment manufacturers for the services indicated in the Contract Documents.

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SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install low-voltage conductors and cabling.
 - 2. Types of cabling required include:
 - a. Insulated cable for installation in raceways.
- B. Related Sections:
 - 1. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ANSI/NETA ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems.
 - 2. ASTM B3, Specification for Soft or Annealed Copper Wire.
 - 3. ASTM B8, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
 - 4. ASTM D3485, Specification for Smooth-Wall Coilable Polyethylene (PE) Conduit (Duct) for Preassembled Wire and Cable.
 - 5. ASTM F2160, Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD).
 - 6. NEMA TC 7, Smooth Wall Coilable Electrical Polyethylene Conduit.
 - 7. UL 44, Thermoset-Insulated Wires and Cables.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the following:
 - 1. NEC Article 300, Wiring Methods.
 - 2. NEC Article 310, Conductors for General Wiring.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Product Data:
 - a. Manufacturer's literature, specifications, and engineering data for low volt insulated cable proposed for use.

- B. Informational Submittals: Submit the following:
 - 1. Field Quality Control Submittals:
 - a. Written results of field insulation resistance tests.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Insulated Cable In Raceways:
 - 1. Application: Use for circuits located indoors and outdoors.
 - 2. Manufacturers: Provide products of one of the following:
 - a. Southwire.
 - b. The Okonite Company.
 - c. American Insulated Wire
 - d. General Cable
 - e. Or equal.
 - 3. Material: Single conductor copper cable complying with ASTM B3 and ASTM B8 with flame-retardant, moisture- and heat-resistant insulation rated for 90 degrees C in dry or wet locations, listed by UL as Type XHHW-2 complying with UL 44.
 - 4. Wire Sizes: Not smaller than No. 12 AWG for power and lighting and No. 14 AWG for 120-volt control circuits.
 - 5. Stranding: 600-volt cable shall be stranded, except that solid cable, No. 10 and smaller may be used for lighting circuits.
- B. Cable Connectors, Solderless Type:
 - 1. Products and Manufacturers: Provide products of one of the following:
 - a. T&B Sta-Kon.
 - b. Burndy Hylug.
 - c. Or equal.
 - 2. For wire sizes No. 4 AWG and above, use either compression type or bolted type with silver-plated contact faces.
 - 3. For wire sizes up to and including No. 6 AWG, use compression type. Alarm and control wire shall be terminated using forked type connectors at terminal boards.
 - 4. For wire sizes No. 250 KCMIL and larger, use connectors with at least two cable clamping elements or compression indents and provision for at least two bolts for joining to apparatus terminal.
 - 5. Properly size connectors to fit fastening device and wire size. Connectors shall be rated for 90 degree C, 600 volts.
- C. Cable Splices:
 - 1. Products and Manufacturers:
 - a. Compression-Type Splices: Provide one of the following:
 - 1) Burndy Hylink.
 - 2) T&B Color-Keyed Compression Connectors.

- 3) Or equal.
 - b. Spring Connectors: Provide one of the following:
 - 1) Buchanan B-Cap.
 - 2) T&B Wire Connector.
 - 3) Or equal.
 - 2. For wire sizes No. 8 AWG and larger, splices shall be made up with compression type copper splice fittings. Splices shall be taped and covered with materials recommended by cable manufacturer to provide insulation equal to that on conductors.
 - 3. For wire sizes No. 10 AWG and smaller, splices may be made up with pre-insulated spring connectors.
 - 4. For wet locations, splices shall be waterproof. Compression type splices shall be waterproofed by sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring thermosetting resin into mold that surrounds the joined conductor. Spring connector splices shall be waterproofed with sealant filler.
 - 5. Splices shall be suitably sized for cable, rated 90 degrees C, and 600 volts.
- D. Wire and Cable Markers:
- 1. Provide wire and cable markers in accordance with Section 26 05 53, Identification for Electrical Systems.

2.2 SOURCE QUALITY CONTROL

- A. Factory Tests:
- 1. Factory-test wire and cable in accordance with UL standards

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install cables complete with proper terminations at both ends. Check and correct for proper phase sequence and proper motor rotation.
- B. Pulling:
- 1. Use insulating types of pulling compounds containing no mineral oil.
 - 2. Pulling tension shall be within limits recommended by wire and cable manufacturer.
 - 3. Use dynamometer where mechanical means are used.
 - 4. Cut off section subject to mechanical means.
- C. Bending Radius: Limit to minimum of six times cable overall diameter.
- D. Slack: Provide maximum slack at all terminal points.

- E. Splices:
1. Where possible, install cable continuous, without splice, from termination to termination.
 2. Where required, splice as shown and also where required for cable installation. Splices below grade, in manholes, handholes, and wet locations shall be waterproof.
 3. Splices are not allowed in conduits.
- F. Identification:
1. Identify conductors in accordance with Section 26 05 53, Identification for Electrical Systems.
 2. Identify power conductors by circuit number and phase at each terminal or splice location.
 3. Identify control and status wiring using numeral tagging system.
- G. Color-code power cables as follows:
1. No. 8 AWG and Smaller: Provide colored conductors.
 2. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, wrapped in overlapping turns to cover an area of at least two inches.
 3. Colors: Match color scheme in use at the Site. If the Site does not have an existing color scheme, use the following colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts Three-Phase, Four-Wire Delta, Center Tap Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts Three-Phase, Four-Wire	rounded Neutral Phase A Phase B Phase C	Gray Brown Orange Yellow

3.2 FIELD QUALITY CONTROL

- A. Site Tests:
1. Test each electrical circuit after permanent cables are in place, to demonstrate that circuit and equipment are connected properly and will perform satisfactorily, free from improper grounds and short circuits.

2. Individually test 600-volt cable mechanical connections after installation and before they are put in service, with calibrated torque wrench. Values shall be in accordance with manufacturer's recommendations.
3. Individually test 600-volt cables for insulation resistance between phases and from each phase to ground. Test after cables are installed and before they are put in service, with Megger for one minute at voltage rating recommended by cable manufacturer or in accordance with ANSI/NETA ATS recommendations.
4. Insulation resistance for each conductor shall not be less than value recommended by cable manufacturer. Cables not meeting recommended value or that fail when tested under full load conditions shall be replaced with a new cable for full length.
5. Where existing cables are spliced to cables provided under the Project, test existing cables prior to splicing. Test cables at 1,000 vdc for one minute. Entire spliced cable installation shall be re-tested after splice is completed. Existing cable that fails or has value less than two megohms shall be brought to attention of ENGINEER and splicing shall not proceed until condition is acceptable.

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install complete grounding for electrical systems, structures, and equipment.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI/NETA ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems.
2. ASTM B8, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
3. UL 467, Grounding and Bonding Equipment.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements

1. National Electrical Code, (NEC).
 - a. NEC Article 250, Grounding and Bonding.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Listing of grounding connector types identifying where each will be used.
 - b. Layouts of each structure's ground grid.
 - c. Test point construction details.
2. Product Data:
 - a. Manufacturer's technical information for grounding materials proposed for use.
3. Testing Plans:
 - a. Ground resistance test procedure.

B. Informational Submittals: Submit the following:

1. Field Quality Control Submittals
 - a. Results of ground resistance tests at each test point.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Bare Ground Cable:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Cablec Corporation.
 - b. General Cable Corporation.
 - c. Southwire Cable Company.
 - d. Or equal.
 - 2. Material: Soft-drawn, bare copper stranded cable complying with ASTM B8. No. 4/0 AWG minimum size unless otherwise shown or indicated on the Drawings.
- B. Ground Rods:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Copperweld, Bimetallics Division.
 - b. ITT Blackburn Company.
 - c. Or equal.
 - 2. Material: Copper-clad rigid steel rods, 3/4-inch diameter, ten feet long.
- C. Grounding Connectors:
 - 1. Products and Manufacturers: Provide one of the following:
 - a. Pressure Connectors:
 - 1) O.Z./Gedney, Division of General Signal Corporation.
 - 2) Burndy Corporation.
 - 3) Or equal.
 - b. Welded Connections:
 - 1) Cadweld by Erico Products, Incorporated.
 - 2) Therm-O-Weld by Burndy Corporation.
 - 3) Or equal.
 - 2. Material: Pressure connectors shall be copper alloy castings, designed and fabricated specifically for items to be connected and assembled with Durium or silicone bronze bolts, nuts, and washers. Welded connections shall be by exothermic process utilizing molds, cartridges, and hardware designed specifically for connection to be made.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions for the Work and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions are corrected.
- B. Connect grids to continuous underground water pipe system, when practical.

- C. Provide accessible test points for measuring the ground resistance of each grid.
- D. Weld all buried connections except for test points.

3.3 EQUIPMENT GROUNDING

- A. Ground electrical equipment in compliance with Laws and Regulations and the Contract Documents.
- B. Equipment grounding conductors shall be bare stranded copper cable of adequate size installed in metal conduit where required for mechanical protection. Ground conductors, pulled into conduits with non-grounded conductors, shall be insulated. Insulation shall be green.
- C. Control panels grounding conductors shall be bare stranded copper cable of adequate size to ground grid from AC ground bus, and an insulated stranded copper cable of adequate size to ground grid from DC ground bus.
- D. Connect ground conductors to conduit with copper clamps, straps, or with grounding bushings.
- E. Connect to piping by welding or brazing. Use copper bonding jumpers on gasketed joints.
- F. Connect to equipment by means of lug compressed on cable end. Bolt lug to equipment frame using holes or terminals provided on equipment specifically for grounding. Do not use hold-down bolts. Where grounding provisions are not included, drill suitable holes in locations recommended by equipment manufacturer or designated by ENGINEER.
- G. Connect to motors by bolting directly to motor frames, not to soleplates or supporting structures.
- H. Connect to service water piping by means of copper clamps. Use copper bonding jumpers on gasketed joints.
- I. Scrape bolted surfaces clean and coat with conductive oxide-resistant compound.

3.4 FIELD QUALITY CONTROL

- A. Site Tests:
 - 1. Test completed grounding systems for resistance to ground using an electrical three-terminal ground resistance tester. Test all grounded cables and metal parts for continuity of connection. ENGINEER and OWNER will witness the testing.
 - 2. Grounding system maximum resistance shall not exceed five ohms under normally dry conditions when measured by resistance tester. Resistance values above five ohms shall be brought to ENGINEER's attention. Provide

additional ground rods as required to attain a resistance to ground of less than five ohms for each ground grid. Add grounding additive installing additional ground rods to increase their effectiveness.

+ + END OF SECTION + +

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install hangers and supports for electrical systemns.
2. Area Classifications: Materials shall by suitable for the area classification(s) shown or indicated on the Drawings, and specified in Section 26 05 05, General Provisions for Electrical Systems.

B. Related Sections:

1. Section 05 05 33, Anchor Systems.
2. Section 26 05 05, General Provisions for Electrical Systems.
3. Section 26 05 33.13, Rigid Conduits.

1.2 REFERENCES

A. Standards referenced in this section are:

1. ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
3. ASTM E84, Test Method For Surface Burning Characteristics of Building Materials

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Detailed installation drawings showing dimensions and compatibility with proposed layout.
2. Product Data:
 - a. Manufacturer's name, product designation, and catalog number of each material item proposed for use.
 - b. Manufacturer's specifications including material, dimensional and weight data, and load capacity for each supporting system component proposed for use.

- c. Pictorial views and corresponding identifying text of each component proposed for installation.
 - d. Documentation that confirms product compatibility with Laws and Regulations.
- B. Informational Submittals: Submit the following:
 - 1. Certifications:
 - a. Submit certifications required under this Section.
 - 2. Manufacturer's Instructions:
 - a. Manufacturer's installation instructions, including recommended tightening torque values for all nuts and bolts.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide products of one of the following:
 - 1. B-Line.
 - 2. Kindorf.
 - 3. Unistrut
 - 4. Or equal.

2.2 MATERIALS

- A. Strut, Fittings, and Accessories:
 - 1. General
 - a. Unless otherwise shown or indicated, strut shall be 1-5/8 inches by 1-5/8 inches. Double struts shall be two pieces of the same strut, welded back-to-back at the factory.
 - b. Attachment holes, when required, shall be factory-punched on hole centers approximately equal to the cross-sectional width and shall be 9/16-inch diameter.
 - c. Fittings, braces, brackets, hardware, and accessories shall be Type 316 stainless steel.
 - d. Strut nuts shall be spring captured Type 316 stainless steel.
 - e. Square and round washers shall be Type 316 stainless steel.
 - 2. Strut materials shall be suitable for area classifications indicated in Section 26 05 05, General Provisions for Electrical Systems, and shown or indicated on the Drawings.
 - a. Dusty Locations:
 - 1) Strut shall be 12-gage carbon steel, hot-dip galvanized after fabrication, complying with ASTM A123/A123M.
 - b. Wet Locations:
 - 1) Strut shall be 12-gage Type 316 stainless steel.
 - c. Corrosive Locations:

1) Strut shall be 12-gage Type 316 stainless steel.

B. Hanger Rods:

1. Material:
 - a. Dry Locations: All-thread, zinc-coated
 - b. Wet, Corrosive, or Hazardous Areas: Stainless steel.
2. Size: Not less than 3/8-inch diameter, unless otherwise shown on the Drawings or specified.

C. Beam Clamps for Attaching Threaded Rods or Bolts to Beam Flanges for Hanging Struts or Conduit Hangers:

1. Beam clamps shall be stainless steel equipped with stainless steel square-head set screw, and shall include threaded hole sized for attaching the all-thread rod or threaded bolt.

D. Miscellaneous Hardware:

1. Bolts, screws, and washers shall be stainless steel.
2. Hex Nuts: Shall be stainless steel and include nylon inserts.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Provide hangers and supports for electrical systems with necessary channels, fittings, brackets, and related hardware for mounting and supporting materials and equipment. Provide anchor systems, concrete inserts, and associated hardware for proper support of electrical systems.
- B. Install equipment and devices on hangers and supports as shown on the Drawings, as specified, and as required.
- C. Install hangers and supports level, true, free of rack, and parallel and perpendicular to building walls and floors, so that the hangers and supports are installed in a neat, professional, workmanlike manner.
- D. Holes in suspended ceilings for rods for hangers and supports and other equipment shall be provided adjacent to bars, where possible, to facilitate removal of ceiling panels.

- E. Coordinate installation of hangers and supports with equipment, cabinets, consoles, panels, enclosures, boxes, conduit, wireway, busway, cablebus, piping, ductwork, lighting fixtures, and other systems and equipment. Locate hangers and supports clear of interferences and access ways.
- F. Anchor Bolts, Expansion Anchors, and Concrete Inserts: Shall be in accordance with Section 05 05 33, Anchor Systems, and requirements of this Section.
- G. Mounting of Conduit:
 - 1. Provide space of not less than 1/4-inch between conduit surfaces and abutting or near surfaces except struts, cable trays, steel beams, and columns.
 - 2. Fasten conduit to struts, cable trays, steel beams, and columns using specified clamps and straps as shown, specified, and required.
 - 3. Devices shall be compatible with size of conduit and type of support. Following installation, size identification shall be visible and legible.
 - 4. Install conduit supports and fasteners in accordance with Section, 26 05 33.13, Rigid Conduits.
- H. Supports for Cabinets, Consoles, Panels, Enclosures, and Boxes:
 - 1. Freestanding: Unless otherwise specified or shown on the Drawings, provide supports for floor-mounted equipment, cabinets, consoles, panels, enclosures, and boxes. Such supports shall be 3.5-inch high concrete equipment base with a 45 degree chamfered edge. Base shall extend two inches beyond outside dimensions of equipment on all sides.
 - 2. Wall-Mounted:
 - a. Provide space not less than 1/4-inch between cabinets, consoles, panels, enclosures, and boxes and the surface on which each is mounted. Provide non-metallic or stainless steel spacers as required.
 - b. Do not mount equipment, enclosures, panels, and boxes directly to beams or columns. Mount struts to beams or columns using beam clamps, and mount equipment, enclosures, panels, and boxes to the struts.
 - 3. Floor Stand Rack:
 - a. Where equipment, cabinets, consoles, panels, enclosures, and boxes cannot be wall-mounted, provide an independent floor stand rack.
 - b. Floor stand rack shall consist of struts, plates, brackets, connection fittings, braces, accessories, and hardware assembled in a rigid framework suitable for mounting of intended materials and equipment.
 - c. Equip floor stand racks with brackets and bases for rigidly-mounting the framework to the ceiling or floor, as applicable; or equip floor stand racks with beam clamps, angle plates, washers, and bolts for fastening to beam flanges, as applicable.
 - d. When equipment, cabinets, consoles, panels, enclosures, and boxes weigh more than 100 pounds:

- 1) Main vertical supports of floor stand rack assemblies shall be back-to-back struts.
 - 2) Bracing, clamping and anchoring of each floor stand rack shall be sufficient to ensure rigidity of the floor stand rack with the intended equipment, enclosures, conduit, cable tray, busway, cablebus, and wireway installed. Floor stand racks shall not be deflected more than 1/8-inch by a 100-pound force applied at any point on the floor stand rack in any direction.
- I. Drilling into beams or columns is not allowed unless authorized by ENGINEER.
- J. Tighten nuts and bolts to the manufacturer's recommended torque values.
- K. Field Cutting:
1. Cut edges of strut and hanger rod shall have rounded corners, edges beveled, and burrs removed. If field cutting the strut is required, use clean, sharp, dedicated tools. Remove oil, shavings, and other residue of cuttings prior to installation.
 2. Coatings: To prevent corrosion:
 - a. Coat cut edges with zinc-rich paint.

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SECTION 26 05 33.13

RIGID CONDUITS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install conduit and fittings to form complete, coordinated and grounded raceway systems.
2. When specific, detailed conduit routings for various systems within buildings and other areas are not be shown on the Drawings, CONTRACTOR shall establish routings based on single-line, riser, and interconnection diagrams and other information on the Drawings. CONTRACTOR shall provide for the proper installation of conduits in each system.
3. Conduit types and the installation methods shall comply with the following, unless otherwise shown or indicated in the Contract Documents:
 - a. Use rigid steel conduit for exposed indoor conduit runs in non-corrosive areas.
 - b. Use PVC-coated rigid steel or aluminum conduit for exposed interior or exterior conduit runs in, wet, and corrosive locations.

B. Coordination:

1. Conduit runs shown are diagrammatic. Coordinate conduit installation with piping, ductwork, light fixtures, and other systems and equipment and locate to avoid interferences.

C. Related Sections:

1. Section 05 05 33, Anchor Systems.
2. Section 26 05 29, Hangers and Supports for Electrical Systems.
3. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI C80.1, Standard for Rigid Electrical Steel Conduit (ERSC).
2. ANSI/NEMA FB1, Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable.
3. NEMA TC2, Electrical Polyvinyl Chloride (PVC) Conduit.
4. NEMA TC3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
5. NEMA TC14, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

6. UL 6, Electrical Rigid Metal Conduit – Steel.
7. UL 514B, Conduit, Tubing, and Cable Fittings.
8. UL 651, Safety Schedule 40 and 80 Rigid PVC Conduit and Fittings.
9. UL 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
10. UL 1242, Electrical Intermediate Metal Conduit – Steel.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the following:
1. NEC Article 342, Intermediate Metal Conduit
 2. NEC Article 344, Rigid Metal Conduit.
 3. NEC Article 352, Rigid Nonmetallic Conduit.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Assembly details of conduit racks and other conduit support systems.
 - b. Layout drawings showing proposed routing of exposed conduits, conduits embedded in structural concrete, and conduits directly buried in the ground. Shop Drawings shall show locations of pull and junction boxes and penetrations in walls and floors. Shop Drawings of embedded conduits shall include cross-sections showing thickness of concrete slabs and locations of conduits relative to reinforcing steel, waterstops, and other features of the slab.
 2. Product Data:
 - a. Manufacturer's catalog cuts and product data for conduit, fittings, and appurtenances.
- B. Informational Submittals: Submit the following:
1. Manufacturer's Instructions:
 - a. When requested by ENGINEER, provide copies of manufacturer's recommendations for handling and installing products.
 2. Site Quality Control Submittals:
 - a. When requested by ENGINEER, provide copies of results of specified Site quality control testing.
- C. Closeout Submittals: Submit the following:
1. Record Drawings:
 - a. Show actual routing of exposed and concealed conduit runs in record documents in accordance with Section 01 78 39, Project Record Documents.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Rigid Steel Conduit, Elbows, and Couplings:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Allied Tube and Conduit.
 - b. Wheatland Tube Company.
 - c. Western Tube and Conduit Corporation.
 - d. Or equal.
 - 2. Material: Rigid, heavy-wall, mild steel, hot-dip galvanized, smooth interior, tapered threads and carefully reamed ends; 3/4-inch NPS minimum size.
- B. PVC-coated Rigid Steel Conduit, Elbows, and Couplings:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Robroy Industries.
 - b. Perma-Cote Industries.
 - c. OCAL, Inc.
 - d. Or equal.
 - 2. Material: Rigid, heavy-wall, mild steel, hot-dip galvanized, smooth urethane interior coating, tapered threads, carefully reamed ends, 3/4-inch NPS minimum size with factory exterior coating of 40-mil thick PVC.
 - 3. Color: Color of coating shall be the same on all conduit and fittings.
- C. Metallic Conduit Fittings, and Outlet Bodies:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Crouse-Hinds Company.
 - b. Appleton Electric Company.
 - c. Or equal.
 - 2. Material and Construction: Cast gray iron alloy, cast malleable iron or aluminum bodies and covers consistent with conduit material. Units shall be threaded type with five full threads. Materials shall comply with ANSI/NEMA FB1 and be listed by UL. Do not use “LB” fittings. Use type “LBD” fittings where use of fittings is unavoidable.
 - 3. Use: Conduits shall be gasketed and watertight in hazardous, wet, and corrosive locations.
- D. PVC-coated Conduit Fittings, and Outlet Bodies:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Robroy Industries.
 - b. Perma-Cote Industries.
 - c. OCAL, Inc.
 - d. Or equal.
 - 2. Material and Construction: Cast gray iron alloy, cast malleable iron bodies and covers with factory coating of 40-mil thick PVC and smooth urethane interior coating. Units shall be threaded type with five full threads. Material shall comply with ANSI/NEMA FB1 and be listed by UL. Do not

use “LB” fittings. Use type “LBD” fittings where use of fittings is unavoidable.

3. Use: Provide PVC-coated or aluminum conduit fittings and outlet bodies in hazardous, wet, and corrosive locations. Fitting material shall be consistent with conduit material.

E. Conduit Hubs:

1. Manufacturers: Provide products one of the following.
 - a. Myers Electrical Products Company.
 - b. Or equal.
2. Material: Threaded conduit hub, vibration-proof, weatherproof, with captive O-ring seal, zinc metal with insulated throat and bonding screw.
3. Use: Provide for all conduit terminations to boxes, cabinets, and other enclosures in areas designated as wet locations.

G. PVC-coated Conduit Hubs:

1. Manufacturers: Provide products one of the following:
 - a. Robroy Industries.
 - b. Perma-Cote Industries.
 - c. OCAL, Inc.
 - d. Or equal.
2. Material: Threaded conduit hub, vibration-proof, weatherproof, with captive O-ring seal, zinc metal with insulated throat and bonding screw, and factory coating of 40-mil thick PVC and smooth urethane interior coating.
3. Use: Provide for PVC-coated steel or aluminum conduit terminations to boxes, cabinets, and other enclosures in areas designated as corrosive location.

H. Conduit Bushings and Locknuts:

1. Manufacturers: Provide products one of the following:
 - a. O-Z/Gedney.
 - b. Appleton Electric Company.
 - c. Or equal.
2. Insulated Bushings: Malleable iron body with plastic liner. Threaded type with steel clamping screw. Provide with bronze grounding lug, as required.
3. Locknuts: Steel for sizes 3/4-inch through two-inch diameter and malleable iron for sizes 2.5-inch through four-inch diameter.
4. Use: Provide for all conduit terminations to boxes, cabinets and other enclosures except threaded type in areas designated as dusty locations.

I. Thruwall Seals

1. For new construction through exterior subsurface walls and exterior concrete walls.
 - a. Manufacturer: Provide one of the following:
 - 1) Type WSK and WSCS by O-Z/Gedney.
 - 2) Or equal.
2. For new construction passing through concrete floors and floor slabs.
 - a. Manufacturer: Provide one of the following:

- 1) Type FSK and FSCS floor seals by O-Z/Gedney.
- 2) Or equal.
3. For conduits passing through new exterior masonry block walls or through core-drilled holes in existing exterior subsurface walls, exterior concrete walls, floor slabs ,and roof slabs, and for conduits passing through existing interior concrete walls or floors and interior masonry block walls.
 - a. Manufacturer: Provide one of the following:
 - 1) Type CSMI sealing bushing at the inside of the structure and Type CSMC sealing bushing at the outside of the structure by O-Z/Gedney.
 - 2) Or equal.

2.2 ACCESSORIES

- A. Fasteners: To the extent possible, fastener material shall be consistent with conduit material. For PVC-coated rigid steel conduit runs, fasteners shall have factory applied PVC coating or be stainless steel. Fasten raceway systems to supporting structures using the following:
 1. To Wood: Wood screws.
 2. To Hollow Masonry Units: Toggle bolts, in accordance with Section 05 05 33, Anchor Systems.
 3. To Brick Masonry: Expansion bolts by Price, or equal.
 4. To Concrete: Anchors in accordance with Section 05 05 33, Anchor Systems.
 5. To Steel: Beam clamps in accordance with Section 26 05 29, Hangers and Supports for Electrical Systems.
- B. Duct Sealing Compound
 1. Soft, fibrous, slightly tacky, non-hardening sealing compound.
 2. Remains workable at all temperatures.
 3. Manufacturer:
 - a. Type DUX by O-Z/Gedney.
 - b. Or equal.

2.3 IDENTIFICATION

- A. Conduit Labels:
 1. Provide conduit labels in accordance with Section 26 05 53, Identification for Electrical Systems.
- B. Warning Tape:
 1. Provide warning tape in accordance with Section 26 05 53, Identification for Electrical Systems.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install in accordance with Laws and Regulations.
- B. Supports:
 - 1. Rigidly support conduits by clamps, hangers, or Unistrut-type channels. Conduit supports and accessories shall be in accordance with Section 26 05 29, Hangers and Supports for Electrical Systems.
 - 2. Support single conduits by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the support surface. Support multiple runs of conduits on trapeze type hangers.
- C. Fastenings: Fasten raceway systems rigidly and neatly to supporting structures using specified materials.
- D. Exposed Conduit:
 - 1. Install parallel or perpendicular to structural members or walls.
 - 2. Where possible, run in groups. Provide conduit racks of suitable width, length, and height, arranged to suit field conditions. Provide support every ten feet, minimum.
 - 3. Install on structural members in protected locations.
 - 4. Locate clear of interferences.
 - 5. Provide six inches of clearance from hot fluid lines and 1/4-inch from walls.
 - 6. Install vertical runs plumb. Unsecured drop length shall not exceed 12 feet.
- E. Empty Conduits:
 - 1. Install nylon pull wire in each empty conduit and cap conduits not terminating in boxes with permanent fittings designed for the purpose.
- F. Field Bends: No indentations. Diameter of conduit shall not vary more than 15 percent at bends.
- G. Joints:
 - 1. Apply conductive compound to joints before assembly.
 - 2. Make up joints tight and ground thoroughly.
 - 3. Use standard tapered pipe threads for conduit and fittings.
 - 4. Cut conduit ends square and ream to prevent damaging wire and cable.
 - 5. Use full threaded couplings. Split couplings are not allowed.

6. Use strap wrenches and vises to install conduit. Replace conduit with wrench marks.
 7. Apply zinc-rich paint to exposed threads and other areas of galvanized conduit system where base metal is exposed.
- H. Terminations:
1. Install insulated bushings on conduits entering boxes or cabinets, except when threaded hubs are used.
 2. Provide locknuts on both inside and outside of enclosure, except when threaded hubs are used.
 3. Use of bushings in lieu of locknuts is not allowed.
 4. Install conduit hubs on conduits entering boxes or cabinets in wet and corrosive areas.
- I. Moisture Protection:
1. Plug or cap conduit ends at time of installation to prevent entrance of moisture and foreign materials.
 2. Underground and embedded conduit connections shall be watertight.
 3. Thruwall Seals and Conduit Sealing Bushings: Install for conduits passing through concrete slabs, floors, walls, or concrete block walls.
 4. Drainage: Conduit runs shall be fully drainable. Where possible install conduit runs to drain to one end and away from building. Avoid pockets or depressions in conduit runs.
 5. Seal conduit openings within control and instrumentation panels and distribution equipment with duct sealing compound to provide watertight seal.
- J. Corrosion Protection:
1. Dissimilar Metals:
 - a. Prevent occurrence of electrolytic action between dissimilar metals.
 - b. Do not use copper products in connection with aluminum, and do not use aluminum in locations subject to drainage of copper compounds on bare aluminum.
 - c. Back paint aluminum in contact with masonry or concrete with two coats of aluminum-pigmented bituminous paint.
- K. Reused Existing Conduits:
1. Pull rag swab through conduits to remove water and to clean conduit prior to installing new cable.
 2. Repeat swabbing until all foreign material is removed.
 3. Pull mandrel through conduit, if necessary, to remove obstructions.
- L. Core drill for individual conduits passing through existing concrete slabs and walls. Notify ENGINEER in writing in advance of core drilling. Prior to core drilling, drill sufficient number of small exploratory holes to establish that the area to be core drilled is free of existing embedded conduits. Seal spaces around conduit.

- M. PVC-coated Rigid Steel Conduit:
 - 1. Install in accordance with manufacturer's recommendations.
 - 2. Install with manufacturer's installation tools to avoid damage to PVC coating.
 - 3. Repair damaged PVC coating with manufacturer's recommended touch-up compound.
- N. Identify conduits, including spares, in accordance with Section 26 05 53, Identification for Electrical Systems.

3.3 FIELD QUALITY CONTROL

- A. Site Tests:
 - 1. Test conduits by pulling through each conduit a cylindrical mandrel with length not less than two pipe inside diameters, having an outside diameter equal to 90 percent of conduit's inside diameter.
 - 2. Maintain a record, by number, of all conduits successfully tested.
 - 3. Repair or replace conduits that do not successfully pass testing, and re-test.

+ + END OF SECTION + +

SECTION 26 05 33.16

FLEXIBLE CONDUITS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install flexible metallic conduit and fittings.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. UL 360, Liquid-Tight Flexible Steel Conduit.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the following:
 - 1. NEC Article 350, Liquid-Tight Flexible Metal Conduit.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Product Data:
 - a. Manufacturer's literature and technical information for flexible conduit and fittings proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Flexible Conduit:
 - 1. Material: Flexible galvanized steel core with smooth, abrasion-resistant, liquid-tight, polyvinyl chloride cover. Continuous copper ground built in for sizes 3/4-inch through 1.25-inch. Material shall be UL-listed.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Anaconda Sealtite Type UA by Anamet Electrical, Inc.
 - b. Liqueflex Type L.A. by Electric-Flex Company.
 - c. Or equal.
- B. Flexible Conduit Fittings:
 - 1. Material and Construction: Malleable iron with cadmium finish. Fittings shall adapt the conduit to standard threaded connections, shall have an inside

diameter not less than that of the corresponding standard conduit size and shall be UL listed.

2. Manufacturers: Provide products of one of the following:
 - a. Crouse-Hinds Company.
 - b. Appleton Electric Company.
 - c. Or equal.
3. Use: Provide on flexible conduit in non-hazardous and Class 1, Division 2 hazardous areas.

C. PVC-Coated Conduit Fittings:

1. Material and Construction: Malleable iron with standard finish and 40-mil PVC exterior coating. Fittings shall adapt the conduit to standard threaded connections, and shall have an inside diameter not less than that of the corresponding standard conduit size.
2. Manufacturers: Provide products of one of the following:
 - a. Robroy Industries.
 - b. Permacote Industries.
 - c. OCAL, Inc.
 - d. Or equal.
3. Use: Provide on flexible conduit in areas designated as corrosive locations.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install at motors, transformers, field instruments, and equipment subject to vibration or require movement for maintenance purposes. Provide necessary reducer where equipment furnished cannot accept 3/4-inch diameter flexible conduit. Limit flexible conduit length to three feet maximum.
- B. Install in conformance with the Laws and Regulations.

+ + END OF SECTION + +

SECTION 26 05 33.33

PULL, JUNCTION, AND TERMINAL BOXES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install pull, junction, and terminal boxes.

B. Related Sections:

1. Section 26 05 05, General Provisions for Electrical Systems.
2. Section 26 05 29, Hangers and Supports for Electrical Systems.
3. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are.

1. AASHTO, Standard Specifications for Highway Bridges.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. NEC Article 314, Outlet, Device, Pull and Junction Boxes; Conduit Bodies; Fittings; and Handhole Enclosures.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:
 - a. Manufacturer's technical information for pull, junction, and terminal boxes proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Pull, Junction, and Terminal Boxes:

1. General – Applicable to All Boxes:
 - a. Description and Performance Criteria:
 - 1) Provide pull, junction, and terminal boxes rated at not less than NEMA 12. Boxes shall be appropriate for each location in accordance with NEMA requirements and as required for area

classifications specified in Section 26 05 05, General Provisions for Electrical Systems.

- b. Manufacturers: Provide products of one of the following:
 - 1) Appleton Electric Company.
 - 2) Crouse-Hinds Company.
 - 3) Hoffman Engineering Company.
 - 4) Or equal.
 - c. Terminal strips and terminal blocks in terminal boxes shall be mounted on terminal box sub-panels.
 - d. Identification: Boxes shall be identified in accordance with Section 26 05 53, Identification for Electrical Systems.
2. Materials and Construction – Dusty Locations:
- a. Material: Welded and galvanized sheet steel of USS gage.
 - b. Gasket: Oil-resistant gasket.
 - c. Access: Lift-off hinges and quick-release latches.
 - d. Material Thickness:
 - 1) Boxes with dimension two feet and smaller shall be 14-gage.
 - 2) Boxes with dimension between two and three feet shall be 12 gage.
 - 3) Boxes with dimension of three feet or more in any direction shall be 10-gage.
3. Materials and Construction - Wet, or Corrosive locations:
- a. Rating:
 - 1) Pull boxes in wet, corrosive, or outdoor areas shall be NEMA 4X.
 - b. Material:
 - 1) Cast gray iron alloy with hot-dip galvanized finish, or cast malleable iron bodies and covers.
 - 2) Large boxes not generally available in cast iron construction shall be copper-free aluminum alloy or Type 316 stainless steel, as required by location.
 - 3) In corrosive locations, where the conduit system is PVC-coated, boxes shall be cast metal with factory-applied 40-mil PVC coating, Type 316 stainless steel, or non-metallic thermoplastic or fiberglass reinforced plastic material.
 - c. Gasket:
 - 1) Provide neoprene gaskets for wet and corrosive locations.
 - 2) Gaskets shall be an approved type designed for the purpose. Improvised gaskets are not acceptable.
 - d. Access: Stainless steel cover bolts.
 - e. Features:
 - 1) External mounting lugs.
 - 2) Drilled and tapped conduit holes.
 - 3) Boxes where conduits enter building or structure below grade shall have 1/4-inch drain hole at bottom of the box.

B. Terminal Blocks:

- 1. Products and Manufacturers: Provide one of the following:
 - a. Allen-Bradley Company, Bulletin, Model 1492.
 - b. General Electric Company, Model CR151K.
 - c. Or equal.

2. Material and Construction:
 - a. NEMA-rated nylon modular terminal blocks.
 - b. 600-volt rated.
 - c. Control and alarm circuit terminals shall be screwed type with permanently affixed numeric identifiers beside each connection.
 - d. Power terminals shall be copper and rated for the circuit ampacity.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Mount boxes so that sufficient access and working space is provided and maintain clearance of not less than 1/4-inch from walls.
- B. Securely fasten boxes to walls or other structural surfaces on which boxes are mounted. Provide independent supports that comply with Section 26 05 29, Hangers and Supports for Electrical Systems, where boxes will not be mounted on walls or other structural surface.
- C. Install pull boxes where shown or indicated, and provide pull boxes where one or more of the following conditions exist:
 1. Conduit runs containing more than three 90-degree bends.
 2. Conduit runs exceeding 200 feet in length.
- D. Provide removable, flame-retardant, insulating cable supports in boxes with any dimension exceeding three feet.
- E. Field-apply PVC touch-up to scratched PVC boxes damaged during installation. Touch-up work shall be in accordance with manufacturer's recommendations and instructions.
- F. Size junction, pull, and terminal boxes in accordance with NEC Article 314 and other Laws and Regulations.
- G. Provide terminal blocks in boxes where shown and where cable terminations or splices are required.

+ + END OF SECTION + +

SECTION 26 05 33.36

OUTLET BOXES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install outlet boxes for mounting wiring devices and lighting fixtures.
- B. Related Sections:
 - 1. Section 26 05 05, General Provisions for Electrical Systems.
 - 2. Section 26 05 29, Hangers and Supports for Electrical Systems.
 - 3. Section 26 05 53, Identification for Electrical Systems.
 - 4. Section 26 27 26.13, Low-Voltage Receptacles.
 - 5. Section 26 27 26.23, Snap Switches.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the following:
 - 1. NEC Article 314, Outlet, Device, Pull and Junction Boxes; Fittings; and Handhole Enclosures.
 - 2. UL 514A, Metallic Outlet Boxes.
 - 3. UL 514B, Fittings for Conduit and Outlet Boxes.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Product Data:
 - a. Manufacturer's technical information for outlet boxes proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Device Boxes:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Crouse-Hinds Company.
 - b. Appleton Electric Company.
 - c. Or equal.

2. Material:
 - a. In Wet Locations: Cast gray iron alloy or cast malleable iron with zinc electroplate finish, or aluminum bodies consistent with conduit material.
 - b. In Dusty Locations: Zinc-coated sheet steel or aluminum bodies consistent with conduit material.
 - c. Where conduit is installed concealed, boxes shall include suitable extension rings and covers, as required.
 - d. Where used with PVC-coated conduit system, boxes shall include factory applied 40-mil-thick PVC coating.
 - e. Cast boxes shall be hub-type and include external mounting lugs.
 - f. Metallic outlet boxes shall comply with UL 514A.
 - g. Fittings for outlet boxes shall comply with UL 514B.
3. NEMA rating of box shall be as required for area classifications specified in Section 26 05 05, General Provisions for Electrical Systems.
3. Cover Plates:
 - a. Type 302 stainless steel alloy for indoor finished areas.
 - b. Plates in corrosive locations shall include factory-applied 40-mil PVC coating.
 - c. Stainless steel screws and hardware.
 - d. For receptacle and switch cover plates, comply with Section 26 27 26.13, Low-Voltage Receptacles, and Section 26 27 26.23, Snap Switches.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Fasten boxes rigidly and neatly to supporting structures.
- B. Securely fasten equipment to walls or other surfaces on which materials or equipment is mounted. Provide independent supports complying with Section 26 05 29, Hangers and Supports for Electrical Systems, where boxes are not mounted on walls or other surface capable of supporting the materials or equipment.
- C. For units mounted on masonry or concrete walls, provide suitable 1/2-inch spacers to prevent mounting back of box directly against wall.
- D. Leave no open conduit holes in boxes. Close unused openings with capped bushings.
- E. Label each circuit in boxes and identify each circuit in accordance with Section 26 05 53, Identification for Electrical Systems.

F. Install outlet boxes in accordance with NEC Article 314.

+ + END OF SECTION + +

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install identification for electrical apparatus and electrical Work.

B. Related Sections:

1. Section 26 05 19, Low Voltage Electrical Power Conductors and Cables.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:

1. NEC Article 110, Requirements for Electrical Installation.
2. NEC Article 210, Branch Circuits.
3. NEC Article 215, Feeders.
5. NEC Article 700, Emergency Systems.
6. NEC Article 701, Legally Required Standby Systems.
7. NEC Article 702, Optional Standby Systems.
8. 40 CFR 1910.145 (OSHA) – Specification for Accident Prevention Signs and Tags.
9. NFPA 70E, Electrical Safety in the Workplace.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings: Submit the following:
 - a. Complete description and listing of proposed electrical identification and electrical identification devices for associated equipment or systems.
 - b. Conduit and wire identification numbering system and equipment signage.
2. Product Data:
 - a. Manufacturer's literature, cut sheets, specifications, dimensions and technical data for all products proposed under this Section.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

A. Engraved Identification Devices (Nameplates and Legend Plates):

1. Nameplates:
 - a. Laminated thermoset plastic, 1/16-inch thick, engraved condensed block black lettering on white background, square corners, and beveled front edges, or match existing.
 - b. Size: As required.
 - c. Letter Size: Minimum 3/16-inch.
 - d. Nameplates one-inch or less in height shall have one mounting hole at each end. Nameplates greater than one-inch in height shall have mounting holes in the four corners.
2. Legend Plates:
 - a. Legend plates for pushbuttons, pilot lights, selector switches, and other panel-mounted devices shall be large size with dimensions of approximately 2-7/16 inches wide by 2-13/32 inches tall (Allen Bradley large automotive size), plastic, custom engraved with black letters on white background.
 - 1) Provide standard-size legend plates where devices are mounted on motor control centers and spacing of devices precludes using automotive-size legend plates.
 - b. Lettering size and line weight shall be the same for all legend plates on the same panel or enclosure. Maximum size shall be 1/4-inch and minimum size shall be 1/8-inch.

B. Safety Signs and Voltage Markers:

1. Low-Voltage Safety Signs:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) B-302-86060 by Brady.
 - 2) Or equal.
 - b. Low voltage safety signs shall be pressure-sensitive vinyl complying with 40 CFR 1910.145, five inches by 3.5 inches in size, and shall read, “DANGER – 480 VOLTS”.
2. Low-Voltage Markers:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) CV442xx by Brady.
 - 2) Or equal.
 - b. Low voltage markers shall be either pressure-sensitive vinyl or vinyl cloth with black lettering on orange background and shall read, “120 VOLTS”, “208 VOLTS”, “120/208 VOLTS”, or “240 VOLTS” as required.

C. Arc-flash Safety Signs:

1. Products and Manufacturers: Provide one of the following:

- a. Brady.
- b. Or equal.
2. Warning signs shall be adhesive-backed polyester.
3. Warning signs shall read, "Warning – Arc Flash and Shock Hazard. Appropriate PPE Required. Arc flash warning signs shall indicate the flash protection boundary, incident energy in calories per square centimeter, hazard level, description of required protective clothing, shock hazard, limited approach boundary, restricted approach boundary, prohibited approach boundary, and equipment name.

D. Voltage System Identification Directories:

1. General:
 - a. Directories shall be laminated thermoset plastic, 1/16-inch thick, engraved block black letters on white background, square corners, and beveled front edges.
 - b. Directories shall identify all voltage systems within building or structure.
 - c. Directories shall list the colors that identify ungrounded and grounded conductors of each system.
 - d. Colors shall be in accordance with Section 26 05 19, Low Voltage Electrical Power Conductors and Cables, Section 26 05 13.23, 15KV Cable, and Section 26 05 13.26, 5KV Cable.
 - e. Example Directory Text:

Voltage System Identification		
System	A, B, C	Neutral
277/480	Brown, Orange, Yellow	Gray
120/208	Black, Blue, Red	White

2. Large directories for rooms shall have text height not less than 1/2-inch.
3. Small directories for equipment shall have text height of not less than 1/4-inch.

E. Conduit Labels:

1. Products and Manufacturers: Provide one of the following:
 - a. B-915-xxxxx by Brady.
 - b. Or equal.
2. Shall be pre-tensioned acrylic/vinyl construction coiled to completely encircle conduit for conduit up through five-inch diameter, or pre-molded to conform to circumference of conduit six-inch diameter and larger.
3. Attach strap-on style for six-inch diameter conduit with stainless steel springs.
4. Shall be blank for use with custom printed labels.
5. Custom Labels:
 - a. Shall have black lettering on yellow background.
 - b. Shall not contain abbreviations in legend.

- c. Shall be custom printed on continuous tape with permanent adhesive using thermal printer specified below.

F. Wire Identification:

- 1. Heat Shrinkable Wire and Cable Labeling System:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) B-341 PS-xxx-2W by Brady.
 - 2) Or equal.
 - b. White heat-shrinkable irradiated polyolefin shrink-on sleeves. Labels shall be thermal printed. Labels shall be not less than two inches wide.
- 2. Wrap-Around Wire and Cable Labeling System:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) THT-XX-427 by Brady.
 - 2) Or equal.
 - b. Self-laminating white/transparent self extinguishing vinyl strips. Length shall be sufficient to provide at least 2.5 wraps. Labels shall be thermally printed and not less than two inches wide.

G. Detectable Underground Warning Tape:

- 1. Products and Manufacturers: Provide one of the following:
 - a. Indentoline by Brady.
 - b. Or equal.
- 2. Material: Polyethylene or polyester with detectable metal core and polyester underlamine.
- 3. Width: Two inches.
- 4. Color and Labeling: Yellow or red with permanently imprinted black letters: "CAUTION – Buried Electric Line", repeated continuously over full length of tape.

H. Thermal Printing System:

- 1. Utilize thermal transfer process to provide non-smearing labels and markers.
- 2. Wire and Cable Markers:
 - a. Portable, Products and Manufacturers: Provide one of the following:
 - 1) TLS2200 by Brady.
 - 2) Or equal.
 - b. Desktop, Products and Manufacturers: Provide one of the following:
 - 1) 200M by Brady.
 - 2) Or equal.
- 3. Cable Markers:
 - a. Portable, Products and Manufacturers: Provide one of the following:
 - 1) Handimark by Brady.
 - 2) Or equal.
 - b. Desktop, Products and Manufacturers: Provide one of the following:
 - 1) Labelizer PLUS by Brady.
 - 2) Or equal.

2.2 FABRICATION

- A. Engraved Identification Devices (Nameplates and Legend Plates):
 - 1. Nameplate and legend plate text is preliminary and subject to change pending final review and approval of nomenclature by ENGINEER after start-up and testing.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Provide electrical identification in accordance with manufacturer recommendations and as required for proper identification of equipment and materials.
- B. Engraved Identification Devices (Nameplates and Legend Plates):
 - 1. Unless otherwise indicated in the Contract Documents, attach permanent nameplates with permanent adhesive and with 3/16-inch diameter, round head, stainless steel machine screws into drilled and tapped holes.
 - 2. Provide nameplate with 1.5-inch high letters to identify each console, cabinet, panel, or enclosure as shown or indicated.
 - 3. Provide nameplates for field-mounted motor starters, disconnect switches, manual starter switches, pushbutton stations, and similar equipment operating components, which shall describe motor or equipment function and circuit number.
 - 4. Provide nameplates with 1/2-inch high letters to identify each junction and terminal box shown or indicated.
 - 5. Except conduit, all electrical appurtenances including lighting panels, convenience outlets, fixtures, and lighting switches, shall be provided with nameplates indicating appropriate circuit breaker number(s).
 - 6. Push Buttons:
 - a. Provide legend plates for identification of functions.
 - b. Provide nameplates for identification of controlled equipment.
 - c. Provide red buttons for stop function.
 - d. Provide black buttons for other functions.
 - 9. Pilot Lights:
 - a. Provide legend plates for identification of functions.
 - b. Provide nameplates for identification of controlled equipment.
 - c. Shall have lens colors as shown or indicated. Where no color is indicated, provide the following lens colors:

Color	Legend
Green	Running, Open
Red	Stopped, Closed
Amber	Alarm
Blue	Power
White	Status

10. Selector Switches:
 - a. Provide legend plates for identification of functions.
 - b. Provide nameplates for identification of controlled equipment.
11. Panel Mounted Instruments:
 - a. Provide nameplates for identification of function.
12. Interiors of Cabinets, Consoles, Panels, Terminal Boxes, and Other Enclosures:
 - a. Provide nameplates for identification.
 - b. Provide each item inside cabinet, console, panel, terminal box, or enclosure with laminated plastic nameplate as shown on approved Shop Drawings and CONTRACTOR's other submittals. Install nameplates with adhesive.
 - c. Interior items requiring nameplates include:
 - 1) Terminal blocks and strips.
 - 2) Bus bars.
 - 3) Relays.
 - 4) Rear of face-mounted items.
 - 5) Rear of door-mounted items.
 - 6) Interior mounted items that require identification when mounted externally.
 - d. Circuit Breaker Directory:
 - 1) Provide engraved laminated plastic directory listing function and load controlled for each circuit breaker within panel used for power distribution.
13. Re-label existing equipment whose designation have changed.

C. Safety Signs and Voltage Markers:

1. Provide safety signs and voltage markers on and around electrical equipment as shown or indicated.
 - a. Install rigid safety signs using stainless steel fasteners.
 - b. Clean surfaces before applying pressure-sensitive signs and markers.
2. Install low voltage safety signs on equipment doors that provide access to uninsulated 480-volt conductors, including terminal devices.
3. Install low voltage markers on each terminal box, safety disconnect switch, and panelboard installed, modified, or relocated as part of the Work and containing 120/208 volt conductors.

D. Voltage System Identification Directories

1. Provide voltage system identification directories as required by NEC Article 210 and NEC Article 215.
2. Provide in each electrical room voltage system identification directory mounted on wall or door at each entrance to room.
3. For panelboards, and other branch circuit or feeder distribution equipment that are not located in electrical rooms, provide voltage system identification directory mounted on equipment.
 - a. Directories shall be affixed using epoxy glue. Screws or bolts shall not penetrate equipment enclosures.
 - b. Directories shall be readily visible and not obscure labels and other markings on equipment.

E. Arc-flash Safety Signs:

1. Provide arc-flash safety signs as required by NEC Article 110.
2. Provide signs for panelboards. Provide arc flash warning signs on other equipment where the incident energy is greater than 1.2 calories per square centimeter.

F. Conduit Labels:

1. Provide conduits with conduit labels unless otherwise shown or indicated.
2. Do not label flexible conduit.
3. Do not label exposed single conduit runs of less than 25 feet between local disconnect switches and their associated equipment.
4. Conduit labels shall indicate the following information:
 - a. Contract Number: Alphanumeric, three or four digits, as applicable.
 - b. Conduit Number: Alphanumeric as shown on the Drawings, as assigned by CONTRACTOR for unlabelled conduits, and in accordance with approved submittals.
5. Provide conduit labels at the following locations:
 - a. Where each conduit enters and exits walls, ceilings, floors, or slabs.
 - b. Where conduit enters or exits boxes, cabinets, consoles, panels, or enclosures, except pull boxes and conduit bodies used for pull boxes.
 - c. At maximum intervals of 50 feet along length of conduit.
6. Orient conduit labels to be readable.

G. Wire and Cable Identification:

1. Color-coding of insulated conductors shall comply with Section 26 05 19, Low Voltage Electrical Power Conductors and Cables.
2. Use heat-shrinkable wire labels where wire or cable is terminated. Use wrap-around labels where wire or cable is to be labeled but is not terminated.
3. Do not provide labels for the following:
 - a. Bare (uninsulated) conductors, unless otherwise shown or indicated as labeled.
4. Provide wire and cable labels for the following:

- a. New, rerouted, or revised wire or cable.
- b. Insulated conductors.
- d. Wire and cable terminations:
 - 1) Wire labels shall be applied between 1/2-inch and one inch of completed termination
 - 2) Apply cable labels between 1/2-inch and one inch of cable breakout into individual conductors.
 - a) Label individual conductors in a cable after breakout as specified for wires.
- e. Wire or cable exiting cabinets, consoles, panels, terminal boxes, and enclosures.
 - 1) Label wires or cables within two inches of entrance to conduit.
- f. Wire or cable in junction boxes and pull boxes
 - 1) Label wires or cables within two inches of entrance to conduit.
- g. Wire and cable installed in cable tray.
 - 1) Wire and cable shall have labels at maximum intervals of 20 feet.
- h. Wire and cable installed without termination in electrical manholes.
 - 1) Wire and cable shall have wrap-around labels applied within one foot of exiting manhole.
- 5. Wire and Cable Identification System:
 - a. Wire and cable labels shall be imprinted with an identifying designator.
 - 1) Wire and cable extending between two devices or items and that does not undergo a change of function shall be identified by a single unique designator as specified below.
 - b. Field Wiring:
 - 1) Wire or cable designator shall consist of:
 - a) Three left-most characters shall consist of the Contract number under which wiring or cable was installed.
 - b) Fourth character from the left shall be an asterisk (*), a plus sign (+) or a hyphen (-). Do not use other punctuation symbols in a wire designator.
 - c) Remaining characters shall be alphanumeric and make wire designator unique.
 - d) Numbering shall reflect actual designations used in the Work and shall be documented in record documents.

H. Terminal Strip Labeling:

- 1. Label panel side of terminal to match panel wire number.
- 2. Label field side of terminal to match field wire number. Terminal number shall not include the Contract number.

+ + END OF SECTION + +

SECTION 26 05 73

ELECTRICAL POWER DISTRIBUTION SYSTEM STUDIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, professional services, and incidentals required to perform electrical power distribution system studies.
2. Motor starting and transformer information used in electrical power distribution system studies shall be based on equipment provided by CONTRACTOR, equipment provided by other contractors on the Project and, where applicable, existing equipment ratings and settings.
3. Electrical power distribution system studies shall include the following, as specified in this Section:
 - a. Short-circuit study.
 - b. Protective device evaluation study.
 - c. Protective device coordination study.
 - d. Arc flash analysis.

B. Related Sections:

1. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI/IEEE C37.91, Guide for Protective Relay Applications to Power Transformers
2. ANSI/NCSL Z540.3 Requirements for the Calibration of Measuring and Test Equipment.
3. IEEE 141, Recommended Practice for Electric Power Distribution in Industrial Plants (IEEE Red Book).
4. IEEE 242, Recommended Practice for Protection and Coord. of Industrial and Commercial Power Systems (IEEE Buff Book).
5. IEEE 399, Analysis (IEEE Brown Book), Recommended Practice for Power System Analysis.
6. IEEE 1584, Guide for Performing Arc-Flash Hazard Calculations.
7. NFPA 70E, Electrical Safety in the Workplace.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Professional Engineer:

- a. Engage a registered professional engineer legally qualified to practice in the jurisdiction where the Project is located and experienced in providing engineering services of the kind indicated. Professional engineer may be employed by independent consulting firm or manufacturer of power distribution equipment.
 - b. Professional engineer shall have not less than five years of experience performing electrical power distribution system studies similar in scope and size to the studies required for the Project.
 - c. Submit qualifications data.
 - d. Responsibilities include but are not necessarily limited to:
 - 1) Performing or supervising the performance of electrical power distribution system studies and related field services.
 - 2) Preparing or supervising the preparation of test plans and test reports, and interpretation and engineering analysis of test data. Test reports shall bear the seal and signature of the professional engineer. State of licensure, license number, and professional engineer's name shall be clearly legible on the seal.
 - 3) Certifying that tests performed and results achieved conform to the Contract Documents.
2. Field Engineer:
- a. Field engineer performing protective device testing shall be experienced in type of testing required and testing equipment used on the Project.
 - b. Field engineer may be an employee of the protective device equipment manufacturer.
- B. Test equipment and instrument calibration shall comply with accuracy standards of NIST and ANSI/NCSL Z540.3.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
- 1. Studies:
 - a. Calculations and results of the short-circuit study, protective device evaluation, and coordination studies in report format. Report shall be sealed and signed by the professional engineer retained for the studies. Submit preliminary reports (when specified) and final reports.
 - b. Time current curves for protective devices included within the power system studies.
 - c. Calculations and results of arc-flash analysis in report format sealed and signed by professional engineer retained for the studies. Submit preliminary reports (when specified) and final reports.
 - 2. Testing Plan: Submit work plan for field testing. Submit and obtain ENGINEER's approval prior to performing tests. Plan shall indicate schedule of field testing, time frames for tests, and duration of equipment outage for testing. Submit shutdown requests for each outage in accordance with Section 01 14 16, Coordination with Owner's Operations.

- B. Informational Submittals: Submit the following:
 - 1. Test Reports:
 - a. Results of field testing.
 - 2. Qualifications Statements:
 - a. Professional engineer.
 - b. Field engineer, when required by ENGINEER.
- C. Closeout Submittals: Submit the following:
 - 1. Final settings of protective devices. Submit compilation of final settings for each equipment lineup within 10 days of programming the associated protective devices.
 - 2. Electronic Files:
 - a. Protective Devices:
 - 1) Settings for all microprocessor-based protective devices.
 - 2) Software versions used to program the protective devices.
 - b. Electrical Power Distribution System Studies:
 - 1) Upon ENGINEER's approval or acceptance, as applicable, of submittals required under this Section, submit for OWNER's use all electronic files developed for the Work under this Section associated with the approved or accepted, as applicable, submittal to ENGINEER.
 - 2) Electronic files submitted for OWNER's use shall become OWNER's property.
 - 3) Source files for power studies performed under this Section.

1.5 ELECTRICAL POWER DISTRIBUTION SYSTEM STUDIES

- A. General:
 - 1. Perform a current and complete short-circuit study, protective device evaluation study, and protective device coordination study for the Site's electrical distribution system. Perform studies in accordance with IEEE 141, IEEE 242, and IEEE 399.
 - 2. Studies shall include all portions of high-, medium-, and low-voltage electrical power distribution systems, from the normal and alternate sources of power through low-voltage distribution system. Thoroughly cover in the study normal system operating method, alternate operation, and operations that could result in maximum fault conditions.
 - 3. Promptly bring to attention of ENGINEER and OWNER problem areas and inadequacies in equipment.
 - b. Final Short-circuit and Coordination Study: Base the evaluation on utility-confirmed contribution. Evaluate the distribution system under each of the various operating modes. Base the evaluation on actual confirmed cable lengths, and installed equipment and protective devices.

B. Short-circuit Study:

1. Perform short-circuit evaluation using computer software specifically designed for such use.
2. Input data shall include electric utility company's short-circuit, single-, and three-phase contributions, with reactance/resistance (X/R) ratio, resistance and reactance components of each branch impedance, motor and generator contributions, base quantities selected, and other applicable circuit parameters.
3. Calculate short-circuit momentary duties and interrupting duties on the basis of maximum available fault current at each switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboards, and other significant locations through the system.
4. Short-circuit tabulations shall include symmetrical fault currents and X/R ratios. For each fault location, total duty on the bus and individual contribution from each connected branch, including motor back electromotive force (EMF) current contributions, shall be listed with its associated X/R ratio.

C. Protective Device Evaluation Study:

1. Determine adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing short-circuit ratings of these devices with the available fault currents.
2. Apply appropriate multiplying factors based upon system X/R ratios and protective device rating standards.

D. Protective Device Coordination Study:

1. Perform study to select or to check selections of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and low-voltage breaker trip characteristics and setting.
2. Overcurrent device settings estimated in the protective device coordination study shall provide complete, 100 percent selectivity. Selectively coordinate system such that only the device nearest a fault will operate to remove the faulted circuit. System selectivity shall be based on both the magnitude and duration of a fault current.
3. Study shall include all voltage classes of equipment starting at electric utility's incoming line protective device, down to and including medium- and low-voltage equipment. Phase and ground overcurrent and phase and ground fault protection shall be included, and settings for other adjustable protective devices.
4. Plot time-current characteristics of installed protective devices on appropriate log-log paper. Maintain reasonable coordination intervals and separation of characteristic curves. Provide coordination plots for phase and ground protective devices for complete system. Use sufficient curves to clearly indicate selective coordination achieved through electric utility's main breaker, power distribution feeder breakers, and overcurrent devices at each major load center.

5. Show maximum of eight protective devices per plot. Appropriately title each plot and include the following information as required for the circuits shown:
 - a. Representative one-line diagram, legends, and types of protective devices selected.
 - b. Power company's relays or fuse characteristics.
 - c. Significant motor starting characteristics.
 - d. Parameters of transformers, magnetizing inrush and withstand curves in accordance with ANSI C37.91.
 - e. Operating bands of low-voltage circuit breaker trip curves, and fuse curves.
 - f. Relay taps, time dial and instantaneous trip settings.
 - g. Cable damage curves.
 - h. Symmetrical and asymmetrical fault currents.
6. Provide selection and settings of protective devices separately in tabular format listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings. Provide a tabulation of recommended power fuse selection for all fuses in system.

E. Arc-Flash Analysis:

1. Conduct arc flash analysis after acceptance by ENGINEER of short-circuit study and coordination study. Perform arc flash analysis for each operating mode of the system, in accordance with IEEE 1584 and NFPA 70E.
2. Document the protection and calculation procedures and coordination review in testing report. Present analysis results in tabular format showing the following:
 - a. Bus and protection device name.
 - b. Bolted and arcing fault values.
 - c. Protective device trip times.
 - d. Arc flash boundary, working distance, and incident energy.
 - e. Required protective flame-resistant (FR) clothing class.

1.6 STUDY REPORT

- A. Summarize results of electrical power distribution system studies in a typed or computer-printed report that includes the following:
 1. Description, purpose, basis, written scope, and single-line diagram of power distribution systems evaluated.
 2. Tabulations of circuit breaker, fuses, and other equipment ratings versus calculated short-circuit duties. Evaluation of short-circuit calculations and identification of underrated equipment.
 3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, and fuse selection. Include an evaluation and discussion of logical compromises for proposed protection.
 4. Fault current tabulation including definition of terms and guide for interpretation.

5. Tabulation of appropriate tap settings for relay seal-in units.
 6. Tabulation of equipment survey information.
- B. Electrical power distribution system studies report shall include a separate section addressing arc flash analysis. In addition to protection and calculation procedures, and coordination review and analysis results, report shall include protective device evaluation for each high-incident energy case to determine if adjustments can improve system performance relative to arc flash hazard level.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION

- A. General:
1. Coordinate with professional engineer performing the studies and assist professional engineer with collecting information necessary to complete the specified studies.
 2. Prior to performing studies, obtain information pertaining to existing system necessary for performing studies.

3.2 FIELD TESTING

- A. Site Tests:
1. Provide protective device field testing in accordance with manufacturers' recommendations. Field testing shall be by CONTRACTOR's field engineer, after submittal of and ENGINEER's acceptance of electrical power distribution system studies. Field testing results shall be documented in a report that shall include final settings of protective devices.
 2. Field engineer shall provide necessary tools and equipment and adjust, set, calibrate, and test protective devices. Protective relays and meters in medium- and low-voltage equipment shall be set, adjusted, calibrated, and tested in accordance with manufacturers' recommendations and the coordination study. Provide minor adjustments, repairs, and lubrication necessary for proper operation.
 3. Electromechanical protective relays provided in accordance with the Contract Documents shall be set and tested for acceptance. Testing shall include visual and mechanical inspection. Testing shall include overcurrent time and pick-up tests.
 4. Solid state and multi-function trip devices shall be set, including required programming necessary for the protection required. Devices shall be checked, configured, and tested for setting and proper operation.

3.5 MAINTENANCE OF OPERATIONS

- A. Field testing may require that certain equipment be temporarily taken out of service. CONTRACTOR shall perform the Work with due regard to the need of OWNER for continuance of operations and in accordance with sequencing required in the Contract Documents, and in accordance with Section 01 14 16, Coordination with Owner's Operations. Submit testing procedures and schedules and obtain acceptance by ENGINEER prior to starting testing and related Work.

3.6 INSTALLATION

- A. Provide personnel protective equipment labels in accordance with Section 26 05 53, Identification for Electrical Systems.
 - 1. Supplier Services: Provide training for OWNER's operation and maintenance personnel in personnel protection equipment. Provide at least eight hours of training, in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.

+ + END OF SECTION + +

SECTION 26 22 14

DRY-TYPE LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install dry type low-voltage distribution transformers.
- B. Related Sections:
 - 1. Section 26 05 05, General Provisions for Electrical Systems.
 - 2. Section 26 05 26, Grounding and Bonding for Electrical Systems.
 - 3. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. NEMA ST-20, Dry Type Transformers for General Applications.
 - 2. NEMA TP-1, Guide for Determining Energy Efficiency for Distribution Transformers.
 - 3. NEMA TP-2, Standard Test Method for Measuring the Energy Consumption for Distribution Transformers.
 - 4. UL 1561, Dry Type General Purpose and Power Transformers.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. NEC Article 450, Transformers and Transformer Vault (Including Secondary Ties).

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Schedule of transformers to be furnished with ratings and other required technical data.
 - b. Proposed location for each transformer, including pad layout, dimensions, and appurtenances.
 - 2. Product Data:
 - a. Supplier's technical information for transformers proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Dry Type Two-Winding Transformer:

1. Type: Dry type, air cooled, low temperature rise. Transformers 15 kVA and larger shall be energy efficient, complying with NEMA TP-1 Class 1 efficiency levels. Transformers less than 15 kVA shall be general purpose.
2. Rating: KVA, primary voltage and connection, secondary voltage and connection, frequency and number of phases shall be as shown on the Drawings.
3. Insulation: Insulation and average winding temperature rise (in a 40 degree C maximum ambient) for rated kVA per the following table. Energy efficient transformers shall be capable of 15 percent continuous overload at 150 degrees C temperature rise.

kVA Rating	Insulation Class (degrees C)	Temperature Rise (degrees C)
1 to 15 kVA	185	115
25 to 500 kVA	220	115

4. Winding Taps, Transformers 15 kVA and Less: Two 5-percent below rated voltage, full capacity taps on primary winding.
5. Winding Taps, Transformers 25 kVA and Larger: Two 2-1/2-percent above rated voltage and four 2-1/2+ percent below rated voltage, full capacity taps on primary.
6. Basic impulse level shall be 10 kV.
7. Sound Level: NEMA ST-20 standard.
8. Enclosure: UL listed for the application.
9. Identification: Identify transformers in accordance with Section 26 05 53, Identification for Electrical Systems, with the transformer number and voltages, connection data, kVA ratings, impedance, and overload capacity.
10. Transformers shall comply with NEMA ST-20, NEMA TP-1, NEMA TP-2, and UL 1561.
11. Transformers shall bear the label of the Underwriters' Laboratories, Inc.

PART 3 - EXECUTION

3.1 INSPECTION

- #### A.
- Examine the conditions under which the dry type transformers are to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install transformers on walls or floors at locations shown. Install floor mounted transformers on raised concrete bases. Provide sufficient access and working space for convenient and safe operation and maintenance.
- B. Mount transformers so that vibrations are not transmitted to the building structural parts and other equipment. Make connections to transformers with flexible conduit.
- C. Adjust tap settings to provide proper voltage at panelboards.
- D. Install dry type transformers in conformance with governing codes and manufacturer's instructions and recommendations, and the Contract Documents.

+ + END OF SECTION + +

SECTION 26 24 16

PANELBOARDS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install panelboards.
- B. Related Sections:
 - 1. Section 26 05 05, General Provisions for Electrical Systems.
 - 2. Section 26 05 53, Identification for Electrical Systems.
 - 3. Section 26 22 14, Dry-Type Low-Voltage Distribution Transformers
 - 4. Section 26 43 00, Surge Protective Devices.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. NEMA PB 1, Panelboards.
 - 2. UL 67, Panelboards.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Listing of panelboards to be furnished with identification of their proposed location, and all electrical characteristics, including number and rating of branch circuit breakers and enclosure type.
 - 2. Product Data:
 - a. Manufacturer's technical information for panelboards proposed for use, including product literature and specifications. Indicate options and features to be provided.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements; Comply with the following:
 - 1. NEC Article 408, Switchboards and Panelboards.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 - 1. Packing:

- a. Inspect prior to packing to assure that assemblies and components are complete and undamaged.
 - b. Protect mating connections.
 - c. Cover all openings into enclosures with-vapor inhibiting, water-repellent material.
 2. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work. Upon deliver, check materials and equipment for evidence of water that may have entered equipment during transit.
 3. Comply with Section 01 65 00, Product Delivery Requirements.
- B. Storage and Protection:
1. Store panelboards in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.
 2. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Panelboards:
1. Manufacturers: Provide products of one of the following:
 - a. General Electric Company.
 - b. Eaton/Cutler-Hammer.
 - c. Schneider Electric/Square D Company.
 - d. Or equal.
 2. Rating: Voltage rating, current rating, number of phases, number of wires and number of poles as shown or indicated on the Drawings.
 3. Circuit Breakers: Molded case, bolt-in thermal magnetic type with number of poles and trip ratings as shown or indicated. Where indicated on the Drawings, circuit breakers shall be ground fault circuit interrupting type equipped with solid state sensing and five-milliamp sensitivity.
 4. Circuit breakers for 480-volt panelboards shall have minimum interrupting rating of 14,000 ampere RMS symmetrical, unless otherwise indicated on the Drawings. Circuit breakers for other panelboards shall have minimum interrupting rating of 10,000 ampere RMS symmetrical, unless otherwise indicated on the Drawings.
 5. Bus Bars: Bus bars shall be 98 percent conductivity copper. Four-wire panelboards shall have solid neutral bar. Each panel shall have ground bus bar.
 6. Main: Panelboards shall have main circuit breaker, unless the Drawings specifically indicate main lugs only.
 7. Connect branch circuit breakers for sequence phasing.
 8. Enclosures: Panel enclosures shall be as required for the area classifications indicated in Section 26 05 05, General Provisions for Electrical Systems, unless otherwise indicated on the Drawings.

9. Construction: Code-grade steel, ample gutter space, flush door, flush snap latch and lock. Panelboards shall comply with NEMA PB 1 and UL 67.
10. Trim: Surface or flush as required.
11. Directory: Typed or computer-printed card, with transparent protective cover in frame on back of door giving circuit numbers and area or equipment served.
12. Identification: Identify panelboards in accordance with Section 26 05 53, Identification for Electrical Systems. Identification shall indicate panel number and voltage.
13. Directory of Existing Panelboards: When adding or removing breakers or loads from existing panelboards, provide a new typed or computer-generated directory card, indicating the circuit numbers and equipment served.
14. Provide surge protective device in accordance with Section 26 43 00, Surge Protective Devices, for each panelboard shown or indicated on the Drawings. Surge protective device shall be included and factory-mounted within panelboard by panelboard manufacturer. Surge protective device monitoring and display shall be visible from front of panelboard.

B. Integrated Panelboard and Transformer:

1. Products and Manufacturers: Provide products of one of the following:
 - a. Mini-Power Zone by Schneider Electric/Square D Company.
 - b. Mini-Power Center by Eaton/Cutler-Hammer.
 - c. Panel Tran by Acme Electric Corporation.
 - d. Or equal.
2. General: Unit shall consist of encapsulated dry-type transformer, primary and secondary main circuit breakers, and secondary panelboard all in one enclosure.
3. Transformer Rating: Transformer portion shall comply with Section 26 22 14, Dry-type Low-Voltage Distribution Transformers. KVA, primary voltage, secondary voltage, frequency and number of phases shall be as shown or indicated on the Drawings.
4. Branch Circuits: Molded case circuit breakers, plug-in thermal magnetic type with number of poles and trip ratings as shown or indicated on the Drawings.
5. Enclosure: Enclosures shall be as required for the area classifications indicated in Section 26 05 05, General Provisions for Electrical Systems, unless otherwise indicated on the Drawings.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Mounting: Install panelboards at locations shown or indicated. Set cabinets so that top branch circuit breaker is not over six feet above the floor.
- B. Directory: Complete typewritten or computer-printed directory indicating items controlled by each circuit breaker and the size of feeder serving the panel.
- C. Arrange circuits to balance the loads on the panelboards.
- D. Identify panelboards in accordance with Section 26 05 53, Identification for Electrical Systems.
- E. Install in accordance with Laws and Regulations, manufacturer's recommendations, and the Contract Documents. Verify proper installation prior to energizing panelboards.

+ + END OF SECTION + +

SECTION 26 27 26.13

LOW-VOLTAGE RECEPTACLES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install low-voltage receptacles.
- B. Related Sections:
 - 1. Section 26 05 05, General Provisions for Electrical Systems.
 - 2. Section 26 05 53, Identification for Electrical Systems.
 - 3. Section 26 05 33.36, Outlet Boxes.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. UL 498, Standard for Attachment Plugs and Receptacles.
 - 2. UL 514D, Cover Plates for Flush-Mounted Wiring Devices.
 - 3. UL 943, Standard for Ground-Fault Circuit-Interrupters.
 - 4. UL 1010, Standard for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
 - 5. UL 1449, Standard for Surge Protective Devices.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the following:
 - 1. Americans with Disabilities Act.
 - 2. NEC Article 406, Receptacles, Cord Connectors, and Attachment Plugs (Caps).

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Product Data: Manufacturer's technical information for receptacles and cover plates proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Receptacles:

1. Grounding receptacle, two-pole, three-wire, NEMA 5-20R configuration, ivory color.
 - a. Single:
 - 1) Products and Manufacturers: Provide one of the following:
 - a) HBL5361I by Hubbell, Inc.
 - b) 5361-I by Pass & Seymour.
 - c) Or equal.
 - b. Duplex:
 - 1) Products and Manufacturers: Provide one of the following:
 - a) HBL5362I by Hubbell, Inc.
 - b) PS5362-I by Pass & Seymour.
 - c) Or equal.
 - c. Weather-resistant Duplex:
 - 1) UL-listed as weather-resistant.
 - 2) Products and Manufacturers: Provide one of the following:
 - a) HBL5362IWR by Hubbell, Inc.
 - b) WR5362-I by Pass & Seymour.
 - c) Or equal.
2. Corrosion-resistant grounding receptacle, two-pole, three-wire, yellow color.
 - a. Single, 125-volt, 20 ampere, NEMA 5-20R configuration:
 - 1) Products and Manufacturers: Provide one of the following:
 - a) HBL53CM61 by Hubbell, Inc.
 - b) CR6301 by Pass & Seymour.
 - c) Or equal.
 - b. Duplex, 125-volt, 20 ampere, NEMA 5-20R configuration:
 - 1) Products and Manufacturers: Provide one of the following:
 - a) HBL53CM62 by Hubbell, Inc.
 - b) CR6300 by Pass & Seymour.
 - c) Or equal.
 - c. Single, 125-volt, 30 ampere, NEMA 5-30 configuration:
 - 1) Products and Manufacturers: Provide one of the following:
 - a) HBL9308 by Hubbell, Inc.
 - b) 3802 by Pass & Seymour.
 - c) Or equal.

B. Ground Fault Interrupting Receptacles:

1. Duplex grounding receptacle, two-pole, three-wire, NEMA 5-20R configuration, 125-volt AC, 20 amperes, gray color with ground fault circuit interrupting (GFCI) protection.
2. Ground fault interrupting receptacles shall comply with UL 943.
3. Provide Type 302 stainless steel cover-plate conforming to UL 514D. Provide weatherproof-while-in-use cover where shown on the Drawings as “WP” or “WPU”, and provide where located in wet or corrosive location.
4. Products and Manufacturers: Provide one of the following:
 - a. GFR5362SGY by Hubbell, Inc.
 - b. 2091-GRY by Pass & Seymour.
 - c. Or equal.
5. Weather-resistant Ground Fault Interrupting Receptacles

- a. Products and Manufacturers: Provide one of the following:
 - 1) 2095TRWRGRY by Pass & Seymour.
 - 2) Or equal.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Non-hazardous Locations: Install receptacles at locations shown, in outlet or device boxes in accordance with Section 26 05 33.36, Outlet Boxes.
- B. Install receptacles with ground pole in the down position.
- C. Mount receptacles 18 inches above finished floor in accordance with the Americans with Disability Act, unless otherwise shown or indicated in the Contract Documents.
- D. Install in conformance with Laws and Regulations.
- F. Identification:
 - 1. Identify each conductor with circuit number and lighting panel number in accordance with Section 26 05 53, Identification for Electrical Systems.
 - 2. Identify each receptacle with permanent phenolic tag. Tags shall include circuit number and lighting panel number.

+ + END OF SECTION + +

SECTION 26 27 26.23

SNAP SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install snap switches for lighting and other systems.
- B. Related Sections:
 - 1. Section 26 05 53, Identification for Electrical Systems
 - 2. Section 26 05 33.36, Outlet Boxes.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. UL 20, General Use Snap Switches.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Americans with Disabilities Act

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Product Data: Manufacturer's technical information for switches proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Switches:
 - 1. Single pole AC toggle switch, quiet type, 120/277-volt AC, 20 amperes, Ivory, specification grade.
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Catalog No. 1221-I, by Harvey Hubbel, Inc.
 - 2) Catalog No. 1991-I, by Arrow-Hart, Inc.
 - 3) Catalog No. 20AC1-I, by Pass & Seymour

- 4) Or equal.
 2. Single pole, three-way AC toggle switch, quiet type, 120/277-volt AC, 20 amperes, Ivory, specification grade.
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Catalog No. 1223-I, by Harvey Hubbell, Inc.
 - 2) Catalog No. 1993-I, by Arrow-Hart, Inc.
 - 3) Catalog No. 20AC3-I, by Pass & Seymour
 - 4) Or equal.
 3. Switches shall be UL-listed in accordance with UL 20.
- B. Switch Covers:
1. Indoor covers shall be Type 304 stainless steel.
 2. Outdoor, wet, or corrosive location covers shall be weatherproof and corrosion resistant.
- C. Key Operated On-Off Switches:
1. Key operated switches shall be complete with legend plate and NEMA 4 enclosure and two keys for each switch.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switches at locations as shown or indicated in the Contract Documents in outlet or device boxes, in accordance with Section 26 05 33.36, Outlet Boxes.
- B. Mount wall switches 4.0 feet above finished floor, in accordance with the Americans with Disability Act, unless otherwise noted.
- C. Identify each conductor with circuit number and lighting panel number. Identification shall be in accordance with Section 26 05 53, Identification for Electrical Systems.

+ + END OF SECTION + +

SECTION 26 28 16.33

DISCONNECT SWITCHES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install disconnect switches.
- B. Related Sections:
 - 1. Section 26 05 05, General Provisions for Electrical Systems.
 - 2. Section 26 05 53, Identification for Electrical Systems.
 - 3. Section 26 27 26.23, Snap Switches.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. UL 98, Enclosed and Dead-Front Switches.
 - 2. NEMA KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 3. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. NEC Article 404, Switches.
 - 2. Disconnect switches shall bear the UL label.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Listing of each switch to be furnished, including location, rating, and NEMA enclosure type for each.
 - 2. Product Data:
 - a. Manufacturer's technical information for disconnect switches proposed for use.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide products of one of the following:

1. Square-D Company.
2. Cutler-Hammer.
3. General Electric Company.
4. Siemens.
5. Or equal.

2.2 MATERIALS

A. Service Disconnect Switches:

1. Type: Fused, heavy-duty, single throw, quick-make, quick-break mechanism, visible blades in "OFF" position and safety handle.
2. Rating: Voltage, current and short circuit ratings and number of poles as shown or indicated on the Drawings. Switch shall bear UL label indicating suitability for use as service equipment and shall comply with UL 98, NEMA KS 1, and NEMA 250.
3. Provide auxiliary dry contacts to indicate switch position where shown on the Drawings.

B. Single Throw, Circuit Disconnect Switches:

1. Type: Fused or unfused, horsepower rated, heavy-duty, single throw, quick- make, quick-break mechanism, visible blades in the "OFF" position and safety handle.
2. Rating: Voltage and current ratings and number of poles as required for motor or equipment circuits being disconnected. Switches shall bear a UL label and shall comply with the requirements of UL 98, NEMA KS 1 and NEMA 250.
3. Provide auxiliary dry contacts to indicate switch position.

C. Double Throw Safety Switches:

1. Type: Unfused, double throw with center "OFF" position, quick-make, quick-break mechanism, visible blades in the "OFF" position, and safety handle.
2. Rating: Voltage and current ratings and number of poles as required for circuits being disconnected. Switches shall bear UL label and shall comply with UL 98, NEMA KS 1, and NEMA 250.
3. Provide auxiliary dry contacts to indicate switch position where shown on the Drawings.

D. Disconnect Switches for 120-volt, Single-phase Circuits:

1. Refer to Section 26 27 26.23, Snap Switches.

E. Enclosures: NEMA rating shall be as required for area classifications specified in Section 26 05 05, General Provisions for Electrical Systems.

F. Identification:

1. Identify enclosures in accordance with Section 26 05 53, Identification for Electrical Systems.

2. Provide nameplate to identify the equipment served by disconnect switch and associated source of power.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
- B. Securely fasten equipment to walls or other structural supports on which they are mounted. Provide independent stainless steel supports where no wall or other structural surface exists. Mount disconnect enclosures at a height not exceeding six feet.
- C. Provide suitable 1/4-inch spacers to prevent mounting enclosure directly against walls.

+ + END OF SECTION + +

SECTION 26 43 00

SURGE PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install surge protective devices (SPD).
2. SPDs furnished under this Section shall be ANSI/UL 1449 Type 2 integrating both surge suppression and high-frequency noise filtering suitable for use on low-voltage distribution systems.

B. Related Sections:

1. Section 26 05 05, General Provisions for Electrical Systems.
2. Section 26 24 16, Panelboards.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI/UL 1449, Surge Protective Devices.
2. IEEE C62.41, Recommended Practice on Surge Voltages in Low-voltage AC Power Circuits.
3. IEEE C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 V and Less) AC Power Circuits.
4. UL 1283, Electromagnetic Interference Filters.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Shall have at least five years experience manufacturing and servicing products substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section regardless of component manufacturer from a single SPD manufacturer.
2. SPD manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. Components shall be suitable for the specified service conditions and shall be integrated into overall assembly by SPD manufacturer.

- C. Regulatory Requirements: Comply with the following:
 - 1. NEC 110.9, Requirements for Electrical Installations, Interrupting Rating.
 - 2. NEC 240.21, Overcurrent Protection, Location in Circuit.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Electrical and mechanical drawings for each type of unit, showing electrical ratings, dimensions, mounting provisions, connection details, and layout diagrams.
 - b. Components list and nameplate schedule.
 - c. Summary sheets with schedules of equipment.
 - 2. Product Data:
 - a. Manufacturer's technical information, including catalog information.
 - b. Manufacturer's technical specifications with assembly and component ratings.
- B. Informational Submittals: Submit the following:
 - 1. Certifications:
 - a. Certification that SPD devices comply with standards referenced in this Section.
 - 2. Source Quality Control Submittals:
 - a. Report of results of testing and inspections performed at manufacturer's shop.
 - 3. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
 - 4. Qualifications Statements:
 - a. Manufacture, when requested by ENGINEER.
- C. Closeout Submittals: Submit the Following
 - 1. Operations and Maintenance Data:
 - a. Submit in accordance with Section 01 78 23, Operations and Maintenance Data.
 - b. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.
 - 2. Warranty Documentation: Submit example warranty at time of shipment of the equipment. Include final warranty accepted by ENGINEER in the operations and maintenance manual for the equipment.

1.5 DELIVERY, STORAGE, AND HANDLING.

- A. Delivery:
 - 1. Upon delivery, check for evidence of water that may have entered equipment during transit.
- B. Storage:
 - 1. Store SPD equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.
 - 2. Protect equipment from corrosion and deterioration.

1.6 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents. The obligations of CONTRACTOR under the Contract Documents shall not be limited in any way by the provisions of the specified special warranty.
- B. Special Warranty on Materials and Equipment:
 - 1. Provide manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct, or at option of OWNER, remove or replace materials or equipment specified in this Section found to be defective during a period of five years after the date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide equipment of one of the following:
 - 1. General Electric.
 - 2. Schneider Electric/Square-D Company.
 - 3. Eaton/Cutler-Hammer.
 - 4. Or equal.

2.2 EQUIPMENT

- A. General:
 - 1. SPD shall be modular, high-energy, parallel design with fast-acting transient voltage suppression using metal oxide varistors. Equipment shall provide noise attenuation with electromagnetic interference filter.
 - 2. SPD shall comply with requirements of the following:
 - a. ANSI/UL 1449.
 - b. UL 1283.
 - c. IEEE C62.11, IEEE C62.41 and IEEE C62.45.

3. SPD shall be suitable for operation under the following environmental conditions:
 - a. Relative Humidity: Zero to 95 percent, non-condensing.
 - b. Frequency: 47 to 63 Hertz.
 - c. Temperature: Zero to 149 degrees F.
 4. SPD operating voltage and IEEE C62.41 and IEEE C62.45 Category A, B, and C application environments shall be suitable for the associated SPD location(s) shown or indicated on the Drawings.
 5. SPD shall be suitable for internal and external mounting. Where shown on the Drawings, SPD shall be factory-mounted and integrated into distribution equipment specified under the following Sections:
 - a. Section 26 24 16, Panelboards.
- B. SPD shall include a surge suppression path for each mode as required for the system configuration shown on the Drawings. Each mode shall be individually fused and equipped with thermal cutouts. SPD short-circuit rating shall be 200 kA. Protection modes shall include, to the extent applicable, the following:
1. Line-to-line.
 2. Line-to-neutral.
 3. Line-to-ground.
 4. Neutral-to-ground.
- C. SPD shall include electromagnetic interference/radio frequency interference (EMI/RFI) noise rejection filter with attenuation up to 30 dB from 10 kHz to 100 MHz.
- D. SPDs and components in the operating path shall have maximum continuous operating voltage greater than 115 percent of nominal system operating voltage.
- E. ANSI/UL 1449 minimum withstand rating shall be 20 kA per pole, and ANSI/UL 1449 voltage protection rating for SPD shall not exceed the following:

Modes	208Y/120	480Y/277
L-N,L-G, N-G	800	1200
L-L	1200	2000

- F. SPD surge capacity based upon IEEE C62.41 location category shall, as a minimum, be the following:

Category	Application	Per Phase	Per Mode
C	Service entrance	240 kA	120 kA
B	High exposure locations (distribution equipment)	160 kA	80 kA
A	Branch locations	120 kA	60 kA

2.3 ACCESSORIES

- A. Provide SPD equipped with the following accessories:

1. Surge counter with display for indicating the number of surges detected.
2. LED indicators for monitoring device status.
3. Audible alarm and silence switch for indicating an inoperative condition.
4. Dry contacts, "Form C", for remote annunciation of unit status.
5. Indicators, counter, alarm, and silence switch shall be visible and accessible from front of the SPD. When SPD is integral to switchgear, motor control center, panelboard, or other equipment, indicators, counter, alarm, and silence switch shall be visible and accessible from front of the equipment in which the SPD is installed.

2.4 SOURCE QUALITY CONTROL

- A. Perform manufacturer's standard factory tests on equipment. Tests shall be in accordance with IEEE C62.45 and ANSI/UL 1449.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install SPD at locations shown on the Drawings in accordance with equipment manufacturer's recommendations, Laws, and Regulations, and the Contract Documents.
- B. Conductor length between suppressor and connection point shall be as short and as straight as possible.

+ + END OF SECTION + +

SECTION 26 50 00

LIGHTING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install lighting fixtures and associated controls.
- B. Coordination:
 - 1. Coordinate location of fixtures with piping, ductwork, openings, and other systems and equipment and locate clear of interferences.
- C. Related Sections:
 - 1. Section 26 05 05, General Provisions for Electrical Systems.
 - 2. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. UL 1598, Safety of Luminaires.
 - 2. LM-79-08 (or latest), IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
 - 3. LM-80-08 (or latest), IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 - 4. NEMA SSL-1-2010 Electronic Drivers for LED Devices, Arrays or Systems.
 - 5. UL 8750, Light Emitting Diode (LED) Equipment for Use in Lighting Products.
 - 6. Designlights Consortium (DLC).

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the following:
 - 1. NEC Article 410, Luminaires, Lampholders, and Lamps.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Schedule of light fixtures to be furnished, indicating fixture type and location for each.
 - b. Customized wiring diagrams.
 - 2. Product Data:
 - a. Manufacturer's technical information, specifications, standard wiring diagrams, and catalog cuts for lighting fixtures proposed.
 - b. Fixture construction details.
 - c. ETL photometric and isocandle curves for each fixture proposed.
 - d. Verification of DesignLights Consortium (DLC) qualified product listing for Eversource [NTS: ADD LATEST YEAR] Express Service Lighting Rebate.
- B. Informational Submittals: Submit the following:
 - 1. Manufacturer's Instructions:
 - a. Instructions and recommendations for handling, storing, and protecting the equipment.
 - b. Installation instructions for the equipment, including setting drawings, templates, and directions and tolerances for installing anchorage devices.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery:
 - 1. Upon delivery, inspect equipment for evidence of water that may have entered equipment during transit.
- B. Storage:
 - 1. Store lighting fixtures, controls, related materials and equipment in clean, dry location with controls for uniform temperature and humidity. Protect materials and equipment with coverings and maintain environmental controls.
 - 2. Store materials and equipment for easy access for inspection and identification. Keep materials and equipment off ground, using pallets, platforms, or other supports. Protect materials and equipment from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Type: Lighting fixtures required shall be in accordance with the Lighting Fixture shown on the Drawings. Fixtures shall be complete with supports, ballasts, lamps, and incidentals, as required.
- B. LED Fixtures
 - 1. Diodes (Light Source) –
 - a. LED diodes shall be acceptable for use in the luminaires that it was designed, tested and listed for.
 - b. Individual LED Diodes shall be designed such that failure of one LED will result in the loss of only the damaged LED. A loss of a single LED shall be isolated to prevent cascading failures.
 - c. The LED light source shall be comprised of LED modules connected to an integrated driver.
 - 2. Drivers
 - a. Driver shall be compatible with LED light sources with rated output voltage and maximum output power for the LED's.
 - b. Driver efficiency shall be greater than ninety percent at full load, at 25 degrees Celsius.
 - c. Driver shall have an operating ambient temperature range within the ambient temperature typically found for the intended installation.
 - d. Driver shall have a life expectancy consistent with the life expectancy of the LED's.
- C. Hardware: Provide necessary hangers, supports, conduit adaptors, reducers, hooks, brackets, and other hardware required for safe fixture mounting. Hardware shall have protective, non-corrosive finish.
- D. Lighting Controls:
 - 1. Provide a lighting dimming switches and intelligent control system for control of each area where shown on the Drawings.
 - 2. Switches shall be toggle type with raise/lower dimming capabilities. Switches shall be communicable with each other and a remote power/relay pack.
 - 3. Product and Manufacturer: Provide switching products of one of the following:
 - a. Type nLight NPODM series by Acuity Controls.
 - b. Wattstopper
 - c. Lithonia
 - d. Or equal.
 - 4. Product and Manufacturer: Provide power relay/pack of one of the following:
 - a. Type nLight nPP-16 series by Acuity Controls.
 - b. Wattstopper
 - c. Lithonia
 - d. Or equal.

- E. Motion/Occupancy Sensor:
 - 1. Products and Manufacturers: Provide one of the following:
 - a. Leviton, Motion Sensor Field-of- View PR 150-1 L W
 - b. Or equal.
 - c. Adjustable time delay interval of 0 minutes to 1 hour.
 - d. Equipped with passive infrared (PIR) sensing technology.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. General:
 - 1. Fixture mounting heights and locations indicated on the Drawings are approximate and are subject to revision in the field where necessary to clear conflicts and obstructions.
 - 2. Mounting Heights: Mounting heights or elevations are to bottom of fixture or to centerline of device.
 - 3. Install fixtures in accordance with Laws and Regulations, the Contract Documents, and manufacturer instructions and recommendations.
 - 4. Mount fixtures so that sufficient access is available for ready and safe maintenance.
 - 5. Securely fasten equipment to walls or other surfaces on which equipment is mounted.
- B. Suspended Fixtures:
 - 1. Pendant-mount using 1/2-inch diameter conduit stems.
 - 2. Ground to outlet box.
 - 3. Attach mounting to building structure with expansion anchors.
 - 4. Fixtures shall not be dependent on the outlet box cover screws for support.
- C. Surface Mounted Fixtures:
 - 1. Attach to appropriate outlet box.
 - 2. Attach to surface using fasteners and sealing washers when mounting fixture in damp or wet locations.
- D. Boxes and Fixtures:
 - 1. For units mounted against masonry or concrete walls, provide suitable 1/4-inch spacers to prevent mounting back of box directly against wall.
 - 2. Bolt units rigidly to building with expansion anchors, toggle bolts, hangers, or Unistrut.
 - 3. Do not install boxes with open conduit holes.

4. Cable each circuit and identify with tag.
- F. Mount photocells as shown and adjust foot-candle setting for proper dusk and dawn photo-control. Provide wiring in conduit from photocell to controls.

+ + END OF SECTION + +

SECTION 31 23 05

EXCAVATION AND FILL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to perform all excavating, filling, and grading, and disposing of earth materials as shown, specified, and required for construction of structures, Underground Facilities, roads, and other facilities required to complete the Work.
2. Preparation of subgrade for slabs and pavements is included under this Section.

B. Related Sections:

1. Section 03 00 05, Concrete.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ACI 522R, Pervious Concrete.
2. ANSI/AISC 360, Specification for Structural Steel for Buildings.
3. ASTM C29/C29M, Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate.
4. ASTM C33/C33M, Specification for Concrete Aggregates.
5. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
6. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
7. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
8. ASTM C150/C150M, Specification for Portland Cement.
9. ASTM C595/C595M, Specification for Blended Hydraulic Cements.
10. ASTM C618, Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
11. ASTM C989, Specification for Slag Cement for Use in Concrete and Mortars.
12. ASTM D422, Test Method for Particle-Size Analysis of Soils.
13. ASTM D448, Classification for Sizes of Aggregate for Road and Bridge Construction.
14. ASTM D698, Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³)).
15. ASTM D1556, Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
16. ASTM D1557, Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).

17. ASTM D2216, Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
18. ASTM D4253, Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
19. ASTM D4254, Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
20. ASTM D4318, Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
21. ASTM D4832, Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
22. ASTM D6023, Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM).
23. ASTM D6103, Test Method for Flow Consistency of Controlled Low Strength Material (CLSM).
24. ASTM D6938, Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
25. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.

1.3 TERMINOLOGY

- A. The following words or terms are not defined but, when used in this Section, have the following meaning:
1. "Subgrade" is the uppermost surface of native soil material unmoved from cuts; the bottom of excavation.

1.4 QUALITY ASSURANCE

- A. Qualifications:
1. Professional Engineer:
 - a. Engage a registered professional engineer legally qualified to practice in the same jurisdiction as the Site and experienced in providing engineering services of the kind indicated.
 - b. Responsibilities include but are not necessarily limited to:
 - 1) Reviewing system performance and requirements shown or indicated in the Contract Documents.
 - 2) Preparing written requests for clarifications or interpretations of performance and requirements for submittal to ENGINEER by CONTRACTOR.
 - 3) Preparing or supervising the preparation of design calculations and related submittals verifying compliance of the system with the requirements of the Contract Documents.
 - 4) Signing and sealing all calculations, drawings, and submittals prepared by professional engineer.
 - 5) Certifying that:
 - a) it has performed the design of the system in accordance with the performance requirements stated in the Contract

Documents, and

- b) the said design conforms to Laws and Regulations, and to the prevailing standards of practice.

2. CONTRACTOR's Testing Laboratory:

- a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials specified in this Section.
- b. Testing laboratory shall comply with ASTM E329 and requirements of Section 01 45 29.13, Testing Laboratory Services Furnished by Contractor.
- c. Testing laboratory shall be experienced in the types of testing required.
- d. Selection of testing laboratory is subject to ENGINEER's acceptance.

B. Quality Assurance Testing:

- 1. Quality assurance testing is in addition to field quality control testing required under Part 3 of this Section.
- 2. Materials used in the Work may require testing and retesting, as directed by ENGINEER, during the Project. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be performed at OWNER's expense, including retesting of rejected materials and installed Work, shall be performed at CONTRACTOR's expense.
- 3. CONTRACTOR's Testing Laboratory Scope:
 - a. Collect samples and perform testing of proposed fill materials in the laboratory and in the field to demonstrate compliance of the Work with the Contract Documents.
 - b. Testing laboratory shall perform testing required to obtain data for selecting moisture content for placing and compacting fill materials.
 - c. Submit to ENGINEER and CONTRACTOR written report results of each test.
- 4. Required Quality Assurance Material Testing by CONTRACTOR's Testing Laboratory:
 - a. Gradation in accordance with ASTM D422. Perform one test for every 1,000 cubic yards of each of the following types of material incorporated into the Work: select fill, general fill, subbase material, drainage fill, and pipe bedding material.
 - b. Atterberg limits in accordance with ASTM D4318. Perform one test for every 1,000 cubic yards of the following types of materials incorporated into the Work: general fill, and pipe bedding material.
 - c. Moisture/density relations in accordance with ASTM D698, ASTM D1557, ASTM D4253, or ASTM D4254, as applicable. Perform one test for every 5,000 cubic yards of the following types of materials incorporated into the Work: select fill, general fill, subbase material, drainage fill, and pipe bedding material.
 - d. Moisture content of stockpiled or borrow material in accordance with ASTM D2216. Perform one test for every 1,000 cubic yards of the following types of material incorporated into the Work: select fill, general fill, subbase material, drainage fill, and pipe bedding material.

- e. Requirement for trial batch may be waived by ENGINEER if sufficient field test data documenting compliance with specified material properties and performance properties is submitted to and accepted by ENGINEER. Tests shall have been made on concrete with identical mix design to mix design proposed for the Work, including sources of aggregate and manufacturers of cementitious materials and admixtures.

C. Regulatory Requirements:

- 1. Perform excavation work in compliance with requirements of authorities having jurisdiction and Laws and Regulations, including:
 - a. OSHA, 29 CFR Part 1926, Section .650 (Subpart P – Excavations).
- 2. Obtain required permits and approvals for excavation and fill Work, including work permits from right-of-way owners and permits from environmental authorities having jurisdiction over discharge of water from excavations.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

- 1. Shop Drawings:
 - a. Modifications to the Work proposed due to design of sheeting, shoring, bracing, cofferdams, and similar excavation supports.
- 2. Samples:
 - a. Submit Sample of each aggregate and soil material required. Samples shall be of sufficient size to demonstrate the array of gradation and material types expected in the Work.

B. Informational Submittals: Submit the following:

- 1. Procedure Submittals:
 - a. Excavation Plan: Prior to starting excavation operations, submit written plan to demonstrate compliance with OSHA 29 CFR Part 1926.650. As a minimum, excavation plan shall include:
 - 1) Name of CONTRACTOR's "competent person" in responsible charge of excavation and fill Work.
 - 2) Excavation method(s) and additional items to be included in the Work, as listed in Paragraph 1.5.B.2.a of this Section.
 - 3) Copies of "manufacturer's data" or other tabulated data if protective system(s) are designed on the basis of such data.
 - 4) Copies of required permits and approvals, from authorities having jurisdiction and affected utility owners, for excavation methods proposed.
 - b. Proposed compaction procedure and compaction equipment proposed for use. Where different procedures or equipment will be used for compacting different types of material or at different locations at the Site, indicate where each procedure and equipment item will be used.
- 2. Quality Assurance Test Results Submittals:

- a. Submit results of quality assurance testing performed by in accordance with Paragraph 1.4.B of this Section, unless included as part of another submittal under this Section. Submit results for the following quality assurance testing:
 - 1) Tests on borrow fill material.
 - 2) Optimum moisture – maximum dry density curve for each type of fill material.
 3. Field Quality Control Submittals:
 - a. Submit results of testing and inspection performed in accordance with the field quality control Article in Part 3 of this Section, including:
 - 1) Field density testing.
 - 2) Tests of actual unconfined compressive strength or bearing tests of each stratum.
 4. Qualifications Statements:
 - a. Professional engineer.
 - b. Quality Assurance Testing laboratory. Submit name and qualifications of testing laboratory to be employed, and qualifications of testing laboratory's personnel that will perform quality assurance testing required in this Section.
 - c. Field Quality Control Testing Laboratory: Names and qualifications of testing laboratory employed, and qualifications of testing laboratory's personnel that will perform field quality control testing as required under this Section.

1.6 SITE CONDITIONS

- A. Soil borings and other exploratory operations may be made by CONTRACTOR, at no additional cost to OWNER. Coordinate CONTRACTOR-performed test borings and other exploratory operations with OWNER and utility owners as appropriate. Perform such explorations without disrupting or otherwise adversely affecting operations of OWNER or utility owners. Comply with Laws and Regulations relative to required notifications.
- B. Existing Structures:
 1. The Contract Documents show or indicate certain structures and Underground Facilities adjacent to the Work. Such information was obtained from existing records and is not guaranteed to be correct or complete. CONTRACTOR shall explore ahead of the excavation to determine the exact location of all existing structures and Underground Facilities. Existing structures and Underground Facilities shall be supported and protected from damage by CONTRACTOR. Immediately repair and restore existing structures and Underground Facilities damaged by CONTRACTOR without additional cost to OWNER.
 2. Movement or operation of construction equipment over Underground Facilities shall be at CONTRACTOR's sole risk and only after CONTRACTOR has prepared and submitted to ENGINEER and utility owners (as applicable), and received acceptance therefrom, a plan describing CONTRACTOR's analysis of the loads to be imparted and

CONTRACTOR's proposed measures to protect structures and Underground Facilities during the Project.

3. Coordinate with utility owners for shut-off of services in active piping and conduits. When required by utility owner, OWNER will assist CONTRACTOR with utility owner notifications. Completely remove buried piping and conduits indicated for removal and not otherwise indicated as being abandoned or to remain in place.
4. Do not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when such interruption is indicated in the Contract Documents or when allowed in writing by ENGINEER after acceptable temporary utility services are provided by CONTRACTOR for the affected structure or property.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Select Fill:

1. Material shall be well-graded, crushed aggregate, free of organic material, complying with the following:

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
1.25-inch	100
No. 4	38 to 65
No. 8	25 to 60
No. 30	10 to 40
No. 200	3 to 12

B. General Fill:

1. Material shall be free of: rock and gravel larger than three inches in any dimension, debris, waste, frozen materials, organic material, and other deleterious matter.
2. Fill shall have a liquid limit not greater than 45, and plasticity index not greater than 25.
3. Previously-excavated materials complying with the Contract Documents requirements for general fill may be used for general fill.
4. When on-Site materials are found unsuitable for use as general fill, provide select fill or approved off-Site general fill materials. Prior to using off-Site material as general fill, furnish submittal for and obtain ENGINEER's approval of the material proposed for use.

C. Subbase Material:

1. Material shall be naturally- or artificially-graded mixture of natural or crushed gravel, crushed stone, or natural or crushed sand, complying with the gradation requirements below. Crushed slag is unacceptable.

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
2-inch	100
1-inch	70 to 100
3/4-inch	50 to 90
No. 4	30 to 60
No. 30	9 to 33
No. 200	0 to 15

D. Drainage Fill:

1. Material shall be washed, uniformly-graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing 1.5-inch sieve and not more than five percent passing a No. 4 sieve.

E. Pipe Bedding Material:

1. Aggregate material shall be crushed stone and gravel, free of: rock or gravel larger than one-inch in any dimension, debris, waste, frozen materials, organic material and other deleterious matter. Material shall comply with gradation requirements below:

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
1-inch	100
3/8-inch	30 to 65
No. 4	25 to 55
No. 10	15 to 40
No. 40	8 to 20
No. 200	2 to 8

2. Sand material, where required, shall consist of natural or manufactured granular material and shall contain no organic material. Sand shall be non-plastic, when tested in accordance with ASTM D4318, 100 percent shall pass a 1/2-inch screen and not more than five percent shall pass a No. 200 screen.

2.2 SOURCE QUALITY CONTROL

- A. Perform quality assurance testing, and submit results to ENGINEER, in accordance with the "Quality Assurance" Article in Part 1 of this Section.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Provide ENGINEER with sufficient notice and with means to examine areas and conditions under which excavating, filling, and grading will be performed. ENGINEER will advise CONTRACTOR in writing when ENGINEER is aware of conditions that may be detrimental to proper and timely completion of the

Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 TEST PITS

A. General:

1. In advance of the construction, excavate, make observations and measurements, and fill test pits to determine conditions or location of the existing Underground Facilities and structures. Perform all work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, filling, and replacing pavement for test pits. CONTRACTOR shall be responsible for the definite location of each existing Underground Facility involved within the area of excavation for the Work. Exercise care during such location work to avoid damaging and disrupting the affected Underground Facility or structure. CONTRACTOR shall be responsible for repairing, at his expense, damage to Underground Facility or structure caused during the Work.

B. Payment for Test Pits:

1. All payment for test pits shown or indicated in the Contract Documents will be part of the lump sum Contract Price. Contractor shall include two test pits in addition to any shown on Contract Documents.
2. Separate payment will not be made for test pits made by CONTRACTOR for CONTRACTOR's own use.

3.3 PREPARATION

A. Site Preparation:

1. Clear areas to be occupied by permanent construction of all trees, brush, roots, stumps, logs, wood and other materials and debris. Clean and strip vegetation, sod, topsoil, and organic matter from subgrades where fills will be placed, and from areas where structures will be constructed. Remove from the Site and properly dispose of all waste materials.
2. Burning is not allowed at the Site.

B. Use of Explosives:

1. Use of explosives is not allowed.

C. Dust Control:

1. Control objectionable dust caused by CONTRACTOR's operation of vehicles and equipment, clearing, and other actions. To minimize airborne dust, apply water or use other methods subject to ENGINEER's acceptance and approval of authorities having jurisdiction.

3.4 DEWATERING

A. Dewatering – General:

1. Provide and maintain adequate drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work and work areas. Keep each excavation dry during excavation, subgrade preparation, and continually thereafter until the structure to be built therein is acceptable to ENGINEER and backfilling operations are completed and acceptable to ENGINEER.
 2. Keep all working areas at the Site free of surface water at all times. Provide temporary drainage ditches and temporary dikes, and provide required temporary pumping and other work necessary for diverting or removing rainfall and all other accumulations of surface water from excavations and fill areas. Perform diversion and removal of surface water in manner that prevents accumulation of water behind permanent or temporary structures and at any other locations in the construction area where such accumulations may be detrimental.
 3. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the surface water or groundwater downstream of the point of discharge, shall not be directly discharged. Divert such waters through temporary settling basin or filter before discharging to surface water, groundwater, or drainage routes.
 4. CONTRACTOR shall be responsible for condition of piping, conduits, and channels used for drainage and such piping, conduits, and channels shall be clean and free of sediment.
 5. Remove water from excavations as fast as water collects.
- C. Disposal of Water Removed by Dewatering System:
1. CONTRACTOR's dewatering system shall discharge to a suitable location acceptable to OWNER", in accordance with Laws and Regulations.
 2. Convey water from excavations in closed conduits. Do not use trench excavations as temporary drainage ditches.
 3. Dispose of water removed from excavations in a manner that does not endanger health and safety, property, the Work, and other portions of the Project.
 4. Dispose of water in manner that causes no inconvenience to OWNER, others involved in the Project, and adjacent and downstream properties.

3.5 EXCAVATION

- A. Perform all excavation required to complete the Work as shown, specified, and required. Excavations shall include removing and handling of earth, sand, clay, gravel, hardpan, soft, weathered or decomposed rock, pavements, rubbish, and other materials within the excavation limits.
- B. Excavation Protection:
1. Provide excavation protection system(s) in accordance with Laws and Regulations to prevent injury to persons and property, including Underground Facilities.
 2. Excavation Less Than Five Feet Deep: Excavations in stable rock or in soil conditions where there is no potential for a cave-in may be made with

- vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced.
3. Excavations Greater Than Five Feet Deep: Excavations in stable rock may be made with vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced.
 4. Provide and maintain excavation protection system(s) in accordance with submittals accepted by ENGINEER and required under Paragraph 1.5.B of this Section.
- C. Maintain excavations in dry condition in accordance with “Dewatering” Article in Part 3 of this Section.
- D. Elevation of bottom of footings shown is approximate. ENGINEER may direct such minor changes in dimensions and elevations as may be required to secure a satisfactory footing.
- E. When excavations are made below required grades without written order of ENGINEER, fill such excavations with compacted select fill material, as directed by ENGINEER, at CONTRACTOR’s expense.
- F. Extend excavations sufficiently on each side of structures, footings, and similar construction to allow setting of forms, installation of shoring and bracing, and the safe sloping of banks, as necessary.
- G. Subgrades – General:
1. Subgrades shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades that are otherwise solid but become soft or mucky on top due to construction operations shall be reinforced with subbase material. Finished elevation of stabilized subgrades shall not be above subgrade elevations shown.
 2. If, in ENGINEER’s opinion, subgrade becomes softened or mucky because of construction delays, failure to dewater properly, or other cause within CONTRACTOR’s control, subgrade shall be excavated to firm material, trimmed, and backfilled with select fill material at CONTRACTOR’s expense.
- H. Pipe Trench Preparation:
1. Not more than 10 feet of trench may be opened in advance of installing pipe in trench.
 2. Trench width shall be minimized to greatest extent practical, and shall comply with the following:
 - a. Trench width shall be sufficient to provide space for installing, jointing and inspecting piping. Refer to Drawings for trench requirements. In no case should trench be wider at top of pipe than pipe barrel OD plus two feet, unless otherwise shown or indicated.
 - b. Enlargement of trench width at pipe joints may be made when required and approved by ENGINEER.

- c. Trench width shall be sufficient for shoring and bracing, or shielding and dewatering.
 - d. Trench width shall be sufficient to allow thorough compaction of fill adjacent to bottom half of pipe.
 - e. Do not use excavating equipment that requires the trench to be excavated to excessive width.
- 3. Depth of trench shall be as shown or indicated. If required and approved by ENGINEER in writing, depths may be revised.
- 4. Where ENGINEER considers existing material beneath bedding material unsuitable, remove and replace such unsuitable material with select fill material.
- I. Excavated Materials to be Used as Fill:
 - 1. Stockpile excavated materials that are acceptable for use as fill.
 - 2. As excavation proceeds, keep stockpiles of excavated materials suitable for use as fill separate from unsuitable materials and waste materials.
 - 3. Place, grade, and shape stockpiles for proper drainage.
 - 4. Locate and retain soil materials away from edge of excavations.
 - 5. Dispose of excess soil material and waste materials as specified in this Section.
 - 6. Stockpiled excavated soils for use as select fill or general fill shall be tested and classified by laboratory as on-Site select fill or on-Site general fill. Perform required quality assurance testing for material verification on stockpiled materials as soon as possible to demonstrate compliance of excavated materials with the Contract Documents.
 - 7. Additional excavation fill shall be provided at no additional cost to the OWNER

3.6 UNAUTHORIZED EXCAVATION

- A. All excavations outside lines and grades shown or indicated and that are not approved by ENGINEER, together with removing and disposing of the associated material, shall be at CONTRACTOR's expense. Fill unauthorized excavations with properly-compacted select fill material at CONTRACTOR's expense.

3.7 EROSION AND SEDIMENT CONTROLS

- A. Provide temporary erosion and sediment controls in accordance with Section 01 57 05, Temporary Controls. When applicable, also comply with requirements of the erosion and sediment control plan approved by authorities having jurisdiction.

3.8 SHEETING, SHORING, AND BRACING

- A. General:
 - 1. Design and provide sheeting, shoring, bracing, cofferdams, and similar excavation supports as shown, specified, and required for the Work.

2. Clearances and types of temporary sheeting, shoring, bracing, and similar excavation supports, insofar as they may affect the finished character of the Work and the design of sheeting to be left in place, will be subject to the ENGINEER's approval; but CONTRACTOR is responsible for adequacy of all sheeting, shoring, bracing, cofferdams, and similar excavation supports.
 3. Materials:
 - a. Previously-used materials shall be in good condition, and shall not be damaged or excessively pitted. All steel or wood sheeting designated to remain in place shall be new. New or used sheeting may be used for temporary sheeting, shoring, and bracing.
 - b. All steel work for sheeting, shoring, bracing, cofferdams and other excavation supports, shall be in accordance with ANSI/AISC 360, except that field welding will be allowed.
 4. As excavation progresses, carry down shoring, bracing, cofferdams, and similar excavation supports to required elevation at bottom of excavation.
 5. Comply with Laws and Regulations regarding sheeting, shoring, bracing, cofferdams, and similar excavation supports.
 6. Maintain sheeting, shoring, bracing, bracing, and other excavation supports in excavations regardless of time period excavations will be open.
 7. Unless otherwise shown, specified, or directed, remove materials used for temporary construction when the Work is completed. Perform such removal in manner not injurious to the structures and Underground Facility, their appearance, and adjacent construction.
- B. Removal of Sheeting and Bracing:
1. Remove sheeting and bracing from excavations, unless otherwise directed by ENGINEER in writing. Perform removal to avoid damaging the Work and adjacent construction. Removal shall be equal on both sides of excavation to ensure no unequal loads on structures and Underground Facilities.
 2. Defer removal of sheeting and bracing, where removal may cause soil to come into contact with concrete, until the following conditions are satisfied:
 - a. Concrete has cured for not less than seven days.
 - b. Wall and floor framing, up to and including grade level floors, is in place.

3.9 FILL AND COMPACTION – GENERAL PROVISIONS

- A. Provide and compact all fill required for the finished grades as shown and as specified in this Section.
- B. Place fill in excavations as promptly as progress of the Work allows, but not until completing the following:
1. ENGINEER's authorization after observation of construction below finish grade, including dampproofing, waterproofing, perimeter insulation, and similar Work.
 2. Inspection, testing, approval, and recording of locations of Underground Facilities.

3. Removal of concrete formwork.
 4. Removal of shoring and bracing, and filling of voids with satisfactory materials.
 5. Removal of trash and debris.
 6. Permanent or temporary horizontal bracing is in place on horizontally-supported walls.
- C. Fill that includes organic materials or other unacceptable material shall be removed and replaced with approved fill material in accordance with the Contract Documents.
- D. Placement – General:
1. Place fill to the grades shown or indicated. Bring up evenly on all sides fill around structures and Underground Facilities.
 2. Fill areas shall be undercut and proof-rolled as directed by ENGINEER.
 3. Place fill materials at moisture content and density as specified in Table 31 23 05-A of this Section and this Article's requirements on compaction density. Furnish and use equipment capable of adding measured amounts of water to the fill materials to bring fill materials to a condition within required moisture content range. Furnish and use equipment capable of discing, aerating, and mixing the fill materials to ensure reasonable uniformity of moisture content throughout the fill materials, and to reduce moisture content of borrow materials by air drying, when necessary. When subgrade or lift of fill materials requires moisture-conditioning before compaction, fill material shall be sufficiently mixed or worked on the subgrade to ensure uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of specified limit shall be dried by aeration or stockpiled for drying.
 4. Perform compaction with equipment suitable for the type of fill material placed. Select and use equipment capable of providing the minimum density required in the Contract Documents. Use light compaction equipment, with equipment gross weight not exceeding 500 pounds within horizontal distance of ten feet from the wall of completed, below-grade structures. Furnish and use equipment capable of compacting in restricted areas next to structures and around piping and Underground Facilities. Effectiveness of the equipment selected by CONTRACTOR shall be tested at start of compacted fill Work by constructing a small section of fill within the area where fill will be placed. If tests on the test section of fill indicate that required compaction is not obtained, do one or more of the following: increase the amount of coverages, decrease the lift thicknesses, or use different compactor equipment.
 5. Place fill materials in horizontal, loose lifts, not exceeding specified uncompacted thickness. Place fill in a manner ensuring uniform lift thickness after placing. Mechanically compact each lift, by not less than two complete coverages of the compactor. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of compactor's compacting surface. Compaction of fill materials by inundation with water is unacceptable.

6. Do not place fill materials when standing water is present on surface of the area where fill will be placed. Do not compact fill when standing water is present on the fill to be compacted. Do not place or compact fill in a frozen condition or on top of frozen material. Fill containing organic materials or other unacceptable material previously described shall be removed and replaced prior to compaction.
7. If required densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly-functioning compaction equipment, CONTRACTOR shall perform all work required to provide the required densities. Such work shall include, at no additional cost to OWNER, complete removal of unacceptable fill areas and replacement and re-compaction until acceptable fill is provided.
8. Repair, at CONTRACTOR's expense, observed or measured settlement. Make repairs and replacements as required within 30 days after being so advised by ENGINEER.

E. Fill Against Concrete:

1. Placing fill against concrete below finished grade is not allowed until the concrete has attained its specified strength, as determined by duration of concrete curing and testing of field-cured concrete cylinders. Requirements for strength and curing time are in Section 03 00 05, Concrete.
2. Elevation of fill placed against concrete walls shall not differ by more than two feet on each side of walls, unless walls are adequately braced or all floor framing is in place up to and including grade level slabs.
3. Backfill structural foundation units as soon as practicable, in accordance with this Section, after concrete has gained sufficient strength to avoid damage, to avoid ponding of surface water and accumulation of debris.
4. Where fill is placed against waterproofed surface, exercise care that waterproofing material is not damaged.

F. Fill in Pipe Trenches:

1. Place pipe bedding material in pipe trenches in horizontal layers, and thoroughly compact each layer before the next layer is placed.
2. Piping Installed in Fills Above Pre-construction Grade:
 - a. Prior to installing piping, place the fill in accordance with the Contract Documents until the fill reaches a minimum elevation two feet higher than the top of piping to be installed. Excavate the trench; install the piping, and backfill. Subsequently provide the remainder of the fill required for the Work.
3. Piping trenches may be backfilled prior to testing of piping, unless nature of the test requires observation of pipe during testing. Do not construct building or structure over piping until piping has been successfully tested and passed.
4. Pipe Bedding: Pipe bedding material shall be as follows:
 - a. Install PVC, CPVC, HDPE, and FRP piping on a layer of sand. Sand shall extend to 12 inches above top of pipe and to the trenchwalls on each side of the pipe.

- b. Unless otherwise shown, install other types of piping on not less than six-inch layer of aggregate pipe bedding material. Aggregate pipe bedding material shall extend 12 inches above top of the pipe.
- 5. Placing and Compacting Pipe Trench Fill: Unless otherwise shown, placement and compaction of pipe trench fill materials shall comply with the following:
 - a. Pipe bedding material shall be spread and the surface graded to provide a uniform and continuous support beneath piping at all points between bell holes or pipe joints. Slight disturbance of installed pipe bedding material surface during withdrawal of pipe slings or other lifting tackle is acceptable.
 - b. After each pipe's bedding material has been graded, and the piping has been aligned, joined in accordance with the Contract Documents, and placed in final position on bedding material, provide and compact sufficient pipe trench fill material under and around each side of the pipe and back of the bell or end thereof to hold piping in proper position and maintain alignment during subsequent pipe jointing and embedment operations. Deposit and compact pipe trench fill material uniformly and simultaneously on each side of piping to prevent lateral displacement of piping. Place and compact pipe trench fill material to an elevation 12 inches above top of pipe, unless otherwise shown or specified.
 - c. Each layer of pipe trench fill material shall be compacted by at least two complete coverages of all portions of surface of each lift using appropriate compaction equipment.
 - d. Method of compaction and compaction equipment used shall be appropriate for material to be compacted and shall not transmit damaging shocks to the piping.

G. Temporary Pavement:

- 1. Place 1.5 inches of temporary asphalt concrete pavement immediately after filling excavations in paved roadways and other paved areas that will remain for permanent use.
- 2. Maintain surface of paved area over the fill in good and safe condition during progress of the Work, and promptly fill depressions over and adjacent to the fill area caused by settlement of fill.
- 3. Permanent replacement pavement shall be equal to that of the existing roadways, unless otherwise shown or specified.

H. Subbase Placement:

- 1. Provide subbase material where shown to the limits shown or indicated.
- 2. Place subbase material in compacted lifts not exceeding depth of six inches each.

I. Drainage Fill Placement:

- 1. Provide drainage fill material where shown to the limits shown or indicated.

2. Place drainage fill material in compacted layers of uniform thickness not exceeding depth of six inches each. Compact lifts of drainage fill using suitable compaction equipment.
- J. Compaction Density Requirements:
1. Compaction required for all types of fills shall be in accordance with Table 31 23 05-A of this Section. Moisten material or aerate the material as necessary to provide the moisture content that will facilitate obtaining the required compaction.

**TABLE 31 23 05-A
REQUIRED MINIMUM DENSITY**

Material	Percent Compaction (ASTM D698)	Uncompacted Lift (inches)
General Fill		
More than five feet below final grade	100	8
Less than five feet below final grade	95	8
Select Fill		
Below concrete slabs or mats	100	8
Below pavement and sidewalks	100	12
Behind concrete walls	95	8
Subbase Material		
Below pavement and sidewalks	100	12
All other locations	100	8
Pipe Bedding Material		
Below structures or pavement	100	8
All other locations	95	6
Drainage Fill	N/A	6

2. Fill shall be wetted and thoroughly mixed to achieve optimum moisture content plus-or-minus three percent, with the following exceptions:
 - a. On-site clayey soils: Optimum to plus three percent.
3. Replace natural, undisturbed soils or compacted soil subsequently disturbed or removed by construction operations with materials compacted as indicated in Table 31 23 05-A of this Section.
4. Field quality control testing for density; to verify that specified density was obtained, will be performed during each day of compaction Work. Responsibility for field quality control testing is specified in the "Field Quality Control" Article in Part 3 of this Section.
5. When field quality control testing indicates unsatisfactory compaction, provide additional compaction necessary to obtain the specified compaction. Perform additional compaction Work at no additional cost to OWNER until specified compaction is obtained. Such work includes complete removal of unacceptable (as determined by ENGINEER) fill areas and replacement and re-compaction until acceptable fill is provided in accordance with the Contract Documents.

- K. Replacement of Unacceptable Excavated Materials: In cases where over-excavation to replace unacceptable soil materials is required, backfill the excavation to required subgrade with select fill material and thoroughly compact in accordance with Table 31 23 05-A and the associated "Compaction Density Requirements" in this Article. Slope the sides of excavation in accordance with the maximum inclinations specified for each structure location.

3.11 GRADING

- A. General:
1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas.
 2. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
- B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free of irregular surface changes, and shall comply with the following:
1. Grassed Areas or Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than one inch above or below the required subgrade elevations.
 2. Sidewalks: Shape surface of areas under sidewalks to line, grade, and cross section, with finish surface not more than one inch above or below the required subgrade elevation.
 3. Pavements: Shape surface of areas under pavement to line, grade, and cross section, with finish surface not more than 1/2-inch above or below the required subgrade elevation.
- C. Grading Surface of Fill Under Concrete Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a ten foot straight edge.
- D. Compaction:
1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

3.12 PAVEMENT SUBBASE COURSE

- A. General:
1. Place subbase material, in layers of specified thickness, over ground surface to support pavement base course.
 2. After completing filling and grading, shape and compact pavement subgrade to an even, firm foundation in accordance with this Section. Remove unsuitable subgrade materials, including soft materials, boulders, vegetation, and loose stones, and replace with compacted fill material as directed by ENGINEER.

- B. Grade Control:
 - 1. During construction, maintain lines and grades including crown and cross-slope of subbase course.
- C. Placing of Pavement Subbase Course:
 - 1. Place subbase course material on prepared subgrade in layers of uniform thickness, in accordance with indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placing operations.
 - 2. Compaction and Grade Control: Comply with compaction requirements for excavation and fill in this Section, and the following requirements:
 - a. Compaction with roller shall begin at the sides of the area to be paved and continue toward the center. Continue compaction until there is no movement of the course ahead of the roller.
 - b. After compaction of top lift of pavement subbase, provide and uniformly spread pipe bedding material and screenings compacted, on the surface, and sweep using gang-dragged broom, followed by compaction.
 - c. After rolling, check for grade with a line not less than 40 feet in length; depression over 1/2-inch deep shall be filled to satisfaction of ENGINEER.
 - 3. After completing compaction, other than that necessary for bringing material for the next course, do not haul or drive over the compacted subbase.
 - 4. Do not install pavement subbase in excess of 500 feet in length without compacting to prevent softening of the subgrade.
 - 5. If subgrade material becomes churned up into or mixed with the subbase material, remove the mixed material and replace with clean, compacted subbase material.

3.15 DISPOSAL OF EXCAVATED MATERIALS

- A. General:
 - 1. CONTRACTOR shall haul away material removed from excavations that does not comply with requirements for fill, or is in excess of the quantity required for fill.
 - 2. Disposal of materials shall be in compliance with Laws and Regulations, at no additional cost to OWNER.

3.16 TEMPORARY BARRIERS

- A. Provide temporary barrier surrounding excavations and excavation work areas to provide temporary protection to persons and property. Barrier shall have openings only at vehicular, equipment, and worker access points.
- B. Minimum Material Requirements for Temporary Barriers:
 - 1. Temporary barrier shall not be less snow fence-type fencing, four feet high.

3.17 FIELD QUALITY CONTROL

- A. Site Tests: CONTRACTOR will employ a testing laboratory to perform field quality control testing.
1. Testing Laboratory Scope:
 - a. Perform field moisture content and density tests to ensure that the specified compaction of fill materials has been obtained.
 - b. Tests of actual unconfined compressive strength or bearing tests on each stratum.
 - c. Report results of each test to ENGINEER and CONTRACTOR.
 2. Required Material Tests:
 - a. Compaction: Comply with ASTM D1556 and ASTM D6938, as applicable.
 3. Authority and Duties of Testing Laboratory:
 - a. Technicians representing the testing laboratory shall inspect the materials in the field, perform testing, and report findings to ENGINEER and CONTRACTOR. When materials furnished or the Work performed does not comply with the Contract Documents, technician will direct attention of ENGINEER and CONTRACTOR to such failure.
 - b. Technician will not act as foreman or perform other duties for CONTRACTOR. Work will be checked as it progresses, but failure to detect defective Work or non-complying materials shall not in any way prevent later rejection when defect is discovered, nor shall it obligate ENGINEER for Substantial Completion or final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release requirements of the Contract Documents, or to approve or accept any portion of the Work.
 4. Responsibilities and Duties of CONTRACTOR:
 - a. Use of testing laboratory shall in no way relieve CONTRACTOR of the responsibility to provide materials and Work in full compliance with the Contract Documents.
 - b. To facilitate testing laboratory, CONTRACTOR shall advise testing laboratory at least two days in advance of filling operations to allow for completion of field quality control testing and for assignment of personnel.
 - c. It shall be CONTRACTOR's responsibility to accomplish the specified compaction for fill and other earthwork. CONTRACTOR shall control construction operations by confirmation tests to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the Contract Documents relative to compaction, control.
 - d. CONTRACTOR shall demonstrate adequacy of compaction equipment and procedures before exceeding one or more of the following quantities of earthwork. Each test location shall include tests for each layer, type, or class of fill to finish grade.
 - 1) 200 linear feet of trench fill.
 - 2) 10 cubic yards of select fill.

- 3) 100 cubic yards of general fill.
- 4) 50 cubic yards of subbase material.
- 5. Testing laboratory will inspect and indicate acceptable subgrades and fill layers before construction work is performed thereon. Testing of subgrades and fill layers shall be taken as follows:
 - a. Trenches for Structures, and Underground Facilities.
 - 1) In Open Fields: Two locations every 1,000 linear feet.
 - 2) Under Pavement Cuts or Within Two Feet of Pavement Edges: One location every 400 linear feet.
 - b. Footing Subgrade: For each stratum of soil on which footings will be placed, perform not less than one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to ENGINEER.
 - c. For Select Fill: On 30-foot intervals on all sides of the structure for every compacted lift, but not less than one per lift on each side of the structure for structures less than 60 feet long on a side.
 - d. For General Fill: One per 1,000 square feet on every compacted lift.
 - e. Subbase Material: One per 1,000 square feet on every compacted lift.
- 6. Periodic compliance tests will be made by ENGINEER to verify that compaction is complying with the requirements specified, at no cost to CONTRACTOR. CONTRACTOR shall remove the overburden above the level at which ENGINEER wishes to test and shall fill and re-compact the excavation after testing is complete.
- 7. If testing laboratory reports or inspections indicate subgrade, fills, or bedding compaction below specified density, CONTRACTOR shall remove unacceptable materials as necessary and replace with specified materials and provide additional compaction at CONTRACTOR's expense until subgrades, bedding, and fill are acceptable. Costs for retesting of subgrade, fills, or bedding materials that did not originally comply with specified density shall be paid by CONTRACTOR.

+ + END OF SECTION + +

SECTION 32 16 13

CONCRETE CURBS, GUTTERS, AND SIDEWALKS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete curbs, gutters, and sidewalks.
2. Types of Work required under this Section include:
 - a. Conventionally-formed or machine-formed curb, gutter, and sidewalk.
3. Width, thickness, geometry, and extent of curb, gutter, and sidewalk shall be as shown or indicated on the Drawings.
4. Requirements for concrete sidewalks apply to concrete driveways, unless otherwise shown or specified, or unless concrete pavement requirements are included in the Contract Documents.

B. Related Sections:

1. Section 03 00 05, Concrete.
2. Section 07 92 00, Joint Sealants.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AASHTO M252, Specification for Corrugated Polyethylene Drainage Pipe.
2. ASTM D1248, Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Installer:
 - a. Installer shall have not less than two years experience installing concrete curbs, gutters, and sidewalks similar to those required for the Work.
 - b. When required by ENGINEER, submit record of experience documenting not less than three successful, completed projects. For each project, submit name the following information: project name, location of project, approximate quantity of concrete curb, gutter, and sidewalk constructed by installer, contract price of concrete curb, gutter, and sidewalk construction, and name and contact information for project owner and the project's construction-phase engineer.

B. Regulatory Requirements:

1. Reference Specifications and Details:

- a. Comply with applicable requirements of New York State Department of Transportation Standard Specifications and Standard Details.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

- 1. Shop Drawings:
 - a. Submit concrete mix design when mix design is different from that submitted under Division 03 Sections on concrete. Submit in accordance with Division 03 Sections on concrete.
 - b. Proposed reinforcing materials.
 - c. Schedule of proposed underdrain piping sizes and materials by location in the Project.
- 2. Product Data:
 - a. Concrete Materials: Submit Supplier's technical information for materials proposed for use, when concrete materials are different from those submitted under Division 03 Sections on concrete.
 - b. Reinforcing Steel: Submit fabricator's technical information, including catalog information and specifications, for materials proposed for use, sufficient for ENGINEER to verify compliance with the Contract Documents.
 - c. Expansion Joint Filler: Submit Supplier's technical information, including manufacturer's product data, brochure, and specifications, for materials proposed for use, when materials are different from those submitted under Division 03 Sections on concrete.
 - d. Underdrain Piping: Manufacturer's product data, brochure, and specifications for underdrain piping proposed for use.

B. Informational Submittals: Submit the following:

- 1. Certifications:
 - a. When concrete materials are different from those approved under Division 03 Sections on concrete, submit certifications as required in concrete Specifications Sections referred to in this Section.
- 2. Site Quality Control Submittals:
 - a. Concrete test results for the Work included under this Section.
- 3. Qualifications Statements:
 - a. Installer, when requested by ENGINEER.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Comply with Division 03 Sections on concrete referenced in this Section.

1.6 SITE CONDITIONS

A. Weather and Temperature Limitations:

- 1. When temperature and environmental conditions warrant, comply with requirements for cold weather placing and hot weather placing under Division

- 03 Sections referenced in this Section, unless otherwise required under this Section.
2. Temperature of aggregate base material under concrete shall be 39 degrees F or higher. Aggregate base material shall not have snow, ice, frost, or standing water on its surface at the time of concrete placing. Use of insulating materials and heating equipment may be required before concrete placing begins.
 3. Discontinue concrete placing when the air temperature falls below 39 degrees F. Do not place concrete in the rain.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Aggregate Bedding Material for Curbs, Sidewalks, and Gutters: Select fill in accordance with Section 03 00 05, Concrete, unless otherwise shown or indicated.
- B. Concrete Materials:
 1. Comply with applicable requirements of: Section 03 00 05, Concrete; including requirements for formwork, concrete materials, admixtures, bonding materials, curing materials, and others as required.
 2. Concrete Mix, Design, and Testing:
 - a. Comply with applicable requirements of Section 03 00 05, Concrete, for concrete mix design, sampling, and testing, and quality control.
 - b. Design the mix to produce concrete of properties of compressive strength, slump range, and air content as specified in Section 03 00 05, Concrete.
 - c. When machine-formed equipment is used for constructing concrete curbs, sidewalks, or gutters, concrete so placed shall have properties in accordance with Section 03 00 05, Concrete, except that maximum slump shall be 2.5 inches and air content shall be two percent of design.
- C. Reinforcing Materials:
 1. Provide deformed steel bars and smooth wire fabric complying with Section 03 00 05, Concrete.
 2. Unless otherwise shown or indicated, provide for sidewalks reinforcing not less than six-inch by six-inch, no. 2.7 wire fabric.
- D. Expansion Joint Material:
 1. Preformed Expansion Joint Filler: Comply with Section 03 00 05, Concrete, for preformed expansion joint fillers.
 2. Joint Sealant: For joint sealants and accessories used on expansion joints, comply with Section 07 92 00, Joint Sealants.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine subgrade, subbase, and conditions under which the Work is will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are been corrected.
- B. Subgrade:
 - 1. Verify that earthwork is completed to correct line and grade.
 - 2. Verify that subgrade is smooth, properly compacted, and free of frost and excessive moisture.
 - 3. Do not commence the Work under this Section until conditions are satisfactory.

3.2 PERFORATED UNDERDRAIN PIPING

- A. Preparation for Underdrain Piping:
 - 1. Provide leveled and compacted bed of the required underdrain bedding material just prior to installing the underdrain piping. Slope bedding as shown and as required for drainage of underdrain piping.
- B. Installation of Underdrain Piping:
 - 1. Install underdrain piping in accordance with pipe manufacturer's recommended installation procedures.
 - 2. Upgrade end of corrugated polyethylene underdrain pipe shall be closed with a solid plastic cap.
 - 3. Unless otherwise shown or required by ENGINEER, install underdrain pipe with perforations down.
 - 4. Install piping to drain to suitable discharge location.
 - 5. When polyethylene underdrains are daylighted through the side slope protect end of pipe from sunlight by providing section of corrugated steel or aluminum pipe, not less than three feet long, at the outlet. Extend the metal pipe not less than six inches into the ground and shall overlap the perforated underdrain piping by not less than the diameter of the underdrain pipe.
- C. Acceptability of Underdrain Piping:
 - 1. With ENGINEER, visually inspect installed underdrain piping after installation and prior to filling and placing additional construction over underdrain piping. Piping will be acceptable when it is verified as installed on acceptable grade for drainage, is installed in accordance with the Contract Documents, and is free of damage and defects.

3.3 CONSTRUCTION OF FORMS

- A. Conventional Forms:
 - 1. Set forms to line and grade. Forms shall be free from warp.
 - 2. Install forms along full length of curb, gutter, and sidewalk.
 - 3. Forms shall extend to the full depth of the curb, sidewalk, and gutter (as applicable) and be secured so no displacement occurs during concrete placing.

- B. At CONTRACTOR's option, machine-formed concrete curbs, sidewalks, and gutters are acceptable.

3.4 REINFORCING

- A. General:
 - 1. Locate, place, and support reinforcing in accordance with Section 03 00 05, Concrete, unless otherwise shown on the Drawings.
 - 2. Size of reinforcing shall be as shown or indicated in the Contract Documents.
 - 3. Unless otherwise shown or indicated, locate reinforcing for sidewalks at the mid-depth point in the concrete slab.

3.5 CONCRETE PLACING

- A. General:
 - 1. Comply with Section 03 00 05, Concrete, and this Section relative to mixing and placing concrete.
- B. Placing:
 - 1. Curbs and Gutters: Place concrete using methods that prevent segregation of the mix. Consolidate concrete along face of forms with an internal vibrator.
 - 2. Sidewalks: Place concrete in one-course, monolithic construction, for full width and depth of sidewalk.
 - 3. Machine-Formed:
 - a. At CONTRACTOR's option, automatic curb, gutter, and sidewalk machine may be used for installing concrete.
 - b. Machine forming shall produce curbs, gutters, and sidewalks of required cross-section, lines, grades, finish, and jointing, as specified for conventionally-formed concrete.
 - c. At curb cuts and driveway entrances, cut-out concrete and hand-finish the curbing to provide the required curb cut or driveway entrance, as applicable.
 - d. If results do not comply with the Contract Documents, remove and replace at no additional cost to OWNER.
- C. Curbs:
 - 1. Provide curb-cuts and driveway entrances for vehicle passage and pedestrian passage where shown, and when not shown but where existing sidewalks and curbs are being replaced, provide curb-cut or driveway entrance (as applicable) at location of existing driveways and pedestrian access ramps in sidewalks.
 - 2. Neatly form transitions from curb to curb-cut or driveway entrance.
 - 3. Unless otherwise shown or indicated, top of curb at curb-cut or driveway entrance shall be not greater than 1/4-inch above elevation of finished pavement surface.
- D. Gutters:
 - 1. Unless otherwise shown or indicated, top of gutter shall be not greater than 1/4-inch above elevation of finished pavement surface.

3.6 JOINTS

- A. General:
 - 1. Provide expansion joints, contraction joints, and construction joints in concrete curbs, gutters, and sidewalks.
 - 2. Provide expansion, contraction, and construction joints perpendicular to formed faces of curb, gutter, or sidewalk.
 - 3. Construct transverse joints at right angles to the Work centerline and as shown.
- B. Contraction Joints: Provide joints as indicated below:
 - 1. Curbs and Gutters: Provide at intervals of ten feet on centers. Joint shall be not less than 1/8- inch and not more than 1/4-inch in width, and have a depth of 1.5 inches.
 - 2. Sidewalks: Provide at intervals of five feet on centers. Joint shall be not less than 1/8- inch and not more than 1/4-inch in width, and have a depth of not less than one-third the total thickness of concrete sidewalk.
 - 3. Joints may be formed or sawcut.
- C. Construction Joints: Place construction joints at locations where concrete placing operations are stopped for more than 30 minutes, except where such pours terminate at expansion joints.
- D. Expansion Joints:
 - 1. General: Provide preformed expansion joint filler at locations indicated. When curb, gutter, or sidewalk is not poured monolithically, provide expansion joints where each abuts the other.
 - 2. Curbs and Gutters: Provide 1 1/16-inch wide preformed expansion joint filter at the intervals of 30 feet along curb and gutter; at expansion joints in pavement; at movable structures (such as bridges); and between curb or gutter and structures, returns, and at 30-foot intervals along length of curb or gutter.
 - 3. Sidewalks: Provide 1/2-inch wide preformed expansion joint filler at 30-foot intervals along length of sidewalk and at all joints between sidewalk and: curb, gutters, pavement, buildings, drainage structures, utility metal appurtenances such as manhole cover frames and valve boxes, and similar construction.
 - 4. Place top of expansion joint material not less than 1/2-inch or more than one-inch below concrete surface. Apply joint sealer on top of expansion joint material flush with concrete surface, and in accordance with sealant manufacturer's instructions and Section 07 92 00, Joint Sealants.

3.7 CONCRETE FINISHING

- A. Smooth exposed surface by screeding and floating. Perform hand-screeding when conventionally-formed concrete is provided.
- B. Work edges of gutter and sidewalks, back top edge of curb, and transverse joints; and round to 1/4-inch radius.

- C. Complete surface finishing by drawing a fine-hair broom across surface, perpendicular to line of traffic.

3.8 CURING

- A. General:
 - 1. Protect and cure finished concrete curbs, gutters, and sidewalks, in accordance with Section 03 00 05, Concrete.
 - 2. Cure driveways and sidewalks at driveways for not less than three days prior to opening to vehicle traffic. In colder weather, as indicated in Article 1.6 of this Section, curing period shall be not less than six days prior to opening to vehicle traffic unless other provisions to determine strength are provided and approved by ENGINEER.

3.9 REPAIR AND CLEANING

- A. Repair or replace broken or defective curbs, gutters, and sidewalk as directed by ENGINEER.
- B. Sweep the concrete curb, sidewalk, and gutter Work and wash free of stains, discolorations, dirt, and other foreign material.

+ + END OF SECTION + +

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SECTION 32 92 00

LAWNS AND MEADOWS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install all lawns and meadows.
2. Extent of lawns and meadows is shown.
3. Types of products required include the following.
 - a. Topsoil.
 - b. Lawn grass seed.
 - c. Meadow grass seed mixture.
 - d. Wildflower meadow seed mixture.
 - e. Plugs.
 - f. Sprigs.
 - g. Sod.
 - h. Inorganic soil amendments.
 - i. Organic soil amendments.
 - j. Fertilizers.
 - k. Mulches.
 - l. Erosion-control materials.
 - m. Accessories.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, lawns and meadows.
2. Notify other contractors in advance of the planting of lawns and meadows to provide them with sufficient time for the installation of items that must be installed with, or before, lawns and meadows.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. Association of Official Analytic Chemists, (AOAC).
 - a. Official Methods of Analysis of AOAC International.
2. Association of Official Seed Analysts, (AOSA).
 - a. Journal of Seed Technology; Rules for Testing Seeds.
3. American Society of Agronomy, (ASA).
 - a. Reference No. 1 - Methods of Soils Analysis, Soil Science Society of America, Incorporated.
4. American Society for Testing and Materials, (ASTM).

- a. ASTM B 221, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
 - b. ASTM C 602, Specification for Agricultural Liming Materials.
 - c. ASTM D 75, Practice for Sampling Aggregates.
 - d. ASTM D 422, Test Method for Particle Size Analysis of Soil.
 - e. ASTM D 977, Specification for Emulsified Asphalt.
 - f. ASTM D 2487, Practice for Classification of Soils for Engineering Purposes (United Soil Classification System).
 - g. ASTM D 5268, Specification for Topsoil Used for Landscape Purposes.
 - h. ASTM E 329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
 - i. ASTM E 548, Guide for General Criteria Used for Evaluating Laboratory Competence.
5. Turfgrass Producers International, (TPI).
- a. Guideline Specifications to Turfgrass Sodding.

1.3 DEFINITIONS

- A. The term “finish grade” shall be used to describe the finished surface elevation of planting soil.
- B. The term “manufactured topsoil” shall be used to describe soil produced off-Site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil acceptable as a component of loam.
- C. The term “loam” shall be used to describe topsoil that has been mixed with additional organic and inorganic additives, as specified.
- D. The term “percentage pure live seed” shall be defined as the percent (%) purity multiplied by percent (%) germination divided by 100 to equal the percent pure live seed (PLS) and shall be calculated for all seed lots using each seed lots own unique purity and germination test results. A PLS pound shall be defined as the bulk weight of seed required to equal one pound of 100 percent pure, germinated seed.
- E. The term “subgrade” shall be used to describe the surface of subsoil remaining after completing excavation; or the top surface of a fill or backfill immediately beneath topsoil and which has not been tested for acceptable use as topsoil.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Engage a single landscape installer skilled, trained and with successful and documented experience in the planting of lawns and meadows and with specific skill and successful experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and

qualifications to ENGINEER along with the following information on a minimum of three successful projects:

- a. Names and telephone numbers of owner, architects or engineers responsible for projects.
 - b. Approximate contract cost of the lawns and meadows.
 - c. Amount of area installed.
2. Installer's Site Supervisor: Require installer to maintain an experienced full-time landscape supervisor on-Site during the time of preparation for, and planting of, lawns and meadows. Supervisor shall have achieved landscape or horticultural certification acceptable to governing authorities having jurisdiction at the Site.
 3. Ratio of laborers to certified landscape supervisors shall not exceed 12 to one. Certified landscape supervisor shall be on-Site throughout the day-to-day performance of the Work of this Section.
 4. Application of herbicides, chemicals and insecticides shall be done by personnel licensed to perform such applications by governing authorities having jurisdiction at the Site and in accordance with each manufacturer's instructions provided on each product label.
- B. Soil-Testing Laboratory Qualifications:
1. An independent laboratory, recognized by governing authorities having jurisdiction at the Site, with the experience and capability to conduct testing indicated and that specializes in types of soil tests to be performed.
 2. To qualify for approval, an independent testing agency shall demonstrate to ENGINEER'S satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work, in accordance with ASTM E 329 and as documented according to ASTM E 548.
- C. References: Comply with the applicable requirements referenced in Section 01 42 00, References.
- D. Source Quality Control:
1. Analysis and Standards: Package all products with manufacturer's certified analysis performed in accordance with methods established by AOAC, wherever applicable, or as specified.
 2. Provide manufactured imported topsoil from a commercial processing facility specializing in the manufacture of topsoil.
 3. Seed that has been stored at temperatures, or under conditions not recommended by the seed supplier, or has become wet, moldy, or otherwise damaged, shall not be acceptable. The PLS for each seed lot shall be 75 percent, minimum.
 4. Certify that all seed has been stored under conditions recommended by the seed supplier and has not been subjected to conditions damaging to PLS percentages.
 5. Seed may be mixed by an approved method on-Site or at the seed supplier's facilities. If the seed is mixed on-Site, each variety shall be delivered in the original containers and shall bear the supplier's certified analysis. Where

seed is mixed by the seed supplier, provide ENGINEER with the seed supplier's certified statement as to the composition of the mixture.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Schedule for lawn and meadow-planting showing anticipated planting dates for each type of Work.
2. Product Data:
 - a. Manufacturer's product data, specifications and installation instructions for all required materials.
 - b. Composition and analysis of commercial fertilizers and all purchase receipts showing the total quantity actually purchased for this Project.
 - c. PLS for each type of seed and each seed lot. Include bulk weight of seed required to equal one pound of 100 percent pure, germinated seed.
3. Samples:
 - a. Submit 12-inch by 12-inch sheet of erosion control fabric with manufacturer's selections of standard biodegradable filler papers, and yarns.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Certification of Grass and Wildflower Seed: For each grass-seed monostand and seed mixture, furnish seed supplier's certification stating the botanical and common name, and percentage by weight of each species and variety, and percentage of purity, germination and weed seed. Include the year of production and date of packaging. Certify that seed has been stored in compliance with all recommendations of the seed supplier.
 - b. Verify that sod contains no noxious weeds or other material that might be detrimental to the proposed planting.
 - c. Certificates of inspection as may be required by governmental authorities to accompany shipments, and manufacturer's certified analysis for soil amendments and fertilizer materials. For standard products submit other data substantiating that materials comply with specified requirements.
2. Test Reports: Submit the following:
 - a. Soil analysis reports for existing soil and imported manufactured topsoil, as specified. Include recommendations for remediating existing soil into acceptable topsoil.
3. Qualifications Data: Submit qualifications data for the following:
 - a. Landscape installer.
 - b. Landscape supervisor.
 - c. Testing agency.
4. Source Quality Control Submittals

- a. Written statement providing the location from which manufactured topsoil is to be obtained and the names and addresses of the suppliers.
- C. Closeout Submittals: Submit the following:
 - 1. Operations and Maintenance Data:
 - a. Submit recommended procedures to be established by OWNER for the maintenance of lawns and meadows for one full year. Submit prior to expiration of required maintenance period.
 - 2. Warranty Documentation:
 - a. Submit written warranty, signed by CONTRACTOR and landscape installer, as specified.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials:
 - 1. Do not deliver seed, sprigs, plugs or sod until Site conditions are ready for installation.
 - 2. Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery.
 - 3. Deliver seed in undamaged, original containers, sealed by the supplier and indicating compliance with approved Shop Drawings.
 - 4. Inspect lawn and meadow materials upon arrival at Site. Immediately and permanently remove unacceptable materials from Site.
- B. Storage of Materials:
 - 1. Store and cover materials to prevent deterioration. Remove packaged materials that become wet or show deterioration or water marks from the Site.
 - 2. Seed that becomes wet, moldy or damaged during the time of storage on-Site or that has been damaged during transit is not acceptable.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Proceed with and complete lawn and meadow planting as rapidly as portions of the Site become available, working within the seasonal limitations for each type of lawn, grass and wildflower planting required.
 - 2. Proceed with planting only when current and forecasted weather conditions are favorable to successful planting and establishment of lawns and meadows.
 - a. Do not spread seed when wind velocity exceeds five miles per hour.
 - b. Do not plant when drought, or excessive moisture, or other unsatisfactory conditions prevail.
 - 3. Herbicides, chemicals and insecticides shall not be used on areas bordering wetlands.

B. Scheduling:

1. Coordinate planting with specified extended service periods to provide required service from date of Substantial Completion. Plant during one of the following periods:
 - a. Spring Planting: March 15 to June 1.
 - b. Fall Planting: September 1 to October 30.
2. Do not begin lawn and meadow planting until water, acceptable for use and adequate in supply, is available on-Site and can be successfully transported to the areas of Work. Coordinate provision of adequate and acceptable water supply with Project Schedule.
3. Do not proceed with installation of loam until all subgrade utility services have been installed, are operating successfully and have been approved by ENGINEER.

C. Pre-installation Conference:

1. Prior to commencement of lawn and meadow planting and associated Work, CONTRACTOR shall schedule and meet at the Site with the landscape installer, the installers of other Work in and around lawn and meadow areas that follows the lawn and meadow Work and ENGINEER and other representatives directly concerned with performance of the Work. Review foreseeable methods and procedures related to the lawn and meadow Work, including the following:
 - a. Review Project requirements and the Contract Documents.
 - b. Review required submittals, both completed and yet to be completed.
 - c. Review availability of water and methods of delivery.
 - d. Review status of below-grade work and required access during lawn and meadow planting and establishment.
 - e. Review Project Schedule and availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
 - f. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
 - g. Review procedures required for protection of lawns and meadows during the remainder of the construction period.
 - h. Review required inspection, testing, and certifying procedures.
2. Record the discussions of the Pre-installation Conference and the decisions and agreements or disagreements reached, and furnish a copy of the record to each party attending.
3. Record all revisions or changes agreed upon, reasons therefor, and parties agreeing or disagreeing with them.
4. Reconvene the meeting at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

1.8 WARRANTY

- A. General Warranty: The special warranties specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents.

- B. Special Warranties: Warranty lawns and meadows through the specified extended service period.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:

1. All soil accepted as topsoil, whether obtained from on-Site or off-Site sources, shall comply with specified topsoil analysis.
2. Provide fertile, friable, natural loam, surface soil, capable of sustaining vigorous plant growth; free of any admixture of subsoil, clods of hard earth, plants or roots, sticks, stones larger than 1-inch in diameter, or other extraneous material harmful to plant growth, in compliance with ASTM D 5268. Provide topsoil with the following analysis:
 - a. 3/4-inch mesh: 100 percent passing.
 - b. No. 4-sieve: 90 to 100 percent passing.
 - c. No. 200-sieve: 0 to 10 percent passing.
 - d. Clay content of material passing No. 200-sieve not greater than 60 percent, as determined by hydrometer tests.
 - e. pH-adjusted with ferrous sulphate or ground limestone to provide pH 5.5 to pH 7.0 at time of installation of lawns, grass and meadow areas, unless particular species of grass or wildflower stand requires a different pH to meet its growing needs.
 - f. Electrical conductivity of a 1:2 soil-water suspension shall not exceed 1.0 milliohm per centimeter and with less than 200 parts per million of extractable aluminum.
 - g. Cation Exchange Capacity: 5, minimum.
 - h. Organic content not less than five percent, as determined by ignition loss of oven-dried samples passing No. 10-sieve (Muffle Furnace Temperature: 110 plus or minus five degrees C for eight hours).
 - i. Free of pests and pest larvae.
3. Topsoil Source: Reuse surface soil stockpiled on-Site, where possible. Verify suitability of stockpiled surface soil to produce topsoil, as specified. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - a. Supplement acceptable on-Site soil with manufactured topsoil from off-Site sources, when quantities available on-Site are insufficient to complete the Work.

B. Lawn Grass Seed:

1. Lawn Grass Seed Mixture: Provide fresh, clean, new-crop seed complying with the tolerance for purity and germination established by AOSA. Provide seed of the grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, specified.

2. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 80 percent pure seed, and not more than 0.25 percent weed seed by weight:
 - a. Full Sun: Bermuda grass (*Cynodon dactylon*).
- C. Fertilizers:
 1. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of four percent nitrogen and 20 percent phosphoric acid.
 2. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
 3. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - a. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports.
 4. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - a. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
- D. Erosion-Control Materials:
 1. Erosion-Control Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, a minimum of 0.92 pounds per cubic yard, with 50 to 65 percent open area. Include manufacturer's recommended 6-inches long steel wire staples.
- E. Accessories:
 1. Provide herbicides, chemicals and insecticides as needed for disease, fungus or pest control. All herbicides, chemicals and insecticides shall be bear approval labels indicating they are approved by the United States Department of Agriculture for the intended uses and application rates.
 2. Post Emergent Crab Grass and Plantain Chemical: Provide recommended post emergent crab grass and plantain control throughout the maintenance period to ensure germinated and established lawns free of crab grass and other undesirable grasses and forbs.
- F. Water: Acceptable for lawn and meadow application and containing no material harmful to plant growth and establishment.

2.2 LOAM MIXES

- A. Follow recommendations of soil-testing laboratory for modifying on-Site soil and manufactured soil, for use as topsoil.
- B. On-Site soil and manufactured soil that has been provided with all inorganic soil amendments and fertilizers recommended by soil-testing laboratory, and acceptable for use as topsoil, shall be mixed with an additional organic soil

amendment mix in a ratio of two parts topsoil to one part organic soil amendment mix, by volume.

1. Prepare soil amendment mix by combining 40 percent compost, 40 percent peat moss, ten percent wood derivatives, five percent well-rotted manure and five percent grit aggregate, by volume.

- C. Loam: Thoroughly blend topsoil with organic soil amendment mix and use as planting media for all lawn and meadow Work.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the areas and conditions under which lawn and meadow Work is to be performed, and notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

- A. Thoroughly blend and mix loam before spreading. Incorporate fertilizers, and ground limestone or acidulant, after spreading, as specified, and at rates recommended by soil-testing laboratory.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- D. Perform percolation tests on existing subgrade and placed fills prior to fine grading.
1. Perform percolation testing of subgrades and placed fills to determine whether or not the subgrade will drain properly. Perform percolation tests in accordance with the following procedure:
 - a. Dig a hole in the subgrade that is 4-inches in diameter and 12-inches deep.
 - b. Fill the hole with water and wait for the water to completely drain from the hole.
 - c. Immediately refill the hole with water and measure the rate of fall in the water level.
 2. In the event that water drains at a rate less than 1-inch in one hour, excavate soil to a minimum depth of 24-inches, and deeper, as necessary to break the compaction. Backfill, recompact and retest each area so prepared to confirm drainage rates exceed one inch in one hour.

3. Perform minimum of one soil percolation test for every 10,000 square feet of lawn and meadow area.
- E. Excavate or fill subgrade, as required, to bring subgrade to elevations shown. Maintain all angles of repose. Confirm that subgrade is at proper elevations and that no further earthwork is required to bring the subgrade to proper elevations. Provide subgrade elevations that slope parallel to finished grade and towards subsurface drains shown.
- F. Remove all construction debris, trash, rubble and all extraneous materials from subgrade. In the event that fuels, oils, concrete washout or other material harmful to plant growth or germination have been spilled into the subgrade, excavate the subgrade sufficiently to remove all such harmful materials and fill with approved fill, compacted to the required subgrade compaction level.

3.3 FINE GRADING

- A. Immediately prior to dumping and spreading loam, clean subgrade of all stones greater than 2-inches and all other extraneous matter. Remove all such material from Site. Notify ENGINEER that subgrade has been cleaned, and obtain approval prior to spreading loam.
- B. Do not attempt to spread excessively wet, muddy or frozen loam. Do not spread loam more than five days before seeding or planting.
- C. Spread loam to a depth of 4-inches but not less than required to meet finish grades after light rolling and natural settlement.
 1. Spread approximately one-half the thickness of required loam depth. After spreading loam, rototill, disk or harrow loam and subgrade to bring top 2-inches of subgrade upward into loam layer, so that there is a transitional layer between loam and subgrade.
 2. Spread remainder of loam to required finish grades.
 3. Compact each lift sufficiently to reduce settling, but not enough to prevent the movement of water and feeder roots through loam. After compaction spread loam should offer firm, even resistance when a soil sampling tube is inserted.
 4. Phase the placement of the final lift so that wheeled vehicles do not have to travel over areas where final lifts are already in-place.
 5. Spread and compact to a smooth, uniform surface plane, to within plus or minus 1/2-inch of finish elevations. Roll and rake and remove all ridges, and fill depressions, as required. Remove all stones larger than 1-inch in any dimension and all sticks, roots, trash and other extraneous matter.
 6. Perform percolation tests as for subgrades, except limit depth of holes to 2/3 the depth of loam layer.
- D. Grade planting areas to smooth, even surface with loose, uniformly fine texture. Remove all stones and extraneous material in excess of 1-inch diameter. Roll, rake and remove ridges and fill depressions, as required to meet finish grades.

- E. Moisten prepared areas before seeding, sodding, sprigging or plugging. Water thoroughly and allow surface moisture to dry before planting. Do not create a muddy loam condition.
- F. Prior to seeding or planting, restore loam to specified condition, if eroded or otherwise disturbed.

3.4 CONVENTIONAL SEEDING

- A. General: Maintain grade stakes until removal is mutually agreed upon by all parties concerned.
- B. Rake or harrow all seedbeds immediately prior to seeding to produce a rough, grooved surface, no deeper than 1-inch. Seed only when seedbed is in a friable condition and not muddy or hard.
- C. Sow seed using a spreader or seeding machine.
- D. Distribute seed evenly over entire area by sowing equal quantity in two directions at right angles to each other.
- E. Using a uniform fine spray, thoroughly and evenly water seeded areas. Provide adequate water to moisten seedbed to a depth of 2-inches.
 - 1. Repeat this process when peat mulch color lightens. Maintain all seedbeds in a uniformly moist condition, conducive to seed germination and plant establishment, as specified.

3.5 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
- B. Mix slurry with asphalt-emulsion tackifier.
- C. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry application at a minimum rate of 500-pounds per acre dry weight, but not less than the rate required to obtain specified seed-sowing rate so that the seed comes into direct contact with loam.
- D. Apply slurry cover coat of fiber mulch at a rate of 1000-pounds per acre.

3.6 RECONDITIONING EXISTING LAWNS AND MEADOWS

- A. Recondition existing lawn and meadow damaged by CONTRACTOR'S operations, including areas used for storage of materials or equipment and areas

damaged by movement of vehicles. Recondition existing lawns and meadow areas where minor regrading is required.

- B. Recondition other existing lawn and meadow areas shown.
- C. Provide fertilizer, seed or sod and soil amendments, as specified for new lawn and meadow, and as required to provide satisfactorily reconditioned lawns and meadows. Provide new loam as required to fill low spots and meet new finish grades.
- D. Till stripped, bare, and compacted areas thoroughly to a depth of 12-inches.
- E. Remove diseased or unsatisfactory lawn and meadow areas; do not bury into soil. Remove topsoil containing extraneous materials resulting from CONTRACTOR'S operations including oil drippings, stone, gravel and other construction materials.
- F. In areas approved by ENGINEER, where substantial lawns and meadows remain (but are thin), mow, dethatch, core aerate and rake. Fill low spots, remove humps, cultivate soil, fertilize, and seed. Remove weeds before seeding or if extensive, apply selective chemical weed killers, as required. Apply a seedbed mulch, if required, to maintain moist condition.
- G. Water newly planted areas and keep moist until new lawns and meadows are established, as specified.

3.10 ACCEPTANCE CRITERIA FOR LAWNS AND MEADOWS

- A. Lawn and meadow Work will be considered acceptable when:
 - 1. Seeded Lawn: When a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 square feet and bare spots not exceeding 5-inches by 5-inches.

3.11 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris, created by lawn and meadow Work, from paved areas. Clean wheels of vehicles before leaving Site to avoid tracking soil and loam onto roads, walks, or other paved areas.
- B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout extended service period and remove when service period ends. Treat, repair or replace damaged lawns and meadows.
- C. Remove erosion-control measures after lawn and meadow extended service period ends.

- D. Take all precautions to ensure that hydroseed slurry is only placed on the areas designated. Completely clean any overspray, on areas not designated to receive slurry.

3.12 INSPECTION AND ACCEPTANCE

- A. Where lawns and meadows do not comply with specified acceptance criteria, reestablish lawns and meadows and continue extended service period until lawns and meadows comply with criteria for acceptance.

+ + END OF SECTION + +