



PROJECT MANUAL  
FOR  
**WATER TREATMENT PLANT  
IMPROVEMENTS – PHASE 1**

FOR  
CITY OF SALISBURY

SALISBURY, NORTH CAROLINA

Commission No. 2191241

December 05, 2019



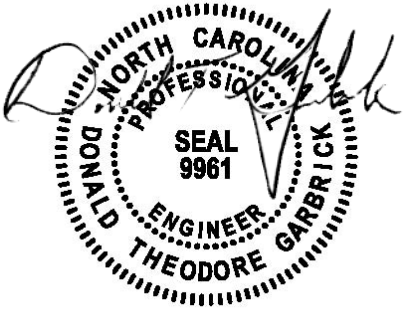

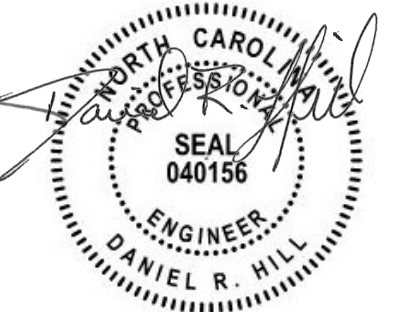
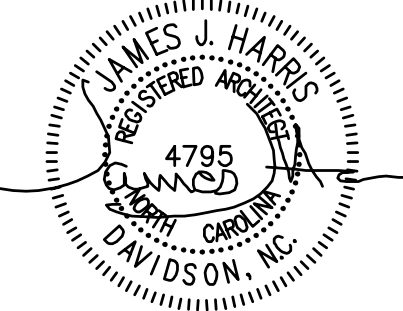
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SECTION 000107 – SEALS PAGE

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 <p>12.05.2019 <u>Architectural</u> Divisions 4-10</p>		

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## ATTACHMENTS

*Note – The following background data is provided **for the Contractor’s convenience for reference only**. Nothing contained within these attachments is intended to modify in any way the Scope of Work, direct the Contractor to certain means and methods, or limit or define the Contractor’s responsibilities or liabilities with regards to any aspect of the Work. Should the Contractor consider these attachments insufficient for their use in pricing or completing the Scope of Work the Contractor may make, at the Contractor’s sole expense, additional investigations as the Contractor deems appropriate.*

**Report of Subsurface Exploration & Geotechnical Evaluation / City of Salisbury Water Treatment Plant Improvements** (Prepared by Catawba Valley Engineering & Testing, dated June 24, 2019)

## END OF SECTION 000110

The following Sections of this Project Manual are MODIFIED versions of the respective EJCDC® documents, Copyright © 2013 by the National Society of Professional Engineers, American Society of Civil Engineers, and American Council of Engineering Companies, or are based in part on excerpts from EJCDC documents. Those portions of the text that originated in published EJCDC documents remain subject to the copyright.

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000310	Advertisement for Bids	C-111	005200	Agreement	C-520
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## **000115 – LIST OF DRAWING SHEETS**

The following drawings, dated 12/05/2019, are a part of the Contract Documents:

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**ARCHITECTURAL**

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E600 ELECTRICAL SCHEDULES AND RISER DIAGRAM

**END OF SECTION 000115**

**DOCUMENT 000310 – ADVERTISEMENT FOR BIDS**

**CITY OF SALISBURY, NORTH CAROLINA  
CITY OF SALISBURY WATER TREATMENT PLANT IMPROVEMENTS**

Sealed Bids for the construction of the City of Salisbury Water Treatment Plant Improvements will be received by the City of Salisbury, in the office of the **City of Salisbury, Salisbury-Rowan Utilities, 1 Water Street, Salisbury, North Carolina** until **2:00 P.M.** local time on **Thursday, January 23, 2020**, at which time the Bids received will be publicly opened and read. Bids may also be sent by USPS mail to the City of Salisbury, Attn: Jason Wilson, Salisbury-Rowan Utilities, 1 Water Street, Salisbury, NC 28144.

The project includes construction of a new pre-engineered metal building, site work, centrifuge installation, replacement filter under drains and all associated piping and appurtenances.

Bids will be received for a **Single Prime Contract**. Bids shall be on a lump sum and unit price basis, with alternate bid items as indicated in the Bid Form. *One original and one copy* of your response should be submitted in a sealed opaque envelope **plainly marked** with the Project title, name and address of the Bidder, and Request for Bid (RFB) number (RFB # 013-2020).

Bidding Documents are available in electronic or printed form from Duncan Parnell via their bid room <http://www.dpibidroom.com> . Registration with Duncan Parnell is required to obtain the bid documents. A Non-Refundable Fee plus tax for a printed set, a printed set with a CD, or for a download is required. Neither Owner nor Engineer will be responsible for copies of the Bidding Documents obtained from sources other than from Duncan Parnell. Addenda will only be notified to those buying full sets from Duncan Parnell via their bid room. The plans and specifications are copyright protected. If you need any assistance ordering or getting registered on <http://www.dpibidroom.com> please contact Michaela Bruinius at [michaela.bruinius@duncan-parnell.com](mailto:michaela.bruinius@duncan-parnell.com) or 704-372-7766 x 1005.

A pre-bid conference will be held at **2:00 P.M.** local time on **Thursday, December 19, 2019** in the Main Conference Room at **1 Water Street, Salisbury, North Carolina**.

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

A conditional or qualified bid will not be accepted.

Award will be made to the lowest responsible, responsive bidder for the entire contract.

The City of Salisbury reserves the right to reject any and all RFBs and to waive formalities.

Owner:	City of Salisbury Salisbury-Rowan Utilities
By:	Mr. Jason H. Wilson, P.E.
Title:	Assistant Utilities Director
Date:	December 5, 2019

+ + END OF ADVERTISEMENT FOR BIDS + +

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## **SECTION 001030 — INSTRUCTIONS TO BIDDERS**

### **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 these Instructions to Bidders have the meanings indicated below:
- A. *Issuing Office* – The office from which the Bidding Documents are to be issued.

### **ARTICLE 2 – COPIES OF BIDDING DOCUMENTS**

- 2.01 Complete sets of the Bidding Documents may be obtained from the Issuing Office in the number and format stated in the advertisement or invitation to bid.
- 2.02 Complete sets of Bidding Documents shall be used in preparing Bids; 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 Each Bidder shall have a minimum five (5) years experience of successful completed contracted work. Up-on award of project, the lowest responsive responsible Bidder may be required to furnish documentation of achieving the requirements noted above.
- 3.02 To demonstrate Bidder's qualifications to perform the Work, after submitting its Bid and within **ten** days of Owner's request, Bidder may be required to furnish (a) written evidence establishing its qualifications such as financial data, previous experience, and present commitments, and (b) the following additional information:
- A. Evidence of Bidder's authority to do business in the state where the Project is located.
- B. Bidder's state or other contractor license number, if applicable.
- C. Subcontractor and Supplier qualification information; coordinate with provisions of Article 12 of these Instructions, "Subcontractors, Suppliers, and Others."
- 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.

**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.
    - d. Technical Data contained in such reports and drawings.
  - 2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. 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, has been identified and established in the Supplementary Conditions. 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. 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.



#### 4.03 *Site Visit 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 conduct 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 conduct 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, 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 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.

#### 4.05 *Other Work at the Site*

- A. Reference is made to Article 8 of the Supplementary Conditions 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. carefully study all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) 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;

- D. 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;
- E. 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;
- F. 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;
- G. 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;
- H. 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
- I. 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.

#### **ARTICLE 6 – PRE-BID CONFERENCE**

6.01 A Pre-Bid conference will be held at the time and location stated in the invitation or advertisement to bid. Representatives of Owner and Engineer will be present 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 are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than seven days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.02 Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.

## **ARTICLE 8 – BID SECURITY**

- 8.01 A Bid must be accompanied by Bid security made payable to the City of Salisbury (Owner) in an amount of five percent (5.0%) of Bidder's **Total Bid Amount** and in the form of a certified check, bank money order, or a Bid bond (on the form included in the Bidding Documents) issued by a surety meeting the requirements of Paragraphs 6.01 and 6.02 of the General Conditions.
- 8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. This deposit may consist of cash or a certified check drawn on a bank or trust company authorized to do business in North Carolina or on a bank insured by the Federal Deposit Insurance Corporation, payable to the City of Salisbury or 5% Bid Bond in the form required by G. S. 143-129, as amended, issued by any insurance company authorized to do business in North Carolina.
- 8.03 If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within (15) days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults.
- 8.04 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 8.05 Bid Bond shall be written on forms acceptable to the Owner and approved by Engineer.
- 8.06 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven days after the Bid opening.
- 8.07 Attorneys-in-fact who sign bonds or Payment Bonds and Performance Bonds must file with each bond a certified and effective dated copy of their power of attorney.

## **ARTICLE 9 – CONTRACT TIMES**

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

## **ARTICLE 10 – LIQUIDATED DAMAGES**

- 10.01 Provisions for liquidated 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, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, and those "or-equal" or substitute materials and equipment subsequently approved by Engineer prior to the submittal of Bids and identified by Addendum. No item of material or equipment will be considered by Engineer as an "or-equal" or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer at least 15 days prior to the date for receipt of Bids in the case of a proposed substituted and 5 days prior in the case of a proposed "or-equal." Each such request

shall comply with the requirements of Paragraphs 7.04 and 7.05 of the General Conditions. The burden of proof of the merit of the proposed item is upon Bidder. Engineer's decision of approval or disapproval of a proposed item will be final. If Engineer approves any such proposed item, such approval will be set forth in an Addendum issued to all prospective Bidders. Bidders shall not rely upon approvals made in any other manner. Substitutes and "or-equal" materials and equipment may be proposed by Contactor in accordance with Paragraphs 7.04 and 7.05 of the General Conditions after the Effective Date of the Contract.

- 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 Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.
- 11.03 If an award is made, Contractor shall be allowed to submit proposed substitutes and "or-equals" in accordance with the General Conditions.

## **ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS**

12.01 [DELETED]

12.02 [DELETED]

- 12.03 Bidders shall identify key Products included in their Bid where provided for in the Bid Form. In addition if required by the bid documents, the apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to Owner a list of the Subcontractors or Suppliers proposed for other portions of the Work. If requested by Owner, such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, or other individual or entity. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Product, Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.
- 12.04 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 as provided in Paragraph 7.06 of the General Conditions.
- 12.05 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.
- 12.06 The Contractor shall not award work to Subcontractor(s) in excess of the limits stated in SC 7.06A.

## **ARTICLE 13 – PREPARATION OF BID**

- 13.01 The Bid Form is included with the Bidding Documents.
  - A. All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid

price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.

- B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."
- 13.02 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 shown.
  - 13.03 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 shown.
  - 13.04 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 shown.
  - 13.05 A Bid by an individual shall show the Bidder's name and address for receiving notices.
  - 13.06 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 shown.
  - 13.07 All names shall be printed in ink below the signatures.
  - 13.08 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
  - 13.09 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.
  - 13.10 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state 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. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.

#### **ARTICLE 14 – BASIS OF BID**

##### **14.01 *Lump Sum***

- A. Bidders shall submit a Bid on a lump sum basis as set forth in the Bid Form.

##### **14.01 *Base Bid with Alternates***

- A. Bidders shall submit a Bid on a lump sum basis for the base Bid and include a separate price for each alternate described in the Bidding Documents and as provided for in the Bid Form. The price for each alternate will be the amount added to or deleted from the base Bid if Owner selects the alternate.
- B. In the comparison of Bids, alternates will be applied in the same order of priority as listed in 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.
- 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.

#### 14.03 Allowances

- A. For cash allowances the Bid price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Paragraph 13.02.B of the General Conditions.

### ARTICLE 15 – SUBMITTAL OF BID

15.01 With each copy of the Bidding Documents, a Bidder is furnished one separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 7 of the Bid Form.

15.02 A Bid shall be received no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be enclosed in a plainly marked package with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of Bidder, Request for Bid (RFB) number, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid shall be addressed to **the recipient and the address indicated in the Bid Form.**

- A. Each bid must be submitted in a sealed envelope, so marked as to indicate its contents without being opened. This envelope shall be placed in another one addressed to Mr. Jason H. Wilson P.E., Assistant Utilities Director, One Water Street, Salisbury, North Carolina 28144. If forwarded otherwise than by mail, it must be delivered to the Assistant Utilities Director, on or before the time set in ADVERTISEMENT.

15.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

### ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

16.01 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 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 If within 24 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 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 promptly and read at the hour and on the date set in the ADVERTISEMENT, in the City of Salisbury Purchasing Department, 5<sup>th</sup> Floor, 132 North Main Street, Salisbury, NC. Bidders, or their authorized agents, are invited to be present. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.
- A. A conditional or qualified bid will not be accepted.
  - B. Award will be made to the lowest responsible, responsive bidder for the entire contract.

#### **ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE**

- 18.01 All Bids will 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 prior to the end of this period.

#### **ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT**

- 19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, 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 nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.
- 19.02 If Owner awards the contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid.
- 19.03 The Award of a Contract for the Work will be made on the total of the Base Bid PLUS any Alternates the Owner selects, the determination of which will be made after the opening of Bids, but before the Award of a Contract.
- 19.04 Evaluation of Bids
- A. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.
- 19.05 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.
- 19.06 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

## **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 as to performance and payment bonds and insurance. The successful Bidder must furnish Performance and Payment Bonds, each in the amount of 100% of the Contract price, as required by 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. Performance and Payment Bonds shall be made payable to City of Salisbury, North Carolina.

## **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 thereafter, 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. 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 All shipments directed to the City of Salisbury for this project must be clearly marked "Care of (name of Contractor)" and delivered to the site. Shipments improperly marked and delivered to the Owner will be rejected.

## **ARTICLE 22 – SALES AND USE TAXES**

22.01 North Carolina state sales and use taxes on materials and equipment to be incorporated in the Work shall be included in the Bid. Refer to Paragraph SC-7.09 of the Supplementary Conditions for additional information.

## **ARTICLE 23 – CONTRACTS TO BE ASSIGNED – NOT USED**



**BID FORM**

**CITY OF SALISBURY WATER TREATMENT PLANT IMPROVEMENTS**

**ARTICLE 1 – BID RECIPIENT**

1.01 This Bid is submitted to:

**City of Salisbury  
Purchasing Department, 5<sup>th</sup> Floor  
132 North Main Street  
Salisbury, NC 28144  
ATTN: Jason H. Wilson**

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the 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 90 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:

<u>Addendum No.</u>	<u>Addendum Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

- 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: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) 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 CERTIFICATION**

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 this 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):

**A. LUMP SUM for all Work, except for Contingency and Alternates listed separately below:**

in numerals: \$ \_\_\_\_\_

in words: \_\_\_\_\_

\_\_\_\_\_ dollars

**B. LUMP SUM Owner's Contingency Amount:**

in numerals: \$ 350,000 \_\_\_\_\_

in words: Three Hundred Fifty Thousand Dollars and no/100 \_\_\_\_\_

Bidder acknowledges that Owner's Contingency Amount is included only for Owner's convenience in authorizing Owner-directed changes to the Work. Payment of any portion of such Amount will be at Owner's sole discretion, and only after written approval of a related Change Order.

**TOTAL BASE BID AMOUNT (LUMP SUM "A" + \$300,000):**

in numerals: \$ \_\_\_\_\_

in words: \_\_\_\_\_

\_\_\_\_\_ dollars

**C. ALTERNATES**

Owner has identified components of the Work which may or may not be required, which are defined in Division 01 Section "Alternates". At Owner's sole discretion, any or all of these components of the Work may be added in any order or combination and if added, Bidder agrees that the Total Contract Amount will be increased/decreased by the corresponding amount(s) as outlined below:

**ALTERNATE No. 1** (Mutually exclusive with Alternate No. 2):

Rehabilitation of Four (4) Additional Dual Media Filters (Phase 1B): Bidder agrees to perform all work as described in the specifications, and as shown on the plans for the following Lump Sum. Should this alternate as described in the contract documents be accepted, the amount written below shall be the amount to be added to the base bid.

in numerals (Add): \$ \_\_\_\_\_

in words: \_\_\_\_\_ dollars

**ALTERNATE No. 2:** (Mutually exclusive with Alternate No. 1):

Rehabilitation of Eight (8) Additional Dual Media Filters (Phases 1B and 1C): Bidder agrees to perform all work as described in the specifications, and as shown on the plans for the following Lump Sum. Should this alternate as described in the contract documents be accepted, the amount written below shall be the amount to be added to the base bid.

in numerals (Add): \$ \_\_\_\_\_

in words: \_\_\_\_\_ dollars

**ALTERNATE No. 3:**

Addition of a Container Handling System: Bidder agrees to perform all work as described in the specifications, including electrical and installation within the Centrifuge Building Loading Area, for the following Lump Sum. Should this alternate as described in the contract documents be accepted, the amount written below shall be the amount to be added to the base bid.

in numerals (Add): \$ \_\_\_\_\_

in words: \_\_\_\_\_ dollars

**ALTERNATE No. 4:**

Installation of Two (2) Centrifuge Disc Sludge Feed Pumps in lieu of Sludge Feed Pumps: Bidder agrees to perform all work as described in the specifications, including piping, layout of equipment and modification to the drawings as required for a complete installation for the following Lump Sum. Should this alternate as described in the contract documents be accepted, the amount written below shall be the amount to be added to the base bid.

in numerals (Add / Subtract): \$ \_\_\_\_\_

in words: \_\_\_\_\_ dollars

**D. UNIT PRICES**

The undersigned bidder also declares that the scope of the work may be either increased or decreased on the order of the Engineer and the Contract amount shall be adjusted in accordance with the following unit prices as applicable. Unit prices quoted for each item shall

include the cost of materials, labor, testing, equipment, overhead, profit, and all else that is required to provide a complete project.

ITEM No.	DESCRIPTION	UNIT PRICE
1	Concrete Pavement Removal, per square yard	\$ _____
2	Asphalt Pavement Removal, per square yard	\$ _____
3	Concrete Pavement, per square yard	\$ _____
4	Full Depth Asphalt Pavement, per square yard	\$ _____
5	Asphalt Road Overlay, per square yard	\$ _____

**E. KEY EQUIPMENT SUPPLIED**

The undersigned further states that this bid is based on providing and installing the following equipment relative to the Specification Sections listed; he further agrees that if he is the successful Bidder and if the listed items of equipment are approved by the Engineer, they will be provided as part of the Work:

- 466127 – Underdrains (circle one): (Leopold) (Triton) Equal: \_\_\_\_\_
- 467633 – Centrifuge: \_\_\_\_\_
- 432300 – Sludge Feed Pump: \_\_\_\_\_
- 467010 – Chain and Scraper Sludge Collector: \_\_\_\_\_
- 467020 – Screw Conveyor Cross Collector: \_\_\_\_\_
- 463333 – Polymer Feed System: \_\_\_\_\_
- 412100 – Shafted Screw Conveyor: \_\_\_\_\_

**F. PRINCIPAL SUBCONTRACTORS**

The undersigned further states that this bid is based on quotations received from the following subcontractors for the categories of work listed; he further agrees that if he is the successful Bidder and if the listed subcontractors are approved by the Engineer, he will contract with the listed subcontractors for the performance of this work:

- Plumbing \_\_\_\_\_ License # \_\_\_\_\_
- Mechanical \_\_\_\_\_ License # \_\_\_\_\_
- Electrical \_\_\_\_\_ License # \_\_\_\_\_

## **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.

## **ARTICLE 7 – ATTACHMENTS TO THIS BID**

- 7.01 The following documents are submitted with and made a condition of this Bid:
- A. Required Bid security;
  - B. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;
  - C. Contractor's License No.: [REDACTED]
- 7.02 If and as requested by the Owner and required by the bid documents, the following documents are submitted and made a condition of this Bid:
- A. List of Proposed Subcontractors;
  - B. List of Proposed Suppliers;
  - C. List of Project References;
  - D. Required Bidder Qualification Statement with supporting data

## **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**

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.: \_\_\_\_\_

## **MINORITY BUSINESS PARTICIPATION REQUIREMENTS**

*Provide on the bid* - Under GS 143-128.2(c) the undersigned bidder shall identify **on its bid** the minority businesses that it will use on the project **and** the total dollar value of the bid that will be performed by the minority businesses **and** list the good faith efforts (Affidavit **A**) made to solicit participation

**Note:** A contractor that performs all of the work with its own workforce may submit an Affidavit (**B**) to that effect in lieu of the affidavit (**A**) required above.

*After the bid opening* - The Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low bidder, the bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

An Affidavit (**C**) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the 10% goal established. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort;

**OR**

Affidavit (**D**) of its good faith effort to meet the goal. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

**Note:** Bidders must submit **with their bid** the **Identification of Minority Business Participation Form and Affidavit A or Affidavit B** as applicable. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder may be grounds for rejection of the bid.

**PROFIT AND OVERHEAD FOR CHANGE ORDERS:** The Bidder agrees to complete all work added by written change order for the actual cost of the work added PLUS the percentages listed below to cover overhead and profit combined:

**FOR WORK PERFORMED BY THE CONTRACTOR:**

Percent: 15%

**FOR WORK INVOLVING A SUBCONTRACTOR:**

Percent for Subcontractor: 15%

Percent for Contractor: 5%

The Bidder, if the successful Bidder, declares that he will substantially complete all work on the project and obtain a Certificate of Substantial Completion within **730** consecutive calendar days after Notice to Proceed. For each day in excess of the stated number of days for substantially completing all work the Contractor shall pay to the Owner Five Hundred Dollars (\$500.00) per calendar day in Liquidated Damages.

The Bidder encloses herewith cash, or a certified check drawn on a bank or trust company authorized to do business in North Carolina or on a bank insured by the Federal Deposit Insurance Corporation, payable to the City of Salisbury, North Carolina; or 5% bid bond in the form required by G. S. 143-129, as



amended, issued by any insurance company authorized to do business in North Carolina; said deposit shall be retained by the Owner, in the event the undersigned, if he is the successful Bidder, fails to execute a formal contract within ten days after notice of the award is given, or fails to give satisfactory surety as required in the INSTRUCTIONS TO BIDDERS.

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# MBE PROPOSAL FORMS

(To be used with the submission of a bid)

## MINORITY BUSINESS PARTICIPATION REQUIREMENTS

---

*Provide on the bid* - Under GS 143-128.2(c) the undersigned bidder shall identify **on its bid** the minority businesses that it will use on the project **and** the total dollar value of the bid that will be performed by the minority businesses **and** list the good faith efforts (Affidavit **A**) made to solicit participation

**Note:** A contractor that performs all of the work with its own workforce may submit an Affidavit (**B**) to that effect in lieu of the affidavit (**A**) required above.

*After the bid opening* - The Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low bidder, the bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

An Affidavit (**C**) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the 5% goal established. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort;

**Or**

Affidavit (**D**) of its good faith effort to meet the goal. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

**Note:** Bidders must submit **with their bid** the *Identification of Minority Business Participation Form* **and** *Affidavit A* **or** *Affidavit B* as applicable. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder may be grounds for rejection of the bid.



Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid  
**State of North Carolina -- AFFIDAVIT A -- Listing of Good Faith Efforts**

County of \_\_\_\_\_

Affidavit of \_\_\_\_\_  
(Name of Bidder)

I have made a good faith effort to comply under the following areas checked:

**Bidders must earn at least 50 points from the good faith efforts listed for their bid to be considered responsive.** (1 NC Administrative Code 30 I.0101)

- 1 – (10 pts)** Contacted minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor, or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
- 2 -- (10 pts)** Made the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bids are due.
- 3 – (15 pts)** Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- 4 – (10 pts)** Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- 5 – (10 pts)** Attended prebid meetings scheduled by the public owner.
- 6 – (20 pts)** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- 7 – (15 pts)** Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- 8 – (25 pts)** Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- 9 – (20 pts)** Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- 10 – (20 pts)** Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

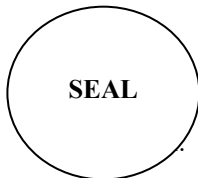
The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure to abide by this statutory provision will constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of the minority business commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: \_\_\_\_\_ Name of Authorized Officer : \_\_\_\_\_

Signature: \_\_\_\_\_

Title: \_\_\_\_\_



State of North Carolina, County of \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_

Notary Public \_\_\_\_\_

My commission expires \_\_\_\_\_

Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid  
**State of North Carolina -- AFFIDAVIT B -- Intent to Perform Contract  
with Own Workforce.**

County of \_\_\_\_\_

Affidavit of \_\_\_\_\_  
(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the \_\_\_\_\_  
\_\_\_\_\_ contract.  
(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

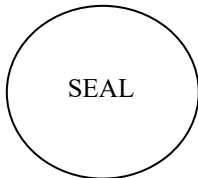
The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement.

The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

Date: \_\_\_\_\_ Name of Authorized Officer: \_\_\_\_\_

Signature: \_\_\_\_\_

Title: \_\_\_\_\_



State of North Carolina, County of \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_

Notary Public \_\_\_\_\_

My commission expires \_\_\_\_\_

# State of North Carolina -- AFFIDAVIT C -- Portion of the Work to be Performed by Minority Firms

County of \_\_\_\_\_

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the portion of the work to be executed by minority businesses as defined in GS143-128.2(g) is equal to or greater than 5% of the bidders total contract price, then the bidder must complete this affidavit.  
 This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being low bidder.

Affidavit of \_\_\_\_\_ I do hereby certify that on the  
 (Name of Bidder)

\_\_\_\_\_  
 (Project Name)

Project ID# \_\_\_\_\_ Amount of Bid \$ \_\_\_\_\_

I will expend a minimum of \_\_\_\_\_% of the total dollar amount of the contract with minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. Attach additional sheets if required.

Name and Phone Number	*Minority Category	Work description	Dollar Value

\*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

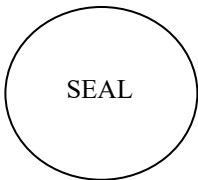
Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: \_\_\_\_\_ Name of Authorized Officer: \_\_\_\_\_

Signature: \_\_\_\_\_

Title: \_\_\_\_\_



State of North Carolina, County of \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_

Notary Public \_\_\_\_\_

My commission expires \_\_\_\_\_

# State of North Carolina -- AFFIDAVIT D -- Good Faith Efforts

County of \_\_\_\_\_

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the goal of 5% participation by minority business **is not** achieved, the Bidder shall provide the following documentation to the Owner of his good faith efforts:

Affidavit of: \_\_\_\_\_  
 (Name of Bidder)

I do certify the attached documentation as true and accurate representation of my good faith efforts. Attach additional sheets if required.

Name and Phone Number	*Minority Category	Work description	Dollar Value

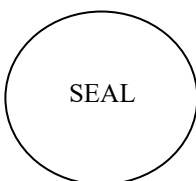
\*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

Documentation of the Bidder's good faith efforts to meet the goals set forth in these provisions. Examples of documentation include, but are not limited to, the following evidence:

- A. Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.
- B. Copies of quotes or responses received from each firm responding to the solicitation.
- C. A telephone log of follow-up calls to each firm sent a solicitation.
- D. For subcontracts where a minority business firm is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.
- E. Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.
- F. Copy of pre-bid roster.
- G. Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.
- H. Letter detailing reasons for rejection of minority business due to lack of qualification.
- I. Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Failure to provide the documentation as listed in these provisions may result in rejection of the bid and award to the next lowest responsible and responsive bidder.

Date: \_\_\_\_\_ Name of Authorized Officer: \_\_\_\_\_  
 Signature: \_\_\_\_\_  
 Title: \_\_\_\_\_



State of North Carolina, County of \_\_\_\_\_  
 Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_  
 Notary Public \_\_\_\_\_  
 My commission expires \_\_\_\_\_



**FORM OF BID BOND**

**KNOW ALL MEN BY THESE PRESENTS, THAT** \_\_\_\_\_  
\_\_\_\_\_ as principal, and  
\_\_\_\_\_, as surety, who is duly licensed to act as  
surety in North Carolina, are held and firmly bound unto the State of North Carolina through  
\_\_\_\_\_ as obligee, in the penal sum of  
\_\_\_\_\_ DOLLARS, lawful money of the United States of America, for the  
payment of which, well and truly to be made, we bind ourselves, our heirs, executors, administrators,  
successors and assigns, jointly and severally, firmly by these presents.

Signed, sealed and dated this \_\_\_\_ day of \_\_\_\_ 20\_\_

**WHEREAS**, the said principal is herewith submitting proposal for the City of Salisbury Water Treatment Plant Improvements and the principal desires to file this bid bond in lieu of making the cash deposit as required by G.S. 143-129.

**NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION** is such, that if the principal shall be awarded the contract for which the bid is submitted and shall execute the contract and give bond for the faithful performance thereof within ten days after the award of same to the principal, then this obligation shall be null and void; but if the principal fails to so execute such contract and give performance bond as required by G.S. 143-129, the surety shall, upon demand, forthwith pay to the obligee the amount set forth in the first paragraph hereof. Provided further, that the bid may be withdrawn as provided by G.S. 143-129.1

\_\_\_\_\_(SEAL)

\_\_\_\_\_(SEAL)

\_\_\_\_\_(SEAL)

\_\_\_\_\_(SEAL)

\_\_\_\_\_(SEAL)

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STATE OF NORTH CAROLINA E-VERIFY AFFIDAVIT

COUNTY OF \_\_\_\_\_

CITY OF \_\_\_\_\_

\*\*\*\*\*

I, \_\_\_\_\_ (the individual attesting below), being duly authorized by and on behalf of \_\_\_\_\_ (the entity bidding on project hereinafter "Employer") after first being duly sworn hereby swears or affirms as follows:

- 1. Employer understands that E-Verify is the federal E-Verify program operated by the United States Department of Homeland Security and other federal agencies, or any successor or equivalent program used to verify the work authorization of newly hired employees pursuant to federal law in accordance with NCGS §64-25(5).
- 2. Employer understands that Employers Must Use E-Verify. Each employer, after hiring an employee to work in the United States, shall verify the work authorization of the employee through E-Verify in accordance with NCGS§64-26(a).
- 3. Employer is a person, business entity, or other organization that transacts business in this State and that employs 25 or more employees in this State. (Please mark Yes or No)

a. YES \_\_\_\_\_, or

b. NO \_\_\_\_\_

- 4. Employer's subcontractors comply with E-Verify, and if Employer is the winning bidder on this project Employer will ensure compliance with E-Verify by any subcontractors subsequently hired by Employer.

This \_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
Signature of Affiant  
Print or Type Name: \_\_\_\_\_

**(Affix Official/Notarial Seal)**

State of North Carolina, County of \_\_\_\_\_, City of \_\_\_\_\_

Signed and sworn to (or affirmed) before me, this the \_\_\_\_ day

of \_\_\_\_\_, 20\_\_.

My Commission Expires:

\_\_\_\_\_  
Notary Public

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## NOTICE OF AWARD

---

Date of Issuance:

Owner: **City of Salisbury, North Carolina** Owner's Contract No.:

Engineer: **LaBella Associates** Engineer's Project No.: **2191241**

Project: **City of Salisbury Water Treatment Plant Improvements** Contract Name:

Bidder:

Bidder's Address:

### TO BIDDER:

You are notified that Owner has accepted your Bid dated [\_\_\_\_\_] for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

\_\_\_\_\_  
*[describe Work, alternates, or sections of Work awarded]*

The Contract Price of the awarded Contract is: \$ \_\_\_\_\_ *[note if subject to unit prices, or cost-plus]*

unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award, or has been transmitted or made available to Bidder electronically. *[revise if multiple copies accompany the Notice of Award]*

a set of the Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of this Notice of Award:

1. Deliver to Owner [\_\_\_\_\_] counterparts of the Agreement, fully executed by Bidder.
2. Deliver with the executed Agreement(s) the Contract security *[e.g., performance and payment bonds]* and insurance documentation as specified in the Instructions to Bidders and General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any):

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

---

Owner:

Authorized Signature

By:

Title:

Copy: Engineer

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AGREEMENT  
BETWEEN OWNER AND CONTRACTOR  
FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

THIS AGREEMENT is by and between City of Salisbury, North Carolina (“Owner”) and  
\_\_\_\_\_ (“Contractor”).

Owner and Contractor hereby agree as follows:

**ARTICLE 1 – WORK**

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

- A. City of Salisbury, Water Treatment Plant Improvements  
Salisbury, NC  
LaBella Commission No. 2191241

**ARTICLE 2 – THE PROJECT**

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

- A. This project includes the construction of a new pre-engineered metal building, site work, centrifuge installation, replacement filter under drains and all associated piping and appurtenances.

**ARTICLE 3 – ENGINEER**

3.01 The part of the Project that pertains to the Work has been designed by LaBella Associates.

3.02 The Owner has retained LaBella Associates (“Engineer”) to act as Owner’s representative, assume all duties and responsibilities, 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: Days*

- A. The Work will be substantially completed within 730 consecutive calendar 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 730 days after the date when the Contract Times commence to run.
- B. Weather conditions **shall not** be a basis for extension of the contract time or additional payment to the Contractor.

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 \$500.00 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 \$500.00 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 [DELETED]

**ARTICLE 5 – CONTRACT PRICE**

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, subject to adjustment under the Contract:

- A. For all Work other than Unit Price Work, a lump sum of: \$  .

All specific cash allowances are included in the above price in accordance with Paragraph 13.02 of the General Conditions.

- B. For all Unit Price Work, an amount equal to the sum of the extended prices (established for each separately identified item of Unit Price Work by multiplying the unit price times the actual quantity of that item):

<b>Unit Price Work</b>					
<b>Item No.</b>	<b>Description</b>	<b>Unit</b>	<b>Estimated Quantity</b>	<b>Unit Price</b>	<b>Extended Price</b>
1	Concrete Pavement Removal	SY			
2	Asphalt Pavement Removal	SY			
3	Concrete Pavement	SY			
4	Full Depth Asphalt Pavement	SY			
5	Asphalt Road Overlay	SY			
Total of all Extended Prices for Unit Price Work (subject to final adjustment based on actual quantities)					\$



The extended prices for Unit Price Work set forth as of the Effective Date of the Contract are based on estimated quantities. 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.

- C. Total of Lump Sum Amount and Unit Price Work (subject to final Unit Price adjustment) \$                     .
- D. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

**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 by Engineer as provided in the General Conditions.

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        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.

- 1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract
  - a. 95 percent of Work completed (with the balance being retainage); and
  - b. 95 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

- B. Upon Substantial Completion of the entire construction to be provided under the Contract Documents, Owner shall pay an amount sufficient to increase total payments to Contractor to 98 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less 100 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of 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.

**ARTICLE 7 – INTEREST**

- 7.01 All amounts not paid when due shall bear interest at the rate of 3.0 percent per annum.

## **ARTICLE 8 – CONTRACTOR’S REPRESENTATIONS**

- 8.01 In order to induce 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: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) 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 [REDACTED], inclusive).
  2. Performance bond (pages [REDACTED] to [REDACTED], inclusive).
  3. Payment bond (pages [REDACTED] to [REDACTED], inclusive).
  4. Other bonds.
    - a. [REDACTED] (pages [REDACTED] to [REDACTED], inclusive).
  5. General Conditions (pages [REDACTED] to [REDACTED], inclusive).
  6. Supplementary Conditions (pages [REDACTED] to [REDACTED], inclusive).
  7. Specifications as listed in the table of contents of the Project Manual.
  8. Drawings (not attached but incorporated by reference) consisting of [REDACTED] sheets with each sheet bearing the following general title: **City of Salisbury Water Treatment Plant Improvements**.
  9. Addenda (numbers [REDACTED] to [REDACTED], inclusive).
  10. Exhibits to this Agreement (enumerated as follows):
    - a. Contractor's Bid (pages [REDACTED] to [REDACTED], inclusive).
  11. 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 Directives.
    - c. Change Orders.
    - d. Field Orders.
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).
- 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.

## **ARTICLE 10 – MISCELLANEOUS**

### **10.01 Terms**

- A. Terms used in this Agreement will have the meanings stated 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 any thing 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. Owner stipulates that if the General Conditions that are made a part of this Contract are based on EJCDC® C-700, Standard General Conditions for the Construction Contract, published by the Engineers Joint Contract Documents Committee®, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.

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

This Agreement will be effective on [REDACTED] (which is the Effective Date of the Contract).

OWNER:

CONTRACTOR:

**City of Salisbury**

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.)*

License No.: \_\_\_\_\_  
*(where applicable)*

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**NOTICE TO PROCEED**

---

Owner: **City of Salisbury, North Carolina** Owner's Contract No.:

Contractor: Contractor's Project No.:

Engineer: **LaBella Associates** Engineer's Project No.: **2191241**

Project: **City of Salisbury Water Treatment Plant Improvements** Contract Name:

Effective Date of Contract:

---

**TO CONTRACTOR:**

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on [REDACTED], 20[REDACTED]. [see Paragraph 4.01 of the General Conditions]

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work shall be done at the Site prior to such date. In accordance with the Agreement, [the date of Substantial Completion is \_\_\_\_\_, and the date of readiness for final payment is \_\_\_\_\_] *or* [the number of days to achieve Substantial Completion is \_\_\_\_\_, and the number of days to achieve readiness for final payment is \_\_\_\_\_].

Before starting any Work at the Site, Contractor must comply with the following:  
*[Note any access limitations, security procedures, or other restrictions]*

---

Owner:

Authorized Signature

By:

Title:

Date Issued:

Copy: Engineer

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**FORM OF PERFORMANCE BOND**

Date of Contract: \_\_\_\_\_  
Date of Execution: \_\_\_\_\_  
Name of Principal  
(Contractor): \_\_\_\_\_  
Name of Surety: \_\_\_\_\_  
Contracting Body: \_\_\_\_\_  
Amount of Bond: \_\_\_\_\_  
Project: \_\_\_\_\_

**KNOW ALL MEN BY THESE PRESENTS**, that we, the Principal and Surety above named, are held and firmly bound unto the above named Contracting Body, hereinafter called the Contracting Body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind, ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

**THE CONDITION OF THIS OBLIGATION IS SUCH**, that whereas the Principal entered into a certain contract with the Contracting Body, identified as shown above and hereto attached:

**NOW, THEREFORE**, if the Principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the Contracting Body, with or without notice to the Surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue.

**IN WITNESS WHEREOF**, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in \_\_\_\_\_ counterparts.

Witness:

\_\_\_\_\_

Contractor: (Trade or Corporate Name)

\_\_\_\_\_  
(Proprietorship or Partnership)

By: \_\_\_\_\_

Attest: (Corporation)

Title: \_\_\_\_\_  
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

By: \_\_\_\_\_

Title: \_\_\_\_\_  
(Corp. Sec. or Asst. Sec. only)

(Corporate Seal)

\_\_\_\_\_  
(Surety Company)

Witness:

\_\_\_\_\_

By:

\_\_\_\_\_

Title:

\_\_\_\_\_  
(Attorney in Fact)

Countersigned:

\_\_\_\_\_

(Surety Corporate Seal)

\_\_\_\_\_  
(N.C. Licensed Resident Agent)

\_\_\_\_\_

\_\_\_\_\_  
Name and Address-Surety Agency

\_\_\_\_\_

\_\_\_\_\_  
Surety Company Name and N.C.  
Regional or Branch Office Address

**FORM OF PAYMENT BOND**

Date of Contract: \_\_\_\_\_

Date of Execution: \_\_\_\_\_

Name of Principal  
(Contractor): \_\_\_\_\_

Name of Surety: \_\_\_\_\_

Contracting Body: \_\_\_\_\_

Amount of Bond: \_\_\_\_\_

Project \_\_\_\_\_

**KNOW ALL MEN BY THESE PRESENTS**, that we, the Principal and Surety above named, are held and firmly bound unto the above named Contracting Body, hereinafter called the Contracting Body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

**THE CONDITION OF THIS OBLIGATION IS SUCH**, that whereas the Principal entered into a certain contract with the Contracting Body identified as shown above and hereto attached:

**NOW, THEREFORE**, if the Principal shall promptly make payment to all persons supplying labor/material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the Surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

**IN WITNESS WHEREOF**, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in \_\_\_\_\_ counterparts.

Witness:

\_\_\_\_\_

Contractor: (Trade or Corporate Name)

\_\_\_\_\_  
(Proprietorship or Partnership)

By: \_\_\_\_\_

Attest: (Corporation)

Title: \_\_\_\_\_  
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

By: \_\_\_\_\_

Title: \_\_\_\_\_  
(Corp. Sec. or Asst. Sec. only)

(Corporate Seal)

\_\_\_\_\_  
(Surety Company)

Witness:

\_\_\_\_\_

By:

\_\_\_\_\_

Title:

\_\_\_\_\_  
(Attorney in Fact)

Countersigned:

\_\_\_\_\_

(Surety Corporate Seal)

\_\_\_\_\_  
(N.C. Licensed Resident Agent)

\_\_\_\_\_

\_\_\_\_\_  
Name and Address-Surety Agency

\_\_\_\_\_

\_\_\_\_\_  
Surety Company Name and N.C.  
Regional or Branch Office Address

# Contractor's Application for Payment No. \_\_\_\_\_

	Application Date: _____
To (Owner): _____	Via (Engineer): _____
Project: _____	Contractor's Project No.: _____
Owner's Contract No.: _____	Engineer's Project No.: _____

## Application For Payment Change Order Summary

Approved Change Orders	Additions	Deductions	
<b>TOTALS</b>			
<b>NET CHANGE BY</b>			
<b>CHANGE ORDERS</b>			

1. ORIGINAL CONTRACT PRICE..... \$ \_\_\_\_\_
2. Net change by Change Orders..... \$ \_\_\_\_\_
3. Current Contract Price (Line 1 ± 2)..... \$ \_\_\_\_\_
4. TOTAL COMPLETED AND STORED TO DATE  
(Column F total on Progress Estimates)..... \$ \_\_\_\_\_
5. RETAINAGE:
  - a.      X      Work Completed..... \$ \_\_\_\_\_
  - b.      X      Stored Material..... \$ \_\_\_\_\_
  - c. Total Retainage (Line 5.a + Line 5.b)..... \$ \_\_\_\_\_
6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5.c)..... \$ \_\_\_\_\_
7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application)..... \$ \_\_\_\_\_
8. AMOUNT DUE THIS APPLICATION..... \$ \_\_\_\_\_
9. BALANCE TO FINISH, PLUS RETAINAGE  
(Column G total on Progress Estimates + Line 5.c above)..... \$ \_\_\_\_\_

<p><b>Contractor's Certification</b></p> <p>The undersigned Contractor certifies, to the best of its knowledge, the following:</p> <p>(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;</p> <p>(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all Liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such Liens, security interest, or encumbrances); and</p> <p>(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents</p>	<p>Payment of: \$ _____ (Line 8 or other - attach explanation of the other amount)</p> <p>is recommended by: _____ (Engineer) _____ (Date)</p> <p>Payment of: \$ _____ (Line 8 or other - attach explanation of the other amount)</p> <p>is approved by: _____ (Owner) _____ (Date)</p> <p>Approved by: _____ Funding or Financing Entity (if applicable) _____ (Date)</p>
<p><b>Contractor Signature</b> _____</p> <p>By: _____ Date: _____</p>	

**Progress Estimate - Lump Sum Work**

**Contractor's Application**

For (Contract):		Application Number:						
Application Period:		Application Date:						
Specification Section No.	A Description	B Scheduled Value (\$)	Work Completed		E Materials Presently Stored (not in C or D)	F Total Completed and Stored to Date (C + D + E)	G Balance to Finish (B - F)	
			C From Previous Application (C+D)	D This Period				
<b>Totals</b>								

# Progress Estimate - Unit Price Work

# Contractor's Application

For (Contract):		Application Number:									
Application Period:		Application Date:									
Bid Item No.	Item Description	Contract Information				C	D	E	F		Balance to Finish (B - F)
		Item Quantity	Units	Unit Price	Total Value of Item (\$)				Total Completed and Stored to Date (D + E)	% (F / B)	
<b>Totals</b>											





---

Date of Issuance: \_\_\_\_\_ Effective Date: \_\_\_\_\_  
Owner: **City of Salisbury, North Carolina** Owner's Contract No.: \_\_\_\_\_  
Contractor: \_\_\_\_\_ Contractor's Project No.: \_\_\_\_\_  
Engineer: **LaBella Associates** Engineer's Project No.: **2191241**  
Project: **City of Salisbury Water Treatment Plant Improvements** Contract Name: \_\_\_\_\_

---

Contractor is hereby directed to promptly execute this Field Order, issued in accordance with General Conditions Paragraph 11.01, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference: \_\_\_\_\_  
Specification(s) \_\_\_\_\_ Drawing(s) / Detail(s) \_\_\_\_\_

Description:

Attachments:

---

ISSUED:	RECEIVED:
By: _____ Engineer (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____
Date: _____	Date: _____

Copy to: Owner

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**Work Change Directive No.**

Date of Issuance: \_\_\_\_\_ Effective Date: \_\_\_\_\_  
 Owner: **City of Salisbury, North Carolina** Owner's Contract No.: \_\_\_\_\_  
 Contractor: \_\_\_\_\_ Contractor's Project No.: \_\_\_\_\_  
 Engineer: **LaBella Associates** Engineer's Project No.: **2191241**  
 Project: **City of Salisbury Water Treatment Plant Improvements** Contract Name: \_\_\_\_\_

Contractor is directed to proceed promptly with the following change(s):

Description:

Attachments: *[List documents supporting change]*

**Purpose for Work Change Directive:**

Directive to proceed promptly with the Work described herein, prior to agreeing to changes on Contract Price and Contract Time, is issued due to: *[check one or both of the following]*

- Non-agreement on pricing of proposed change.
- Necessity to proceed for schedule or other Project reasons.

**Estimated Change in Contract Price and Contract Times (non-binding, preliminary):**

Contract Price \$ \_\_\_\_\_ [increase] [decrease].  
 Contract Time \_\_\_\_\_ days [increase] [decrease].

**Basis of estimated change in Contract Price:**

- Lump Sum  Unit Price
- Cost of the Work  Other

RECOMMENDED:

AUTHORIZED BY:

RECEIVED:

By: _____	By: _____	By: _____
Engineer (Authorized Signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable)

By: \_\_\_\_\_ Date: \_\_\_\_\_  
 Title: \_\_\_\_\_

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Date of Issuance:	Effective Date:
Owner: <b>City of Salisbury, North Carolina</b>	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer: <b>LaBella Associates</b>	Engineer's Project No.: <b>2191241</b>
Project: <b>City of Salisbury Water Treatment Plant Improvements</b>	Contract Name:

The Contract is modified as follows upon execution of this Change Order:

Description:

Attachments: *[List documents supporting change]*

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIMES <i>[note changes in Milestones if applicable]</i>
Original Contract Price: \$ _____	Original Contract Times: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] from previously approved Change Orders No. ___ to No. ___: \$ _____	[Increase] [Decrease] from previously approved Change Orders No. ___ to No. ___: Substantial Completion: _____ Ready for Final Payment: _____ days
Contract Price prior to this Change Order: \$ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] of this Change Order: \$ _____	[Increase] [Decrease] of this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
Contract Price incorporating this Change Order: \$ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for Final Payment: _____ days or dates

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____ Engineer (if required)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title _____	Title _____
Date: _____	Date _____	Date _____

Approved by Funding Agency (if applicable)

By: \_\_\_\_\_ Date: \_\_\_\_\_  
Title: \_\_\_\_\_

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**CERTIFICATE OF SUBSTANTIAL COMPLETION**

Owner: **City of Salisbury, North Carolina**  
 Contractor:  
 Engineer: **LaBella Associates**  
 Project: **City of Salisbury Water Treatment Plant  
 Improvements**

Owner's Contract No.:  
 Contractor's Project No.:  
 Engineer's Project No.: **2191241**  
 Contract Name:

**This [preliminary] [final] Certificate of Substantial Completion applies to:**

- All Work  The following specified portions of the Work:

**Date of Substantial Completion**

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work shall be as provided in the Contract, except as amended as follows: *[Note: Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.]*

Amendments to Owner's responsibilities:  None  
 As follows

Amendments to Contractor's responsibilities:  None  
 As follows:

The following documents are attached to and made a part of this Certificate: *[punch list; others]*

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract.

EXECUTED BY ENGINEER:	RECEIVED:	RECEIVED:
By: _____ (Authorized signature)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

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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



Issued and Published Jointly by



Endorsed by



These General Conditions have been prepared for use with the Agreement Between Owner and Contractor for Construction Contract (EJCDC® C-520, Stipulated Sum, or C-525, Cost-Plus, 2013 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other.

To prepare supplementary conditions that are coordinated with the General Conditions, use EJCDC's Guide to the Preparation of Supplementary Conditions (EJCDC® C-800, 2013 Edition). The full EJCDC Construction series of documents is discussed in the Commentary on the 2013 EJCDC Construction Documents (EJCDC® C-001, 2013 Edition).

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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 considered 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.



## SECTION 007300 — SUPPLEMENTARY CONDITIONS

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

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

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

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### ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

#### SC-1.01 *Defined Terms*

A. Include the following definitions:

**SC-1.01.** Add to the list of definitions in Paragraph 1.01.A by inserting the following as numbered items in their proper alphabetical positions:

**Abnormal Weather Conditions** – Conditions of extreme or unusual weather for a given region, elevation, or season as determined by Engineer. Extreme or unusual weather that is typical for a given region, elevation, or season should not be considered Abnormal Weather Conditions.

**Geotechnical Data Report (GDR)** — The factual report that collects and presents data regarding actual subsurface conditions at or adjacent to the Site, including Technical Data and other geotechnical data, prepared by or for Owner in support of the Geotechnical Baseline Report. The GDR's content may include logs of borings, trenches, and other site investigations, recorded measurements of subsurface water levels, the results of field and laboratory testing, and descriptions of the investigative and testing programs. The GDR does not include an interpretation of the data. If opinions, or interpretive or speculative non-factual comments or statements appear in a document that is labeled a GDR, such opinions, comments, or statements are not operative parts of the GDR and do not have contractual standing. Subject to that exception, the GDR is a Contract Document.

B. Make the following modifications to definitions:

**SC-1.01.A.8** Add the following language at the end of the last sentence of Paragraph 1.01.A.8:

The Change Order form to be used on this Project is EJCDC C-941.

**SC-1.01.A.48** Add the following language at the end of the last sentence of Paragraph 1.01.A.48:

A Work Change Directive cannot change Contract Price or Contract Times without a subsequent Change Order.

## ARTICLE 2 – PRELIMINARY MATTERS

### *SC-2.01 Delivery of Bonds and Evidence of Insurance*

**SC-2.01** Delete Paragraphs 2.01 B. and C. in their entirety and insert the following in their place:

**B. Evidence of Contractor’s Insurance:** When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies of insurance (including all endorsements, and identification of applicable self-insured retentions and deductibles) required to be provided by Contractor in Article 6. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

**C. [Deleted]**

### *SC-2.02 Copies of Documents*

**SC-2.02.A.** Amend the first sentence of Paragraph 2.02.A. to read as follows:

Owner shall furnish to Contractor five copies of the Contract Documents (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF).

## ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

### *SC-4.01 Commencement of Contract Times; Notice to Proceed*

**SC-4.01.A** Amend the last sentence of Paragraph 4.01.A by striking out the following words:

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.

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

### *SC-5.03 Subsurface and Physical Conditions*

**SC-5.03** Add the following new paragraphs immediately after Paragraph 5.03.B:

**C. The following reports of explorations and tests of subsurface conditions at or adjacent to the Site are known to Owner:**

- 1. Report dated July 12, 2019, prepared by Catawba Valley Engineering & Testing, entitled “Geotechnical Engineering Report”, consisting of 48 pages. The Technical Data contained in such report upon whose accuracy Contractor may rely are those indicated in the definition of Technical Data in the General Conditions.**

**ARTICLE 6 – BONDS AND INSURANCE**

*SC-6.03 Contractor’s Insurance*

**SC 6.03 Add the following new paragraph immediately after Paragraph 6.03.J:**

**K. The limits of liability for the 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:**

<b>State:</b>	<u><b>Statutory</b></u>
<b>Federal, if applicable (e.g., Longshoreman’s):</b>	<u><b>Statutory</b></u>
<b>Foreign voluntary worker compensation</b>	<u><b>Statutory</b></u>

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

<b>Personal Injury Each Person</b>	<u><b>\$ \$1,000,000</b></u>
<b>Each Occurrence (Bodily Injury and Property Damage)</b>	<u><b>\$ \$2,000,000</b></u>

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

<b>Bodily Injury:</b>	
<b>Each person</b>	<u><b>\$ \$1,000,000</b></u>
<b>Each accident</b>	<u><b>\$ \$2,000,000</b></u>
<b>Property Damage:</b>	
<b>Each accident</b>	<u><b>\$ \$2,000,000</b></u>

- 4. Excess or Umbrella Liability:**

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

- 6. Additional Insureds: In addition to Owner and Engineer, include as additional insureds the following:**

**Catawba Valley Engineering & Testing, PC**

**ARTICLE 7 – CONTRACTOR’S RESPONSIBILITIES**

*SC-7.04 “Or Equals”*

- A. Make the following changes to existing language:**

**SC-7.04.A** Amend the third sentence of Paragraph 7.04.A by striking out the following words:

Unless the specification or description contains or is followed by words reading that no like, equivalent, or 'or-equal' item is permitted.

**SC-7.04.A.1.a.3)** Amend the last sentence of Paragraph a.3) by striking out "and;" and adding a period at the end of Paragraph a.3).

**SC-7.04.A.1.a.4)** Delete paragraph 7.04.A.1.a.4) in its entirety.

*SC-7.06 Concerning Subcontractors, Suppliers, and Others*

A. Make the following changes to existing language:

**SC-7.06.A** Amend Paragraph 7.06.A by adding the following text to the end of the Paragraph:

The Contractor shall not award work valued at more than fifty percent of the Contract Price to Subcontractor(s), without prior written approval of the Owner.

**SC-7.06.B** Delete paragraph 7.06.B in its entirety.

**SC-7.06.E** Amend the second sentence of Paragraph 7.06.E by striking out "Owner may also require Contractor to retain specific replacements; provided, however, that".

*SC-7.09 Taxes*

**SC 7.09** Add a new paragraph immediately after Paragraph 7.09.A:

B. Owner is exempt from payment of sales and compensating use taxes of the State of North Carolina and of cities and counties thereof on all materials to be incorporated into the Work.

1. Each of Contractor's Applications for Payment shall include itemization for such taxes, and shall be accompanied by a notarized statement of taxes paid on a form acceptable to the Owner. The form shall provide proper documentary proof of the payment of State Sales and Use Tax on all building materials purchased and tool and equipment rentals paid by the Contractor for use in the Work. The documentary proof shall itemize invoices by number indicating date, to whom paid, state and county where paid, amount of invoice, amount paid for state and local taxes, and shall certify that the materials, tools and equipment were used in the Work. The Contractor shall keep available all invoices for inspection as required by law.

**ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION**

*SC-10.03 Project Representative*

**SC-10.03** Add the following new paragraphs immediately after Paragraph 10.03.A:

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 Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.
3. **Conferences and Meetings:** Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.
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 on-Site 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 and Samples:**
  - a. Record date of receipt of Samples and Contractor-approved Shop Drawings.
  - 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 or Sample submittal for which RPR believes that the submittal has not been approved 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 on-Site 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 conducted 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 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 Shop Drawing and Sample submittals.
- b. Draft and recommend to 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 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.
    - 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 substitution of materials or equipment (including "or-equal" items).
  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 Drawing or Sample submittals from anyone other than Contractor.
  8. Authorize Owner to occupy the Project in whole or in part.

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

*SC-11.07 Execution of Change Orders*

**SC-11.07.C Add the following new Paragraph after Paragraph 11.07.B:**

- C. All Contract Change Orders must be approved by Owner before they are effective.**

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

*SC-13.02 Allowances*

- A. Make the following change to existing language:

**SC-13.02.C Delete Paragraph 13.02.C in its entirety.**

**ARTICLE PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD**

*SC-15.01 Progress Payments*

- A. Make the following changes to existing language:

**SC-15.01.B.1 Amend the second sentence of Paragraph 15.01.B.1 by striking out the following text: “a bill of sale, invoice, or other.”**

**SC-15.01.B.3 Add the following language at the end of paragraph 15.01.B.3:**

**No payments will be made that would deplete the retainage, place in escrow any funds that are required for retainage, or invest the retainage for benefit of the Contractor.**

**SC-15.01.B.4 Add the following new paragraph immediately after Paragraph 15.01.B.3**

- 4. The Application for Payment form to be used on this Project is EJCDC C-620. The Agency must approve all Applications for Payment before payment is made.**

**SC-15.01.D.1 Delete Paragraph 15.01.D.1 in its entirety and insert the following in its place:**

- 1. The Application for Payment with Engineer’s recommendations will be presented to the Owner and Agency for consideration. If both the Owner and Agency find the Application for Payment acceptable, the recommended amount less any reduction under the provisions of Paragraph 15.01.E will become due twenty (20) days after the Application for Payment is presented to the Owner, and the Owner will make payment to the Contractor.**

*SC-15.02 Contractor’s Warranty of Title*

- A. Make the following change to existing language:



**SC-15.02.A Amend Paragraph 15.02.A by striking out the following text: “no later than seven days after the time of payment by Owner” and insert “no later than the time of payment by Owner.”**

*SC-15.03 Substantial Completion*

A. Make the following changes to existing language:

**SC 15.03.B Add the following new subparagraph to Paragraph 15.03.B:**

- 1. If some or all of the 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 or re-testing, including the cost of time, travel and living 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.**

**ARTICLE 17 – FINAL RESOLUTION OF DISPUTES**

*SC-17.02 Attorneys’ Fees*

**SC-17.02 Add the following new paragraph immediately after Paragraph 17.01.**

**SC-17.02 Attorneys’ Fees: For any matter subject to final resolution under this Article, the prevailing party shall be entitled to an award of its attorneys’ fees incurred in the final resolution proceedings, in an equitable amount to be determined in the discretion of the court, arbitrator, arbitration panel, or other arbiter of the matter subject to final resolution, taking into account the parties’ initial demand or defense positions in comparison with the final result.**

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## SECTION 011000 – SUMMARY OF WORK

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes:
  - 1. Project information.
  - 2. Work covered by Contract Documents.
  - 3. Work by Owner.
  - 4. Owner-furnished products.
  - 5. Access to site.
  - 6. Work restrictions.
  - 7. Specification and drawing conventions.

#### 1.2 PROJECT INFORMATION

- A. Project Identification: City of Salisbury Water Treatment Plant Improvements
  - 1. Project Location: 1 Water Street, Salisbury, NC 28144
- B. Owner: City of Salisbury, North Carolina, One Water Street, Salisbury, North Carolina, 28144
  - 1. Address: 1 Water Street, Salisbury, NC 28144
  - 2. Owner's Representative: Jason H. Wilson, P.E., Assistant Utilities Director
- C. Engineer: LaBella Associates, PC, 400 South Tryon Street, Suite 1300, Charlotte, NC 28285

#### 1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and consists of the following:
  - A. This project includes the construction of a new pre-engineered metal building, site work, centrifuge installation, replacement filter under drains and all associated piping and appurtenances.
- B. Type of Contract
  - 1. The project will be constructed under a **Single Prime Contract**.

#### 1.4 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Preceding Work: None
- C. Concurrent Work: None

- D. Subsequent Work: None

#### 1.5 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products.
- B. Owner-Furnished Products:
  - 1. None

#### 1.6 ACCESS TO SITE/WORK LIMITS

- A. All work performed by the Contractor on this project shall be constructed within the established project boundaries, property boundaries, permanent and temporary easements secured by the Owner, and/or the existing road rights-of-way, as authorized by the North Carolina Department of Transportation or the local jurisdiction having authority as appropriate. Should the Contractor deem it necessary to operate outside the boundaries, easements and/or rights-of-way, he shall notify the Owner and Engineer immediately, and shall have the Owner's approval prior to initiating this portion of work. The Contractor shall be responsible for making special agreements with the property owners and for all additional costs.
- B. Where pipe is to be constructed across an existing roadway, the Contractor shall have the road restored with aggregate base and open to two-way traffic at the end of each workday. The surface shall be restored with a bituminous surface within 3 days of the complete installation of utilities for each section.
- C. When work is carried out in easements on private property, Contractor shall not operate equipment outside the easement lines. Contractor shall not use private property or private drives for parking of vehicles or equipment, or for deliveries of materials or supplies without written consent of the affected property owners. Damage done to property outside the easements shall be the entire responsibility of the Contractor and any damage shall be repaired by the Contractor at his expense to the satisfaction of the affected party without delay.
- D. Contractor must assure that each property owner has adequate access to their property at all times.
- E. Trees which are cleared from the project may become the property of the property owners at their request. If the property owner is not interested in the trees, they then become the property of the Contractor and shall be disposed of by the Contractor in accordance with all local, state, and federal regulations.
- F. Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

#### 1.7 WORK RESTRICTIONS

- A. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing and then only after providing temporary utility services

according to requirements indicated. Notify Owner no fewer than three days in advance of proposed interruption of service.

1. The drawings show the location of all underground utilities and obstructions that were known to the Engineer at the time the drawings were prepared. NC One Call and the individual utilities were contacted to determine the extent of existing utilities in the project area. The drawings do not show the depth of existing utilities in every case, also where depths are shown they shall be verified by the contractor in the field during the installation of the project. The Contractor is hereby notified that there may be existing utilities and obstructions that may be encountered by the Contractor that are not shown on the drawings. The contractor shall be responsible for determining the depth of all existing utilities and obstructions. No claims for increases in the contract amount or time shall be allowed due to the depth of existing utilities and obstructions. The Contractor shall endeavor to locate all existing utilities before digging by contacting NC One Call, contacting the individual utility companies involved, thoroughly reviewing all available Engineer and Owner drawings, interviewing the Owner's operating personnel, and if necessary utilizing a locating service experienced in locating underground utilities.
2. No claims for increases in the contract amount or time shall be allowed due to utilities or obstructions not shown on the drawings if the Contractor has not complied with all the above requirements.
3. It shall further be the Contractor's responsibility to determine the location and elevations wherever necessary of any existing subterranean underground obstruction in advance of the work being done, either from the above information or by actually uncovering the utility or obstruction. Any such existing water line, sewer line, gas line, telephone line, cable, conduit or any other utility or obstruction either underground or above ground, or work by other Contractors damaged by the Contractor in performing the work, shall immediately be repaired at his expense.

B. Controlled Substances: Use of controlled substances on the Project site is not permitted.

## 1.8 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations.

## PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

**END OF SECTION 011000**

## SECTION 012100 - ALLOWANCES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
  - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to the Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
  - 1. Contingency allowances.

#### 1.2 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Engineer of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Engineer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Engineer from the designated supplier.

#### 1.3 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

#### 1.4 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Engineer for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.
- C. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

### 3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

### 3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Contingency Allowance:
  - 1. Include a contingency allowance of \$350,000 for use according to Owner's instructions.

**END OF SECTION 012100**



## SECTION 012200 - UNIT PRICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.

#### 1.2 DEFINITIONS

- A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

#### 1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1: Concrete Pavement Removal
  - 1. Description: The unit price quoted under this item shall be for **Concrete Pavement Removal**, complete, as shown on the drawings. The quoted price shall also include all labor, materials, equipment, demolition, sawcutting, hauling and disposal, overhead, profit, insurance, etc., necessary to provide a complete project in place, unless such material or work is specifically included as a separate "Item" in the Bid.
  - 2. Unit of Measurement: Square yard based upon the actual quantity removed.

- B. Unit Price No. 2: Asphalt Pavement Removal
1. Description: The unit price quoted under this item shall be for **Asphalt Pavement Removal**, complete, as shown on the drawings. The quoted price shall also include all labor, materials, equipment, demolition, sawcutting, hauling and disposal, overhead, profit, insurance, etc., necessary to provide a complete project in place, unless such material or work is specifically included as a separate "Item" in the Bid.
  2. Unit of Measurement: Square yard based upon the actual quantity removed.
- C. Unit Price No. 3: Concrete Pavement
1. Description: The unit price quoted under this item shall be for furnishing and installing **Concrete Pavement**, complete in place, as shown on the drawings. The quoted price shall also include all labor, materials, equipment, preparation of subgrade, subgrade and concrete testing, overhead, profit, insurance, etc., necessary to provide a complete project in place, unless such material or work is specifically included as a separate "Item" in the Bid.
  2. Unit of Measurement: Square yard basis for the actual quantity installed.
- D. Unit Price No. 4: Full Depth Asphalt Pavement Patch
1. Description: The unit price quoted under this item shall be for furnishing and installing **Full Depth Asphalt Pavement**, complete in place, as shown on the drawings. The quoted price shall also include all labor, materials, equipment, preparation of subbase, subbase and asphalt testing, overhead, profit, insurance, etc., necessary to provide a complete project in place, unless such material or work is specifically included as a separate "Item" in the Bid.
  2. Unit of Measurement: Square yard based upon the actual quantity installed.
- E. Unit Price No. 5: Asphalt Road Overlay
1. Description: The unit price quoted under this item shall be for furnishing and installing **Asphalt Road Overlay**, complete in place, as shown on the drawings. The quoted price shall also include all labor, materials, equipment, sawcutting, milling, removal of milled surface, hauling, testing, overhead, profit, insurance, etc., necessary to provide a complete project in place, unless such material or work is specifically included as a separate "Item" in the Bid.
  2. Unit of Measurement: Square yard based upon the actual quantity overlaid.

**END OF SECTION 012200**

## SECTION 012300 – ALTERNATES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. The Alternates are identified on the Project Drawings and in the Project Specifications. Alternates may or may not be taken by the Owner according to the corresponding amounts identified in the Contractor's Bid. Such determination will be made by the Owner at Owner's sole discretion, after the opening of Bids but before the Award of a Contract.

#### 1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
  - 2. Base Bid Work includes all Work shown on the Drawings and enumerated in the Specifications, except for those components or portions explicitly called out in the Drawings, identified in this Section or explicitly called out in another Section of the Specifications as belonging to an Alternate.
  - 3. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

#### 1.3 DETERMINATION PROCESS

- A. Each Alternate Deduct shall be included as a separate line item in Contractor's Schedule of Values.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 SCHEDULE OF ALTERNATIVES

- A. Alternate No. 1: Rehabilitation of Four (4) Additional Dual Media Filters (Phase 1B)
  - 1. In addition to Base Bid Rehabilitation of Filters 5 through 8, also include rehabilitation of Filters 9 through 12. The Alternate Work includes for these additional Filters:

- a. Demolition of Filter Surface Wash piping in the pipe gallery associated with the additional filters being renovated. Header piping required for the continued use of Filters 1 through 4 will remain in service.
  - b. Air piping from the flanged connection at the Filter's Air Valve (including the addition of the valve and relocation of the Surface Wash valve actuator) to and into the Filter.
  - c. All Work within the Filter box and its associated Influent and Waste Gullet.
  - d. SCADA reprogramming for the additional Filters.
- B. Alternate No. 2: Rehabilitation of Eight (8) Additional Dual Media Filters (Phases 1B and 1C)
- 1. In addition to Base Bid Rehabilitation of Filters 5 through 8, also include rehabilitation of Filters 1 through 4 AND 9 through 12. The Alternate Work includes for these additional Filters:
    - a. Demolition of all Filter Surface Wash piping in the pipe gallery, up to points of connection to the wash water source(s).
    - b. Air piping from the flanged connection at the Filter's Air Valve (including the addition of the valve and relocation of the Surface Wash valve actuator) to and into the Filter.
    - c. All Work within the Filter box and its associated Influent and Waste Gullet.
    - d. SCADA reprogramming for the additional Filters.
- C. Alternate No. 3: Addition of Container Handling System
- 1. This alternate is for the addition of a container handling system to provide a way to evenly distribute material into a roll away container being deposited from a conveyor or chute. Specifications for this alternate can be found in Division 41 Section "Container Handling System".
- D. Alternate No. 4: Addition of Two (2) Centrifuge Disc Sludge Feed Pumps in lieu of Sludge Feed Pumps
- 1. This alternate is for the addition of two (2) Centrifuge Disc Sludge Feed Pumps in lieu of Sludge Feed Pumps. Specifications for this alternate can be found in Division 43 Section "Centrifuge Disc Sludge Feed Pump".

**END OF SECTION 012300**

## SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

#### 1.2 MINOR CHANGES IN THE WORK

- A. Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, in the form of a Field Order on EJCDC Document C-942.

#### 1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Proposal Requests issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.
  - 2. Within 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
    - e. Quotation Form: Use forms acceptable to Engineer.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Engineer.
  - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
  - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Engineer.

#### 1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Engineer will issue a Change Order for signatures of Owner and Contractor.

#### 1.5 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Engineer may issue a Construction Change Directive on EJCDC Document C-940. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

**END OF SECTION 012600**

## SECTION 012900 - PAYMENT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

#### 1.2 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

#### 1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with continuation sheets.
    - b. Submittal schedule.
    - c. Items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Engineer at earliest possible date but no later than 14 days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Name of Engineer.
    - c. Engineer's project number.
    - d. Contractor's name and address.
    - e. Date of submittal.
  - 2. Arrange schedule of values consistent with format of EJCDC Document C-620.
  - 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of Contract Sum.
    - a. Include separate line items under principal subcontracts for operation and maintenance manuals (where applicable), punch list activities, Project Record Documents, demonstration and training (where applicable), and project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
  - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item
9. Schedule of Values Revisions: Revise and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

#### 1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.
  1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use EJCDC Document C-620 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.
  1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
  4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
  1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.



2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  3. Provide summary documentation for stored materials indicating the following:
    - a. Materials previously stored and included in previous Applications for Payment.
    - b. Work completed for this Application utilizing previously stored materials.
    - c. Additional materials stored with this Application.
    - d. Total materials remaining stored, including materials with this Application.
- F. Transmittal: Submit four signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt within 48 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  2. When an application shows completion of an item, submit conditional final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of values.
  3. Contractor's construction schedule (preliminary if not final).
  4. Products list (preliminary if not final).
  5. Schedule of unit prices.
  6. Submittal schedule (preliminary if not final).
  7. List of Contractor's staff assignments.
  8. List of Contractor's principal consultants.
  9. Copies of building permits.
  10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  11. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
  5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
  6. AIA Document G707, "Consent of Surety to Final Payment."
  7. Evidence that claims have been settled.
  8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

**END OF SECTION 012900**

## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Work sequencing
  - 2. Construction Time and Liquidated Damages.
  - 3. Inclement Weather
  - 4. General project coordination procedures.
  - 5. Administrative and supervisory personnel.
  - 6. Requests for Information (RFIs).
  - 7. Project meetings.

#### 1.2 DEFINITIONS

- A. RFI: Request from Owner, Engineer, or Contractor seeking information from each other during construction.

#### 1.3 WORK SEQUENCE

- A. Sequencing: The Contractor is responsible for sequencing the Work, subject to the constraints of the Owner. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

#### 1.4 CONSTRUCTION TIME AND LIQUIDATED DAMAGES

- A. The Contractor shall commence work to be performed under his agreement on a date to be specified in a written order from the Engineer and shall fully complete all work within 730 consecutive calendar days regardless of actual weather or other conditions encountered.
- B. For each day in excess of the stated number of days for fully completing all work the Contractor shall pay to the Owner the following sum of liquidated damages:
  - 1. Single Prime, General Construction \$ 500.00

#### 1.5 INCLEMENT WEATHER

- A. For consideration of weather days, CRITICAL PATH work tasks are those that must be conducted outside. If during any month it is apparent that the critical path generally went through inside (weather protected) work, no weather days will be calculated (either positive or negative).

- B. A PRECIPITATION DAY will be defined as any day during which the precipitation total exceeded 0.10-inches. Values will be rounded (up or down) to establish the number of ‘normal’ Precipitation Days, which will be considered the baseline, only above which time compensation will be made. These values are:

<b>MONTHLY ANTICIPATED PRECIPITATION DAYS</b>											
<b>JAN</b>	<b>FEB</b>	<b>MAR</b>	<b>APR</b>	<b>MAY</b>	<b>JUN</b>	<b>JUL</b>	<b>AUG</b>	<b>SEP</b>	<b>OCT</b>	<b>NOV</b>	<b>DEC</b>
6	6	7	6	6	6	7	6	5	5	5	6

- C. At the end of each calendar month, the number of ACTUAL PRECIPITATION DAYS will be determined from the Project weather station (rain guage) and each will be counted regardless of the day of the week during which it occurred.
- D. A WEATHER DAYS TALLY will be maintained throughout the duration of the Project. The Tally will be increased each month by the number of Actual Precipitation Days in excess of the number of Normal Precipitation Days for that respective month. The Tally will be decreased each month by the number of Normal Precipitation Days in excess of Actual Precipitation Days.
- E. For heavier rains, RECOVERY DAYS will be added to Actual Precipitation Days to account for resultant site conditions that significantly impede the progress of the work. Values are rounded to establish the number of ‘normal’ heavier precipitation days, which will be considered baseline, only above which time compensation will be made. These values are:

<b>RECOVERY DAYS</b>		
<b>MONTH</b>	<b>≥ 0.5-inches</b>	<b>≥ 1.0-inch</b>
<b>JAN</b>	3	1
<b>FEB</b>	2	1
<b>MAR</b>	3	1
<b>APR</b>	3	1
<b>MAY</b>	2	1
<b>JUN</b>	2	1
<b>JUL</b>	3	2
<b>AUG</b>	3	1
<b>SEP</b>	2	1
<b>OCT</b>	3	2
<b>NOV</b>	3	1
<b>DEC</b>	3	1

NOTE: values for ≥ 0.5-inches INCLUDE values for ≥ 1.0-inch

- F. For a number of days each month with daily precipitation totals equal to or greater than 1.00-inch, which is greater than the normal number of such days, two (2) Recovery Days will be added. For a number of days each month with daily precipitation totals equal to or greater than 0.50-inches but less than 1.00-inch, which is greater than the normal number of such days, one (1) Recovery Day will be added.
- G. Since Recovery Days for normal conditions are to be expected, each Recovery Day calculation will be made in reverse as well: For a number of days each month with

daily precipitation totals equal to or greater than 1.00-inch, which is less than the normal number of such days, two (2) Recovery Days will be subtracted. For a number of days each month with daily precipitation totals equal to or greater than 0.50-inches but less than 1.00-inch, which is less than the normal number of such days, one (1) Recovery Day will be subtracted.

- H. Both Weather Days and Recovery Days will be allowed to fall below zero. The Tally will also cumulatively be allowed to fall below zero. At the end of the Project, any positive number of days remaining in the Tally will be granted to the Contractor in a Time Extension Change Order. Only Time Compensation (no monetary compensation) will be made for Weather Days.

## 1.6 GENERAL PROJECT COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's construction schedule.
  - 2. Preparation of the schedule of values.
  - 3. Delivery and processing of submittals.
  - 4. Progress meetings.
  - 5. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

## 1.7 KEY PERSONNEL

- A. Key Personnel Names: Prior to mobilizing for construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

## 1.8 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Engineer will return RFIs submitted to the Engineer by other entities controlled by Contractor with no response.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
  2. Project number.
  3. Date.
  4. Name of Contractor.
  5. Name of Engineer.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: CSI Form 13.2A
- D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven working days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals.

- b. Requests for approval of substitutions.
  - c. Requests for information already indicated in the Contract Documents.
  - d. Requests for adjustments in the Contract Time or the Contract Sum.
  - e. Requests for interpretation of Engineer's actions on submittals.
  - f. Incomplete RFIs or inaccurately prepared RFIs.
- 2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.
  - 3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal.
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 10 days of receipt of the RFI response.
- E. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly.
- 1. Project name.
  - 2. Name and address of Contractor.
  - 3. Name and address of Engineer.
  - 4. RFI number including RFIs that were dropped and not submitted.
  - 5. RFI description.
  - 6. Date the RFI was submitted.
  - 7. Date Engineer's response was received.
  - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
  - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

## 1.9 DIGITAL PROJECT MANAGEMENT PROCEDURES

### A. Electronically Transmitted Drawings and Specifications

- 1. General: At Contractor's written request, copies of Engineer's CAD files may be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
  - a. No Contractor, subcontractor, supplier or manufacturer shall have access to electronic drawings (CAD) or other files prepared by the Engineer as a part of this contract. The Engineer may provide, at the option of the Engineer, electronically transmitted drawings, specifications and other documents upon written request by the Contractor, and receipt of payment to the Engineer for the documents. All documents electronically transmitted as CAD by the Engineer shall have the Engineer's seal removed from the file and the electronic media shall not be considered to be a certified document.

## 1.10 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
  - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times.
  - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.
  
- B. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement.
  - 1. Conduct the conference to review responsibilities and personnel assignments.
  - 2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long-lead items.
    - d. Designation of key personnel and their duties.
    - e. Lines of communications.
    - f. Procedures for processing field decisions and Change Orders.
    - g. Procedures for RFIs.
    - h. Procedures for testing and inspecting.
    - i. Procedures for processing Applications for Payment.
    - j. Distribution of the Contract Documents.
    - k. Submittal procedures.
    - l. Preparation of record documents.
    - m. Work restrictions.
    - n. Working hours.
    - o. Responsibility for temporary facilities and controls.
    - p. Office, work, and storage areas.
    - q. Equipment deliveries and priorities.
    - r. First aid.
    - s. Security.
    - t. Progress cleaning.
  - 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
  
- C. Progress Meetings: Conduct progress meetings at monthly intervals.
  - 1. Coordinate dates of meetings with preparation of payment requests.



2. Attendees: Contractor and a Representative of the Owner shall attend monthly job site progress conferences as called by the Representative of the Owner. Contractor shall be represented at the job progress conferences by an authoritative representative of the home office of the Contractor as well as by project personnel representatives. These meetings shall be open to subcontractors, material suppliers, and any others who can contribute beneficially toward maintaining required job progress. It shall be the principal purpose of these meetings, or conferences, to effect coordination, cooperation, and assistance in every practical way toward the end of maintaining progress of the project on schedule and to complete the project within the specified contract time. Contractor shall be prepared to assess progress of the work as required in his particular contract and to recommend remedial measures for correction of progress as may be appropriate. The Owner's Representative shall be the coordinator of the conferences and shall preside as chairman.
3. The Contractor, at his expense shall make all necessary arrangements and provide the facilities for all construction progress conferences.
1. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
  - a. Contractor's Construction Schedule:
    - 1) Contractor shall submit the schedule to the Engineer within 30 days following the date of the written notice to commence work. The Contractor shall present a review of the schedule at each construction progress conference. The Engineer shall be provided with a type-written copy of the summaries and reviews for inclusion into the conference minutes.
    - 2) At each construction progress conference Contractor shall present a summary of project progress since the last meeting and shall review activities for the upcoming month. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Should any item of work become more than 30 days behind the dates indicated in the schedule, the Contractor shall immediately revise the schedule to indicate the necessary operations required to restore the project to the initial schedule to ensure that current and subsequent activities will be completed within the Contract Time, and submit the revised schedule to the Engineer.
    - 3) Review schedule for next period.
  - b. Review present and future needs of each entity present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Status of submittals.
    - 4) Deliveries.
    - 5) Access.
    - 6) Temporary facilities and controls.
    - 7) Progress cleaning.
    - 8) Status of correction of deficient items.
    - 9) Field observations.
    - 10) Status of RFIs.
    - 11) Status of proposal requests.

- 12) Pending changes.
  - 13) Status of Change Orders.
  - 14) Pending claims and disputes.
  - 15) Documentation of information for payment requests.
2. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
    - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

**END OF SECTION 013100**

## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Contractor's Construction Schedule.
  - 2. Submittals Schedule.
  - 3. Daily construction reports.
  - 4. Material location reports.
  - 5. Field condition reports.
  - 6. Special reports.

#### 1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
  - 1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Engineer.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

- H. Major Area: A separate building or structure, or a similar significant construction element.
- I. Milestone: A key or critical point in time for reference or measurement.
- J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.
- K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

### 1.3 SUBMITTALS

- A. Format for Submittals: Submit required submittals as a PDF file.
- B. Submittals Schedule: Submit 3 copies of schedule. Arrange the following information in a tabular format:
  - 1. Scheduled date for first submittal.
  - 2. Specification Section number and title.
  - 3. Submittal category (action or informational).
  - 4. Name of subcontractor.
  - 5. Description of the Work covered.
  - 6. Scheduled date for Engineer's final release or approval.
- C. Preliminary Construction Schedule: Submit two (2) opaque hard copies or one (1) electronic file.
  - 1. Approval of cost-loaded preliminary construction schedule will not constitute approval of Schedule of Values for cost-loaded activities.
- D. Preliminary Network Diagram: Submit two (2) opaque hard copies or one (1) electronic file , large enough to show entire network for entire construction period. Show logic ties for activities.
- E. Contractor's Construction Schedule: Submit two (2) opaque hard copies or one (1) electronic file of initial schedule, large enough to show entire schedule for entire construction period.
  - 1. Submit an electronic copy of schedule, using software indicated, on CD-R, and labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.
- F. Daily Construction Reports: Submit two (2) hard copies or one (1) electronic file at monthly intervals.
- G. Material Location Reports: Submit two (2) hard copies or one (1) electronic file at monthly intervals.
- H. Field Condition Reports: Submit two (2) hard copies or one (1) electronic file at time of discovery of differing conditions.
- I. Special Reports: Submit (2) hard copies or one (1) electronic file at time of unusual event.

## 1.4 QUALITY ASSURANCE

- A. Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:
  - 1. Review software limitations and content and format for reports.
  - 2. Verify availability of qualified personnel needed to develop and update schedule.
  - 3. Discuss constraints, including phasing, work stages, and interim milestones.
  - 4. Review time required for review of submittals and resubmittals.
  - 5. Review requirements for tests and inspections by independent testing and inspecting agencies.
  - 6. Review time required for completion procedures.
  - 7. Review and finalize list of construction activities to be included in schedule.
  - 8. Review submittal requirements and procedures.
  - 9. Review procedures for updating schedule.

## 1.5 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
  - 1. Secure time commitments for performing critical elements of the Work from parties involved.
  - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

## PART 2 - PRODUCTS

### 2.1 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
  - 1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
  - 2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
    - a. At Contractor's option, show submittals on the Preliminary Construction Schedule, instead of tabulating them separately.
  - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

### 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Engineer.
  2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
  4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
  2. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Uninterruptible services.
    - c. Use of premises restrictions.
    - d. Provisions for future construction.
    - e. Seasonal variations.
  3. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
    - a. Subcontract awards.
    - b. Submittals.
    - c. Deliveries.
    - d. Installation.
    - e. Tests and inspections.
    - f. Adjusting.
    - g. Startup and placement into final use and operation.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.
- F. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.
- G. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

## 2.3 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within 30 days of date established for the Notice of Award.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

## 2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
  - 1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.
- C. Upon request, the Contractor shall provide the Engineer opportunity to review the schedule electronically in its native format at the Contractor's onsite office and with Contractor's licensed copy of the scheduling software.

## 2.5 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
  - 1. List of subcontractors at Project site.
  - 2. Approximate count of personnel at Project site.
  - 3. Equipment at Project site.
  - 4. Material deliveries.
  - 5. High and low temperatures and general weather conditions.
  - 6. Accidents.
  - 7. Meetings and significant decisions.
  - 8. Unusual events (refer to special reports).
  - 9. Stoppages, delays, shortages, and losses.
  - 10. Emergency procedures.
  - 11. Orders and requests of authorities having jurisdiction.
  - 12. Change Orders received and implemented.
  - 13. Construction Change Directives received and implemented.
  - 14. Services connected and disconnected.
  - 15. Equipment or system tests and startups.
  - 16. Partial Completions and occupancies.
  - 17. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials

previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation on CSI Form 13.2A. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## 2.6 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
  - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  - 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- C. Distribution: Distribute copies of initial approved schedule and updated monthly schedule to Engineer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
  - 1. Post copies in Project meeting rooms and temporary field offices.
  - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

**END OF SECTION 013200**



## SECTION 013300 - SUBMITTAL PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

#### 1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Engineer's responsive action. Submittals may be rejected for not complying with requirements.
- B. Informational Submittals: Written information that does not require Engineer's responsive action.

#### 1.3 GENERAL

- A. Submittal process (except for samples and similar physical items, final Operation & Maintenance Manuals if requested, and final Record Drawings) is electronic. Engineer will provide instructions for use of Engineer's electronic document processing system, and an editable copy of Form 013300A concurrent with Notice to Proceed. Comply with Engineer's electronic document processing requirements.
  - 1. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
    - a. Electronic document processing system or Email: Prepare submittals as PDF package, and transmit to Engineer. Include PDF transmittal form. Include information on Form 013300A as requested by Engineer.
      - 1) Engineer will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
- B. Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Engineer for Contractor's use in preparing submittals.
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

- E. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 days for review of each resubmittal.
  4. Sequential Review: Where sequential review of submittals by Engineer's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
  5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Engineer and to Engineer's consultants, allow 15 days for review of each submittal. Submittal will be returned to Engineer before being returned to Contractor.
- F. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
- G. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- H. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

#### 1.4 SUBMITTAL PROCESS

- A. Provide submittal documents in Portable Document Format (PDF), with each individual submittal in a single unprotected PDF file. Filename shall be the same as the unique submittal number established as described below, with a ".PDF" extension (e.g., "013300.01-A.PDF").
1. Attach editable Submittal Form 013300A as the first page of each PDF file, with all fields in title block, "Submittal Details" and "Contractor Certification" sections completed. Engineer will complete "LaBella Review" section, digitally markup the submittal and "flatten" to an uneditable form before returning reviewed submittal to Contractor.
    - a. For Single Prime Contract, all submittals shall be submitted by the General Contractor. Engineer will return unreviewed any submittals received under cover or name of a subcontractor who is not party to a Contract with the Owner.
    - b. Establish a unique Submittal # for each new submittal.
      - 1) Submittal number shall use the 6-digit Specification Section number followed by a decimal point and then a 2-digit sequential number (e.g., 013300.01). Resubmittals shall include a sequential alphabetic suffix after a dash (e.g., 013300.01-A for the first resubmittal, 013300.01-B for the second, and so on).

- c. Provide a phrase description (more specific than the related Specification Section title, if appropriate) for the subject of the submittal.
  - d. Provide name, phone number, and email address for Contractor contact who can respond to questions specific to the subject submittal.
  - e. Provide transmittal date consistent with date that item is submitted. Indicate requested response date, consistent with paragraph 1.3E review periods above (or longer review time), even if submittal is to be marked "Critical". Engineer will prioritize submittals indicated as Critical, making reasonable effort to respond in a more expedited fashion.
  - f. Indicate the title of the Specification Section corresponding to the Submittal number, and as applicable, the primary sheet number(s) of any Drawings on which the item appears.
  - g. Provide clarifying notes or comments as necessary, including directing reviewer's attention to any deviations from the Contract Documents. Attach additional pages directly following Form 013300A if necessary.
- 2. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals. Contractor's signature (or digitally-entered name) on Form 013300A indicates full compliance with the Contract Documents except as specifically identified in this manner.
  - 3. Following Form 013300A, for multi-component or large (>20 pages) submittals, include an indexed table of contents with hyperlinks enabling navigation to each item.
- B. Physical submittal items: Submit samples, color charts, O&M manuals if requested, and final Record Drawings in tangible form by mail or other delivery. Submit parallel electronic submittal with digital Form 013300A as described above and photo or other digital representation of tangible item for submittal tracking and record-keeping purposes. Engineer will reply to such submittals electronically as described above.
  - C. Resubmittals: Make resubmittals in same form as initial submittal. Immediately following new Submittal Form 013300A, attach related initial (and any subsequent resubmittal's) Form 013300A bearing the Engineer's review mark.
    - 1. Resubmit submittals until they are marked "NET-No Exceptions Taken or EI-Exceptions Indicated"
    - 2. Note content of revision in notes / comment block and clearly indicate extent of revision. Attach additional pages directly following Form 013300A if necessary.
  - D. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities.
  - E. Use for Construction: Use only final submittals with mark indicating "NET-No Exceptions Taken or EI-Exceptions Indicated by Engineer."

## PART 2 - PRODUCTS

### 2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.

- B. **Product Data:** Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's written recommendations.
    - b. Manufacturer's product specifications.
    - c. Manufacturer's installation instructions.
    - d. Standard color charts.
    - e. Manufacturer's catalog cuts.
    - f. Wiring diagrams showing factory-installed wiring.
    - g. Printed performance curves.
    - h. Operational range diagrams.
    - i. Mill reports.
    - j. Standard product operation and maintenance manuals.
    - k. Compliance with specified referenced standards.
    - l. Testing by recognized testing agency.
    - m. Application of testing agency labels and seals.
    - n. Notation of coordination requirements.
  4. Submit Product Data before or concurrent with Samples.
- C. **Shop Drawings:** Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Dimensions.
    - b. Identification of products.
    - c. Fabrication and installation drawings.
    - d. Roughing-in and setting diagrams.
    - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
    - f. Shopwork manufacturing instructions.
    - g. Templates and patterns.
    - h. Schedules.
    - i. Design calculations.
    - j. Compliance with specified standards.
    - k. Notation of coordination requirements.
    - l. Notation of dimensions established by field measurement.
    - m. Relationship to adjoining construction clearly indicated.
    - n. Seal and signature of professional engineer if specified.
    - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
- D. **Samples:** Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Attach label on unexposed side of Samples that includes the following:

- a. Generic description of Sample.
  - b. Product name and name of manufacturer.
  - c. Sample source.
  - d. Number and title of appropriate Specification Section.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
- a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
  - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
- a. Number of Samples: Submit two (2) full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
- a. Number of Samples: Submit three (3) sets of Samples. Engineer will retain two (2) Sample sets; one sample set will be returned.
    - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
    - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three (3) sets of paired units that show approximate limits of variations.
- E. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation" for Construction Manager's action.
- F. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A. Include the following information in tabular form:
- 1. Name, address, and telephone number of entity performing subcontract or supplying products.

2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

## 2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
  1. Number of Copies: Submit two (2) copies of each submittal, unless otherwise indicated. Engineer will not return copies.
  2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
  3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of Engineers and owners, and other information specified.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on

evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

- L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - 1. Name of evaluation organization.
  - 2. Date of evaluation.
  - 3. Time period when report is in effect.
  - 4. Product and manufacturers' names.
  - 5. Description of product.
  - 6. Test procedures and results.
  - 7. Limitations of use.
- M. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- N. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- O. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- Q. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations (with page numbers), and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations.
- R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
  - 1. Preparation of substrates.
  - 2. Required substrate tolerances.
  - 3. Sequence of installation or erection.
  - 4. Required installation tolerances.
  - 5. Required adjustments.
  - 6. Recommendations for cleaning and protection.
- S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- T. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- U. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Engineer.
1. Engineer will not review submittals that include MSDSs and will return them for resubmittal.

### 2.3 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three (3) copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.



### 3.2 ENGINEER'S ACTION

- A. General: Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
  - 1. Drawings returned to the contractor with the Engineer's "NO EXCEPTIONS TAKEN" or "EXCEPTIONS INDICATED" stamp need not be resubmitted, except that corrected copies of "EXCEPTIONS INDICATED" shop drawings shall be furnished for record when requested. Drawings returned to the Contractor with the Engineer's "REVISE AND RESUBMIT" or "REJECTED, RESUBMIT" stamp shall be corrected to comply with Contract requirements and resubmitted to the Engineer for review. The Engineer's shop drawing stamp categories shall be interpreted as follows.
    - a. NO EXCEPTIONS TAKEN: Fabrication and installation or erection may be undertaken.
    - b. EXCEPTIONS INDICATED: Fabrication and installation or erection may be undertaken, however, Contractor shall comply with all notes or corrections indicated.
    - c. REVISE AND RESUBMIT: Neither fabrication nor installation or erection shall be undertaken. Resubmit corrected copies for review. Corrections shall be limited to items marked, except that changes required in order to coordinate the corrections indicated shall be made. All changes, other than those indicated, shall be called specifically to the Engineer's attention.
    - d. REJECTED, RESUBMIT: Neither fabrication nor installation or erection shall be undertaken. Revise entire submission to comply with information given in the Contract Documents and resubmit.
- C. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

**END OF SECTION 013300**

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Contractor:  
Address:

Project Name:  
Project #:  
Owner:  
Transmitted to LaBella:

Phone:  
☒:

Response Requested: Critical:  
Response Provided:

**SUBMITTAL DETAILS**

Submittal Type:  
Manufacturer/Supplier:  
Spec Section Name:  
Related Drawings:  
Submittal Contents / Attachments

Notes / Comments

**CONTRACTOR CERTIFICATION**

The contents of this submittal have been reviewed, checked and approved by the Contractor and except as noted above, area in full compliance with the requirements of the Contract Documents.

Signed:

Date:

**LABELLA REVIEW:**

Corrections or comments made on the submittal during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.

**LaBella Associates**

By:

Date:

Notes / Comments

## SECTION 014000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Engineer, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.
  - 4. Specific test and inspection requirements are not specified in this Section.

#### 1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency

qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

- F. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Engineer or Construction Manager.

### 1.3 DELEGATED-DESIGN SERVICES

- A. In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Entity responsible for performing tests and inspections.
  - 3. Description of test and inspection.
  - 4. Identification of applicable standards.
  - 5. Identification of test and inspection methods.
  - 6. Number of tests and inspections required.
  - 7. Time schedule or time span for tests and inspections.
  - 8. Requirements for obtaining samples.
  - 9. Unique characteristics of each quality-control service.
- C. Reports: Prepare and submit certified written reports and documents as specified.
- D. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee

payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

## 1.5 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Engineer. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
  - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
  - 1. Contractor-performed tests and inspections including Subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
  - 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
  - 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Engineer has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

## 1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, telephone number, and email address of testing agency.
  - 4. Dates and locations of samples and tests or inspections.

5. Names of individuals making tests and inspections.
  6. Description of the Work and test and inspection method.
  7. Identification of product and Specification Section.
  8. Complete test or inspection data.
  9. Test and inspection results and an interpretation of test results.
  10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
  2. Statement that equipment complies with requirements.
  3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  4. Statement whether conditions, products, and installation will affect warranty.
  5. Other required items indicated in individual Specification Sections.

## 1.7 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
  - 1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Provide sizes and configurations of test assemblies to adequately demonstrate capability of products to comply with performance requirements.
    - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
    - e. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
  - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer, through Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report



whether tested and inspected work complies with or deviates from the Contract Documents.

## 1.8 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
  - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
  - 1. Payment for these services will be made from testing and inspection allowances (if included in contract), as authorized by Change Orders or from Item listed in bid (if included in contract).
  - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
  
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
  - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  - 2. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  - 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
  - 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  - 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  - 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
  
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
  
- D. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
  - 1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  - 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Associated Contractor Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
  1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
  1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update as the Work progresses.
  1. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
  1. Date test or inspection was conducted.

2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Engineer.
  4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division "Execution Requirements."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

**END OF SECTION 014000**

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

#### 1.2 DEFINITIONS

- A. Permanent Enclosure: As determined by Engineer, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

#### 1.3 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Engineer, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Water Service: If water is available on site from Owner's existing water system (or made available by Contractor through performance of relevant portions of the Work) for flushing and testing, it will be available to Contractor for use without metering and without payment of use charges. Provide connection with all necessary piping, valves, backflow prevention and extensions of services as required for construction operations.
  - 1. The availability of water may be restricted to non-peak demand periods or other times as may be designated by the Owner. The Contractor shall not use water without prior approval from the Owner.
  - 2. It shall be the Contractor's responsibility to make all necessary arrangements and pay all the costs to obtain water from other sources when water is not available from the Owner's system. Contractor shall obtain approval from the Owner for utilizing other sources of water for this project.
- C. Electrical Power Service: Contractor shall pay electrical power service charges for electricity used by all entities for construction operations.

#### 1.4 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

## 1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Pavement: Comply with Division 33 pavement Sections.
- B. Temporary Chain-Link Fencing: Minimum 2-inch (50 mm), 0.148-inch- (3.76 mm-) thick, galvanized steel, chain-link fabric fencing; minimum 6-feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60 mm-) OD line posts and 2-7/8-inch- (73 mm-) OD corner and pull posts, with 1-5/8-inch- (42 mm-) OD top rails.
- C. Portable Chain-Link Fencing: Minimum 2-inch (50 mm), 9-gage, galvanized steel, chain-link fabric fencing; minimum 6-feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60 mm-) OD line posts and 2-7/8-inch- (73 mm-) OD corner and pull posts, with 1-5/8-inch- (42 mm-) OD top and bottom rails. Provide concrete bases for supporting posts.
- D. Wood Enclosure Fence: Plywood, 8-feet (2.4 m) high, framed with four 2-by-4-inch (50 by 100 mm) rails, with preservative-treated wood posts spaced not more than 8-feet (2.4 m) apart.
- E. Gypsum Board: Minimum ½-inch (12.7 mm) thick by 48-inches (1219 mm) wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36/C 36M.
- F. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

### 2.2 TEMPORARY FACILITIES

- A. Storage and Fabrication Sheds
  - 1. Contractor shall provide storage sheds for his use on the premises where directed or approved, such sheds shall be maintained in good condition, and shall be removed when directed. Storage sheds shall be substantial, watertight sheds in which he shall store all materials that might be damaged by the weather. All storage sheds shall have floors raised at least 6-inches above the ground on heavy joists, or sleepers. Lumber used for temporary sheds may be secondhand. Items too large to be placed in the storage sheds but which are subject to damage from the elements shall be placed on blocking and securely covered with waterproof covers satisfactory to the Engineer.
  - 2. Store combustible materials apart from building.
- B. Scaffold, Tools, Etc.
  - 1. Contractor shall provide all necessary platforms and scaffolds of ample strength, all hoisting machinery, all appliances and materials such as ladders, planks, ropes, wedges,

centers, and other tools and materials, including the transportation thereof to and from the site, as required for proper handling, installation and/or erection of materials and equipment included in his work.

- C. Off-Site Storage of Materials and Equipment
  - 1. Should the Contractor desire to include materials and equipment stored at off-site locations in his request for progress payments, such materials and equipment shall be suitably stored in a bonded warehouse.
- D. Electrical Power and Lighting
  - 1. Electrical power required during construction for the construction of the project shall be provided by Contractor. The cost of the service shall be paid by the Contractor. This temporary service shall be installed by a qualified Electrical Contractor. Lighting shall be provided by Contractor in all spaces at all times where necessary for good and proper workmanship, for inspection, or for safety.
  - 2. Power for testing and operating the permanent equipment and lighting installed under this contract shall be via the Owner's service.

### 2.3 CONSTRUCTION OFFICE

- A. In addition to onsite construction office(s) required for Contractor's personnel, provide and pay for a separate fully-furnished well-lit lockable office dedicated for Owner's and Engineer's personnel, complete with all utilities and maintenance services, starting within 15 days after Notice To Proceed until after all Work is Substantially Complete or lesser period only with Owner approval.
  - 1. Spaces:
    - a. One lockable office, minimum 10-ft x 12-ft with windows
    - b. Access to and use of unisex restroom with lavatory
    - c. Access to and shared use of conference area, minimum 10-ft x 16-ft with windows
  - 2. Commercial Quality Furnishings:
    - a. Each office – 3-ft x 6-ft executive desk, adjustable office chair, side chair, two-drawer lateral file cabinet, 4-shelf bookshelf
    - b. Restroom – shelving for utility storage
    - c. Conference area – conference table and chairs suitable for 6-person meeting, 3-ft x 5-ft tilting drafting table, 4-shelf bookshelf
  - 3. Utilities:
    - a. Water / Sewer
    - b. Electric Service
    - c. Heat / Air Conditioning
    - d. Internet – minimum 15 Mbps with WiFi
  - 4. Services:
    - a. Trash collection – minimum every other day
    - b. Cleaning / Housekeeping / Supplies refill – minimum once per week
    - c. Repair service – as required / requested by Owner or Engineer.
- B. Provide office keys to Owner and Engineer only. Locate Owners/Engineer's construction office immediately adjacent to Contractor's construction office. Meet all requirements of authorities having jurisdiction. If requested by Owner or Engineer or otherwise required, provide handicapped accessible entry way(s).

## 2.4 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### 3.2 TEMPORARY UTILITY INSTALLATION

- A. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water, secluded from public observation, for use by all project personnel. They shall be kept in a clean and sanitary condition and shall comply with requirements and regulations of public authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities. The temporary sanitary facilities shall commit no public nuisance. Temporary sanitary facilities shall be removed upon completion of work and premises shall be left clean.
  - 1. Toilets: Use of Owner's existing toilet facilities or Owner's/Engineer's construction office will not be permitted.
- B. Electrical Power Service: Provide temporary power service through the local power supplier for use by all entities engaged in construction operations.
  - 1. Electrical power required during construction for the construction of the project shall be provided by Contractor. The cost of the service shall be paid by the Contractor. This temporary service shall be installed by a qualified Electrical Contractor. Lighting shall be provided by Contractor in all spaces at all times where necessary for good and proper workmanship, for inspection, or for safety.
  - 2. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
  - 3. Install electric power service overhead, unless otherwise indicated.
  - 4. Power for testing and operating the permanent equipment and lighting installed under this contract shall be via the Owner's service.
- C. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
  - 2. Install lighting for Project identification sign.
- D. Telephone Service: Provide superintendent with cellular telephone.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
  - 1. Provide incombustible construction for shops and sheds located within construction area or within 30-feet (9 m) of building lines. Comply with NFPA 241.
  - 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas in same location as permanent roads and paved areas. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
  - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
  - 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 33 Sections.
  - 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
  - 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 33 Section "Asphalt Paving."
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary parking areas for construction personnel.
- E. Project Identification and Temporary Signs: Provide Project identification and other signs as indicated on Drawings. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
  - 1. Provide temporary, directional signs for construction personnel and visitors.
  - 2. Maintain and touchup signs so they are legible at all times.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution Requirements" for progress cleaning requirements.
- G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that



minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

- A. Temporary Erosion and Sedimentation Control: Soil erosion- and sedimentation-control measures shall be provided on all areas of the site which are disturbed or graded. Comply with Division 31 Section “Erosion & Sedimentation Controls” requirements.
- B. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- C. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- D. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- E. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Outside of WTP secured limits, provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- F. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

**END OF SECTION 015000**

## SECTION 016000 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

#### 1.2 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design" or "basis of specification," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

#### 1.3 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
  - 1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
  - 2. Form: Tabulate information for each product under the following column headings:
    - a. Specification Section number and title.
    - b. Generic name used in the Contract Documents.

- c. Proprietary name, model number, and similar designations.
  - d. Manufacturer's name and address.
  - e. Supplier's name and address.
  - f. Installer's name and address.
  - g. Projected delivery date or time span of delivery period.
  - h. Identification of items that require early submittal approval for scheduled delivery date.
3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
    - a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
  4. Completed List: Within 60 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
  5. Engineer's Action: Engineer will respond in writing to Contractor within two weeks of receipt of completed product list. Engineer's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Engineer's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.
- B. Substitution Requests: Submit three copies of each request for consideration unless more stringent requirements are listed within individual product specification sections. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Substitution Request Form: Use CSI Form 13.1A.
  2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified material or product cannot be provided.
    - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. List of similar installations for completed projects with project names and addresses and names and addresses of engineers and owners.
    - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
    - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.

- j. Cost information, including a proposal of change, if any, in the Contract Sum.
  - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
  - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
- C. Comparable Product Requests: Submit three copies of each request for consideration unless more stringent requirements are listed within individual product specification sections. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
- 1. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within two weeks of receipt of request, or 1 week of receipt of additional information or documentation, whichever is later.
    - a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
    - b. Use product specified if Engineer cannot make a decision on use of a comparable product request within time allocated.
- D. Basis-of-Design Product Specification Submittal: Comply with requirements listed in individual product specification sections. Show compliance with requirements.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
- 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
  - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

#### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
- 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

- C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.
  2. Store materials in a manner that will not endanger Project structure.
  3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
  4. Store cementitious products and materials on elevated platforms.
  5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
  6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  7. Protect stored products from damage and liquids from freezing.
  8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

## 1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents. Unless otherwise specified in this Project Manual, Contractor shall ensure that manufacturer's warranty periods begin upon Substantial Completion.
1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
  3. Refer to Divisions 02 through 46 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Engineer will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Engineer's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.
  - a. Submit additional documentation required by Engineer in order to establish equivalency of proposed products. Evaluation of "or equal" product status is by the Engineer, whose determination is final.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.
  - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
  - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Engineer will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
  - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Engineer will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Engineer will consider requests for substitution if received within 90 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Engineer.
- B. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:
  1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
  2. Requested substitution does not require extensive revisions to the Contract Documents.
  3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  4. Substitution request is fully documented and properly submitted.
  5. Requested substitution will not adversely affect Contractor's Construction Schedule.
  6. Requested substitution has received necessary approvals of authorities having jurisdiction.
  7. Requested substitution is compatible with other portions of the Work.
  8. Requested substitution has been coordinated with other portions of the Work.
  9. Requested substitution provides specified warranty.
  10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

## 2.3 COMPARABLE PRODUCTS

- A. Conditions: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:
  1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

**END OF SECTION 016000**



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**SUBSTITUTION  
REQUEST  
(After the Bidding Phase)**

Project: City of Salisbury Water Treatment Plant Improvements Substitution Request Number: \_\_\_\_\_  
Salisbury, North Carolina From: \_\_\_\_\_  
To: \_\_\_\_\_ Date: \_\_\_\_\_  
\_\_\_\_\_ A/E Project Number: 2191241  
Re: \_\_\_\_\_ Contract For: \_\_\_\_\_

Specification Title: \_\_\_\_\_ Description: \_\_\_\_\_  
Section: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone: \_\_\_\_\_  
Trade Name: \_\_\_\_\_ Model No.: \_\_\_\_\_  
Installer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone: \_\_\_\_\_  
History:  New product  2-5 years old  5-10 yrs old  More than 10 years old  
Differences between proposed substitution and specified product: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Point-by-point comparative data attached - REQUIRED BY A/E

Reason for not providing specified item: \_\_\_\_\_  
\_\_\_\_\_

Similar Installation:  
Project: \_\_\_\_\_ Architect: \_\_\_\_\_  
Address: \_\_\_\_\_ Owner: \_\_\_\_\_  
\_\_\_\_\_ Date Installed: \_\_\_\_\_

Proposed substitution affects other parts of Work:  No  Yes; explain \_\_\_\_\_  
\_\_\_\_\_

Savings to Owner for accepting substitution: \_\_\_\_\_ (\$ \_\_\_\_\_).

Proposed substitution changes Contract Time:  No  Yes [Add] [Deduct] \_\_\_\_\_ days.

Supporting Data Attached:  Drawings  Product Data  Samples  Tests  Reports  \_\_\_\_\_

# SUBSTITUTION REQUEST (Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution 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 related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- 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: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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### A/E's REVIEW AND ACTION

- Substitution approved - Make submittals in accordance with Specification Section 01330.
- Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
- Substitution rejected - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by:

Date:

---

Additional Comments:     Contractor     Subcontractor     Supplier     Manufacturer     A/E     \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## **SECTION 017300 - EXECUTION REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. General installation of products.
  - 4. Coordination of Owner-installed products.
  - 5. Progress cleaning.
  - 6. Starting and adjusting.
  - 7. Protection of installed construction.
  - 8. Correction of the Work.

#### **1.2 SUBMITTALS**

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

#### **1.3 QUALITY ASSURANCE**

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Existing Utilities
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
  - 2. Before construction, verify the location and points of connection of utility services.

3. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction.
  - B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
  - D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on CSI Form 13.2A, "Request for Interpretation."
- A. One complete clean set of drawings and specifications shall be kept on the job, in the Contractor's job office, at all times and shall be available to the Owner, the Engineer, and all authorized Construction Observers. A separate complete set shall be continuously kept up to date and marked to show all variations between actual project installation and contract drawing and specification requirements. Contractor shall keep his subcontractors and suppliers informed of changes made to these drawings and specifications at all times. A separate completely marked-up set of drawings and specifications shall be returned to the Engineer upon completion of the work in accordance with Division 01 Section "Project Record Documents".
  - B. Emergency Response: Contractor shall have an Engineer-approved emergency response plan prior to initiating work. The Contractor shall designate a 24 hr/7 day per week contact person(s) with authority and available resources to respond immediately to an emergency. The Contractor shall respond immediately when notified by the Engineer or Owner of any job site condition which may endanger the health, safety or welfare of the public and shall make necessary corrections. Failure of the Contractor to respond within a reasonable time will result in Owner making the necessary correction and deducting the cost of such corrections from the Contractor's contract amount.
  - C. Special Requirements and Permits: Permits (from agencies including but not limited to NCDEQ, NCDWQ, NCPWS, NCDOT, City or County, etc.) may be required for the construction-related activities planned by the Contractor. The Owner has obtained overall project related permits. The Contractor will be required to obtain permits for project specific activities not covered by the overall project permits. Obtaining and/or complying with the provisions of such permits are the sole and exclusive responsibility of the Contractor, and all work associated with or required to obtain or comply with such permits is included with the Contractor's bid. No additional compensation will be made for any such work.

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
  - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 3. Inform installers of lines and levels to which they must comply.
  - 4. Check the location, level and plumb, of every major element as the Work progresses.
  - 5. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.
  - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

### 3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
- B. Benchmarks: Establish and maintain a minimum of two (2) permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- C. The Contractor shall employ a Registered Engineer or Registered Land Surveyor to lay out the work, establish bench marks in locations where same will not be disturbed and where direct instrument sights may be taken.
- D. Contractor shall inform Engineer at least 48 hours in advance of date he proposes to establish any line or grade in order that representatives of Engineer may be present.

### 3.5 INSTALLATION

- A. Contractor shall assume entire responsibility for all work, materials and equipment provided by him until final completion and acceptance of the project, and he shall be held responsible and liable for employee safety.
  - 1. Contractor shall comply with the latest revisions and interpretations of Department of Labor safety and health regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-S96) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-54).
  - 2. Work on and for the project shall conform to requirements of the “North Carolina State Building Code” and to all other applicable codes, laws, rules and regulations, to the extent that such requirements do not conflict with federal laws or regulations. Contractor shall familiarize himself with all local, state and federal laws, orders, rules and regulations relative to the site and its vicinity, shall be knowledgeable regarding the laws, orders, rules and regulations applicable to open fires, air pollution, erosion and sedimentation control, curb cuts and ramps, tree and shrubbery protection, and agricultural quarantines affecting the work, and shall conduct his affairs under this contract accordingly.
  - 3. Contractor shall provide and maintain, on the job, up-to-date copies of applicable codes, applicable OSHA regulations, and other applicable laws, rules and regulations governing the work and its performance. Such data shall be maintained in a readily accessible location available to all personnel requiring reference thereto.
- B. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
- C. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- D. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- E. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
- I. Chemicals: All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant, or of other classification, must

show approval of either Environmental Protection Agency or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with instructions.

### 3.6 CUTTING, DIGGING, FITTING AND PATCHING

- A. The Contractor shall cut, fit, and patch the work, as necessary to properly prepare, connect, and replace various parts of the work. The word “cutting” as used in this paragraph shall be taken to mean cutting, including sawcutting but exclusive of core drilling. Patching shall include structural patches following cutting activities including asphalt/concrete patching and shall be as necessary to match existing construction or conditions unless otherwise directed by the Owner.
- B. The Contractor shall be entirely responsible for all cutting, digging, fitting, and patching required and shall coordinate the work as necessary to provide a complete and finished job.
- C. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction.
  - 1. In general, use hand or small power tools designed for cutting, not hammering and chopping. Cut holes neatly to minimum size required and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use. Sawcut edges of asphalt/concrete as necessary to provide a clean, stable surface for patching activities to adhere to.
  - 2. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  - 3. Proceed with patching after construction operations requiring cutting are complete.
- D. Patching: Patch construction by filling, repairing, closing up, or similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.

### 3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80°F (27°C).



3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
  - C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
    1. Remove liquid spills promptly.
    2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
  - D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
  - E. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
  - F. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
  - G. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
  - H. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
  - I. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

**END OF SECTION 017300**

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# REQUEST FOR INTERPRETATION

Project: City of Salisbury Water Treatment Plant Improvements R.F.I. Number: \_\_\_\_\_  
Salisbury, North Carolina From: \_\_\_\_\_  
To: \_\_\_\_\_ Date: \_\_\_\_\_  
\_\_\_\_\_ A/E Project Number: 2191241  
Re: \_\_\_\_\_ Contract For: \_\_\_\_\_

Specification Section: Paragraph: Drawing Reference: Detail:

Request:

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

Response:

Attachments

Response From: To: Date Rec'd: Date Ret'd:

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

Copies:  Owner  Consultants  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  File

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## SECTION 017700 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Inspection procedures.
  - 4. Warranties.
  - 5. Final cleaning.
  - 6. Repair of the Work.

#### 1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
  - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  - 2. Advise Owner of pending insurance changeover requirements.
  - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities.
  - 5. Prepare and submit Project Record Documents, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
  - 6. Deliver tools, spare parts as required in each Section of the specifications, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  - 7. Submit testing records.
  - 8. Terminate and remove temporary facilities from Project site, construction tools, and similar elements.
  - 9. Complete final cleaning requirements, including touchup painting.
  - 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
  - 11. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems, if applicable. Submit demonstration and training video recordings specified in Division 01 Section "Demonstration and Training."

#### 1.3 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

#### 1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three (3) copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A.
  1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding to underground and interior items.
  2. Include the following information at the top of each page:
    - a. Project name and number.
    - b. Date.
    - c. Name of Engineer.
    - d. Name of Contractor.
    - e. Page number.

#### 1.5 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
  1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8½-by-11-inch (215-by-280 mm) paper.
  2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.
- D. Provide an electronic copy (.pdf) of the combined Warranty Documents tabbed and organized in the exact same manner as the paper binder copies.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Remove snow and ice to provide safe access.
    - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Leave Project clean and ready for use.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.



- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts or damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

**END OF SECTION 017700**

# PUNCH LIST

Project: City of Salisbury Water Treatment Plant Improvements  
Salisbury, North Carolina

From (A/E): LaBella Associates, PC

Site Visit Date: \_\_\_\_\_

To (Contractor): \_\_\_\_\_

A/E Project Number: 2191241

\_\_\_\_\_

Contract For: \_\_\_\_\_

The following items require the attention of the Contractor for completion or correction. This list may not be all-inclusive, and the failure to include any items on this list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Item Number	Room Number	Location (Area)	Description	Correction/Completion Date	Verification A/E Check
-------------	-------------	-----------------	-------------	----------------------------	------------------------

Attachments

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

Copies:  Owner  Consultants  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  File

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## SECTION 017823 – OPERATION AND MAINTENANCE DATA

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing and providing operation and maintenance manual data, including the following:
  - 1. Operation manuals for systems, subsystems, and equipment.
  - 2. Maintenance manuals for the care and maintenance of systems and equipment.
  - 3. Product maintenance manuals.
- B. Engineer will prepare Operation and Maintenance Manuals for Owner's use from manufacturer data supplied under this Section.

#### 1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

#### 1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic Portable Document Format (PDF) file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
  - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8½-by-11-inch (215-by-280 mm) paper, with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, subject matter of

contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
  - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
  - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

#### 1.4 SUBMITTALS

- A. Preliminary Submittal: At least 180 days before requesting inspection for Substantial Completion, submit a list of manuals to be provided. For each manual, identify Specification section(s), Drawing number(s), and equipment tag number(s) from Drawing / Specifications (or if no tag, use descriptive label), and manual type (operation, maintenance, product documentation, etc.). Organize list in order according to work area / equipment tag. Engineer will return one copy of list within 30 days, indicating any additional manual(s) required. Revise list and henceforward use revised list as a checklist for completion of Operation and Maintenance Data submittals. Include completed checklist with each submittal.
- B. Pre-Final Submittal: In a single submission, submit one hardcopy (if requested) of each manual in final form at least 120 days before final inspection, with identical digital copy in Portable Document Format (PDF). PDF file(s) shall be unsecured, or otherwise directly digitally modifiable for Engineer's purposes in incorporating into the overall Operation and Maintenance Manual for Owner's use. Name PDF files according to Drawing / Specification tag numbers, or descriptive label where tag numbers are not identified. Engineer will return digital copy with embedded comments within 30 days.
  1. Correct, modify, or augment each manual to comply with Engineer's comments. Submit modifiable PDF of each corrected manual within 30 days of receipt of Engineer's comments.
  2. If required, re-submit each manual (hardcopy if requested, and PDF) within 15 days of receipt of further comments until Engineer has approved as final.
- C. Final Submittal: If and as requested once submittal has been approved as final and within 15 days of request, in a single submission submit up to three hardcopies of each manual in final form, with identical digital copy in unsecured Portable Document Format (PDF), named as described above.

#### 1.5 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and provide these associated manuals in an assembled form.

## PART 2 - PRODUCTS

### 2.1 MANUALS, GENERAL

- A. Whether or not specified, provide manufacturers' standard owner's manual(s), operation manual(s), care and maintenance manual(s), and other standard product documentation and manual(s) for every item of maintainable products, materials and finishes and electrical, mechanical and instrumentation equipment provided under the Scope of the Project. Provide additional page(s) to meet requirements specified herein, which are not met in the manufacturer's standard documents.
- B. Where manuals contain manufacturers' standard printed data applying to a range of products, include only sheets pertinent to product or component installed. Mark individual sheets that describe multiple products to identify which product or component is incorporated into the Work. Delete or mask references to information not applicable. Strike-through inapplicable data only with Engineer's approval.
  - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- C. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials:
  - 1. Cover.
  - 2. Title page.
  - 3. Table of contents.
  - 4. Manual contents.
  - 5. Additional data.
- D. Provide additional sheet(s) for each item of equipment including the following, as applicable:
  - 1. Equipment or product designation, by tag number or other descriptive label if no tag number exists.
  - 2. Specification Section number(s) and Drawing number(s).
  - 3. Product name and model number.
  - 4. Manufacturer's name.
  - 5. Equipment identification with serial number including, where applicable, of each separately numbered component.
  - 6. Equipment or product function.
  - 7. Specified Operating characteristics, where applicable.
  - 8. List of associated manual(s) provided.
  - 9. Name, address, phone number, and other contact information for supplier's local service provider.
- E. Tables of Contents: Include a table of contents for each manual.
  - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- F. Additional Data: Include with PDF versions of submittals under this Section, the following items for inclusion in Operation and Maintenance Manuals, as applicable:
  - 1. Performance curves.

2. Engineering data and tests.
3. Complete nomenclature and number of spare and replacement parts.

## 2.2 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  1. Performance and design criteria if Contractor has delegated design responsibility.
  2. Operating standards.
  3. Operating procedures.
  4. Wiring diagrams.
  5. Control diagrams.
  6. Typical Piped system diagrams.
  7. Precautions against improper use.
- B. Operating Procedures: Include the following, as applicable:
  1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Required sequences for electric or electronic systems of a single supplier source.
  8. Special operating instructions and procedures.
- C. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed, where items are provided as a System.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals.
  1. Emergency Procedures: Include the following, as applicable:
    - a. Instructions on stopping.
    - b. Shutdown requirements and instructions for each type of emergency.
    - c. Operating instructions for conditions outside normal operating limits.
    - d. Required sequences for electric or electronic systems.
    - e. Special operating instructions and procedures.
- E. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  1. Include procedures to follow and required notifications for warranty claims.
  2. Indicate start date of warranty period.

## 2.3 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
  2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  3. Identification and nomenclature of parts and components.
  4. List of items recommended to be stocked as spare parts.
- C. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
  2. Troubleshooting guide.
  3. Precautions against improper maintenance.
  4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  5. Aligning, adjusting, and checking instructions.
  6. Demonstration and training video recording, if available. When provided, include digital copy (MPEG-4 video file format, .mp4, or other format with Engineer's prior approval.)
- D. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- E. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- F. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

## 2.4 PRODUCT MAINTENANCE MANUALS

- A. Content: Include for each product, material, and finish: product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Product Information: Include the following, as applicable:
1. Product name and model number.
  2. Manufacturer's name.
  3. Color, pattern, and texture.
  4. Material and chemical composition.
  5. Reordering information for specially manufactured products.
- C. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
  2. Types of cleaning agents to be used and methods of cleaning.
  3. List of cleaning agents and methods of cleaning detrimental to product.



4. Schedule for routine cleaning and maintenance.
  5. Repair instructions.
- D. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- E. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION (NOT USED)

**END OF SECTION 017823**

## SECTION 017839 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.

#### 1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Initial Submittal:
    - a. Submit PDF electronic files of scanned record prints and one paper-copy set of marked-up record prints.
    - b. Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
  - 2. Final Submittal: Make corrections and additions as directed and submit up to three hardcopies (as requested) and identical PDF of marked-up Record Drawings.
- B. Record Specifications: Submit one hardcopy (if requested) and identical PDF of marked-up Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal.
  - 1. Where Record Product Data is required as part of Operation and Maintenance Manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

### PART 2 - PRODUCTS

#### 2.1 RECORD DRAWINGS

- A. Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
  - 1. Preparation: Mark Record Drawings to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Drawings. Mark neatly and legibly.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an understandable drawing technique.
    - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Locations and depths of underground utilities.
    - d. Revisions to routing of piping and conduits.
    - e. Changes made by Change Order or Work Change Directive.
    - f. Changes made following Engineer's written orders.
    - g. Details not on the original Contract Drawings.
    - h. Field records for variable and concealed conditions.
    - i. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
  4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Identification as follows:
    - a. Project name and number.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Engineer.
    - e. Name of Contractor.

## 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
  5. Note related Change Orders and Record Drawings where applicable.
- B. Format: Submit record Specifications as a paper copy and a scanned PDF electronic file of the marked-up paper copy of Specifications.

## 2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
- B. Format: Submit record Product Data as a paper copy and a scanned PDF electronic file of the marked-up paper copy of Specifications.

## 2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

## PART 3 - EXECUTION

### 3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours.

**END OF SECTION 017839**

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## SECTION 017900 – DEMONSTRATION AND TRAINING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.

#### 1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
  - 1. Identification: On each copy, provide an applied label with the following information:
    - a. Name of Project.
    - b. Name and address of videographer.
    - c. Name of Owner.
    - d. Name of Engineer.
    - e. Name of Contractor.
    - f. Date of video recording.
  - 2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Also prepare in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
  - 3. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Division 01 Section "Operation and Maintenance Data."

## 1.4 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved operation and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Engineer.

## PART 2 - PRODUCTS

## PART 3 - EXECUTION

### 3.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
  - 1. For Basis of System Design, Operational Requirements, and Criteria, include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  - 2. For Documentation, review the following items in detail:
    - a. Systems and equipment operation manuals.
    - b. Systems and equipment maintenance manuals.
    - c. Product maintenance manuals.
    - d. Project Record Documents.
    - e. Identification systems.
    - f. Warranties and bonds.
    - g. Maintenance service agreements and similar continuing commitments.
  - 3. Emergencies: Include the following, as applicable:
    - a. Instructions on meaning of warnings, trouble indications, and error messages.
    - b. Instructions on stopping.
    - c. Shutdown instructions for each type of emergency.

- d. Operating instructions for conditions outside of normal operating limits.
- e. Sequences for electric or electronic systems.
- f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
  - a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning.
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

### 3.2 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.



### 3.3 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Schedule training with Owner, through Engineer with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

### 3.4 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
  - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode.
  - 1. Submit video recordings on CD-ROM or thumb drive.
  - 2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
  - 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
  - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
    - a. Name of Contractor/Installer.
    - b. Business address.
    - c. Business phone number.
    - d. Point of contact.
    - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
  - 1. Film training session(s) in segments not to exceed 15 minutes.
    - a. Produce segments to present a single significant piece of equipment per segment.
    - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.

- c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
  
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
  - 1. Furnish additional portable lighting as required.
  
- E. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

**END OF SECTION 017900**

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## SECTION 020800 - ASBESTOS ABATEMENT & DISPOSAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. The Asbestos Abatement Contractor, herein referred to as the Contractor, will be responsible for performing all work in strict accordance with the Project Documents and all governing codes, rules, and regulations. Where conflicts occur between the Project Documents and applicable codes, rules, and regulations, the more stringent shall apply. Unless otherwise expressly indicated, the requirements of this specification are solely the Contractor's responsibility.
- B. This Section references procedures for the removal of existing asbestos-containing materials (ACM) that will be disturbed or are disturbed during construction of this project.
- C. Furnish all labor, materials, supervision, construction tools and equipment necessary to remove and dispose of **all asbestos-containing materials** disturbed during construction.
- D. Asbestos-containing pipe insulation is present on piping in the filter building, and is labeled as Asbestos-Containing. The pipe shall be removed as part of the project.
- E. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all work to be performed as referenced in the Contract Documents. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the work.
- F. Any Contractor who requires the removal or disturbance of asbestos-containing material (ACM) to complete his work shall obtain the services of a licensed asbestos abatement contractor to remove the ACM in compliance with this specification and all applicable rules and regulations.
- G. The Owner's Representative shall approve the asbestos abatement contractor prior to the beginning of the work.
- H. Working hours shall be as required and approved by the Owner. The Contractor shall coordinate and schedule all Work with the facility and Owner's representative.
- I. Locations and quantities of all materials to be removed by the abatement contractor must be field verified. Information given on drawings and in the specifications is for general orientation and information only.
- J. The contractor shall have at least one supervisor on the job site at all times who can read and write and is fluent in English, while the project is in progress. The supervisor must be able to communicate fluently with all employees.
- K. Contractor shall provide temporary protection to keep the work areas enclosed, where required, during the performance of the Contract Work. The Contractor shall be responsible for any damage caused because of improper temporary protection.

- L. The Contractor is responsible for keeping the work area in a clean and safe condition at all times.
- M. Contractor is to coordinate with other trades on the job concerning scheduling, phasing, etc.

## 1.2 SPECIAL CONDITIONS

- A. Abatement will be required in locations of the Plant where areas immediately adjacent to the abatement work area will remain occupied and in service. The Contractor shall carefully observe regulatory requirements for the isolation of abatement work areas and appropriate notifications to occupants and signage at project area boundaries.
- B. Asbestos-containing pipe insulation and associated pipe to be removed and properly disposed of.

## 1.3 CODES AND REGULATIONS

- A. All Asbestos abatement work to be done under this contract shall be in compliance with all applicable Federal, State and Local regulations.
  - 1. General Applicability of Codes and Regulations and Standards
    - a. Except to the extent that more explicit or more stringent requirements are written directly into the Contract Documents, all applicable codes, regulations and standards have the same force and effect (and are made a part of the Contract Documents by reference) as if copied directly into the Contract Documents, or as if published copies are bound herewith.
  - 2. Contractor Responsibility
    - a. The Contractor shall assume full responsibility and liability for the compliance with all applicable Federal, State and local regulations pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site and persons occupying areas adjacent to the site. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable Federal, State and local regulations. The contractor shall hold the Owner and Owner's Representative harmless for failure to comply with any applicable work, hauling, disposal, safety, health or other regulation on the part of himself, his employees or his subcontractors.
  - 3. Federal Requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:
    - a. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), including but not limited to:
      - 1) Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite; Final Rules Title 29, Part 1926, Section 1101 of the Code of Federal Regulations
      - 2) Respiratory Protection
        - a) Title 29, Part 1910, Section 134 of the Code of Federal Regulations
      - 3) Access to Employee Exposure and Medical Records
        - a) Title 29, Part 1910, Section 2 of the Code of Federal Regulations
      - 4) Hazard Communication
        - a) Title 29, Part 1910, Section 1200 of the Code of Federal Regulations
    - b. U.S. Department of Transportation (DOT), including but not limited to:

- 1) Hazardous Substances
  - a) Title 29, Part 171 and 172 of the Code of Federal Regulations
  - c. U.S. Environmental Protection Agency (EPA), including but not limited to:
  - d. National Emission Standard for Hazardous Air Pollutants (NESHAPS)
  - e. National Emission Standard for Asbestos
    - 1) Title 40, Part 61, Subpart A, and revised Subpart M (Revised Subpart B) of the Code of Federal Regulations dated November 20, 1990
- B. State Requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:
  - 1. North Carolina Department of Health and Human Services Administrative Code 10A NCAC 41C .0601 Asbestos Hazard Management Program (AHMP).
  - 2. North Carolina Solid Waste Rules (10A NCAC 10G .0505) regarding waste collector and transportation requirements.
- C. Local Requirements
  - 1. Abide by all local requirements that govern asbestos abatement work or hauling and disposal of asbestos waste materials.

#### 1.4 SUBMITTALS

- A. A minimum of seven days prior to the commencement of any work involving the disturbance of ACM, the Contractor shall submit the following to the Owner's Representative for review and approval:
  - 1. Copy of current General Contractor's License.
  - 2. Copy of current asbestos specific liability insurance.
  - 3. Copy of required Removal Permit.
  - 4. Copies of required Project Notifications and proof of submittal (e.g. certified mail receipt).
  - 5. Copy of permit for waste hauler.
  - 6. Name and address of landfill where asbestos-containing waste materials are to be buried. Include contact person and telephone number, and permit number or other applicable permits.
  - 7. Site-specific work plan in accordance with Section 1.6.D.
  - 8. On a weekly basis, submit copies of all waste shipment records and disposal site receipts to the Owner.
- B. During the project, legible copies of the following items must be submitted to the Owner's Representative. If personnel records are not available at this time, workers will not be able to work on-site until copies are provided:
  - 1. Asbestos Worker Accreditation for all persons within the abatement work areas.
  - 2. Project Log Book entries.
  - 3. Any and all changes to the Contract, should any occur.
- C. Upon completion of the project, legible copies of the following items must be submitted to the Owner's Representative:
  - 1. Waste manifests, shipment records, and landfill receipts signed by the landfill operator submitted within 30 days after the waste leaves the site. All waste shipment records shall be submitted on the appropriate Asbestos Hazard Management Program form or an

equivalent. A percentage of the final payment will be withheld until the Owner or Owner's Representative receives copies of the waste shipment record.

## 1.5 QUALITY ASSURANCE

- A. Comply with the most recent edition of compilation of Codes, Rules and Regulations of the State of North Carolina.
- B. Comply with all current and appropriate Federal, State and Local rules and regulations regarding work of this section, including those of the following agencies. Comply with the applicable requirements of:
  - 1. ASSE A10.6 and NFPA 241
- C. Pre-Work Conference: Before the work of this section is scheduled to commence, a conference may be held at the site for the purpose of reviewing the Contract Documents, discussing requirements for the work and reviewing the work procedures. The asbestos abatement contractor shall attend the conference.
- D. Work Plan: The Contractor shall prepare a detailed work plan and submit the plan no later than one week prior to the start of the abatement project. The work plan shall include, but not be limited to:
  - 1. A preliminary schedule for completion of the work.
    - a. Show the complete sequence of abatement activities and the sequencing of Work within each building or building section.
    - b. Show the dates for the beginning and completion of each major element of Work including substantial completion dates for each Work Area, building, or phase.
  - 2. Work procedures that will be utilized (including anticipated decon and negative air exhaust locations).
  - 3. Estimated crew size.
  - 4. The anticipated work hours.
  - 5. Emergency procedures for fire and medical emergencies, and for failure of containment barriers.
  - 6. Project Notifications: As required by Federal and State regulatory agencies together with proof of transmittal (i.e. certified mail return receipt).
  - 7. Building Occupant Notification: As required by regulatory agencies.
  - 8. Abatement Work Plan
    - a. Provide plans that clearly indicate the following:
      - 1) All Work Areas/containments numbered sequentially.
      - 2) Locations and types of all decontamination enclosures.
      - 3) Entrances and exits to each Work Areas/containments.
      - 4) Type of abatement activity/technique for each Work Area/containment.
      - 5) Number and location of negative air units and exhaust. Also, provide calculations for determining number of negative air pressure units.
      - 6) Proposed location and construction of storage facilities and field office.
      - 7) Location of water and electrical connections to building services.
      - 8) Waste transport routes through the buildings to the waste storage container.
  - 9. Disposal Site/Landfill Permit from applicable regulatory agency.
  - 10. State Waste Transporter Permit.

- E. Progress Meetings: The Owner's Representative will hold general progress meetings as required. A representative of the Contractor and the Owner is to be properly represented at each meeting.
- F. Daily Log: The Contractor is to maintain within the Decontamination Unit a daily log documenting the dates and time of, but not limited to, the following items:
  - 1. Meetings; purpose, attendees, brief discussion
  - 2. Visitations; authorized and unauthorized
  - 3. Special or unusual events, i.e. barrier breeching, equipment failures, accidents
  - 4. Air monitoring tests and test results.
  - 5. Submit three (3) copies of this log at final closeout of the Project as a Project closeout submittal.
- G. Project Monitor: The Project Monitor shall be a representative of the Owner during the asbestos abatement portion of the project. The Project Monitor has the following responsibilities:
  - 1. The Project Monitor shall oversee work practices and inspect for compliance with all applicable regulations and standards, and the Contract Documents.
  - 2. The Project Monitor shall have at all times access to the work areas whenever it is in preparation or in progress. The Contractor shall provide the Project Monitor with keys to all locks located on the entrance(s) to the decontamination unit(s) and all other secured areas.
  - 3. The Project Monitor, in conjunction with the Owner, will be the interpreter of the requirements of the Contract Documents and the judge of the performance thereunder.
  - 4. The Project Monitor and/or the Owner will have the authority to reject work that is not in compliance with the requirements of the Contract Documents or Federal, State, or Local Regulations. The decision of the Owner will be final.
- H. Air Sampling and Analysis
  - 1. Area Air Sampling and Analysis
    - a. The Owner will be responsible where required for hiring an independent third party firm to perform required area air sampling and analysis in accordance with state and federal regulations.
    - b. The Contractor is required to ensure cooperation of its personnel with the Air Monitor for general air sampling, and testing of each work area after completion of asbestos work prior to removal of containment barriers.
    - c. All air samples shall be analyzed using appropriate methods as required by State and Federal regulations.
  - 2. Personal Air Sampling
    - a. As per the requirements of OSHA 1926.1101, the Contractor shall be required to perform personal air monitoring in order to determine that appropriate respiratory protection is being utilized.
    - b. The analysis of personal air samples shall be conducted by an accredited laboratory, subject to approval of the Owner or the Owner's Representative.
    - c. Results of personnel air sample analysis shall be available, verbally, within twenty-four (24) hours of sampling and shall be posted at the work site within 48 hours. Results shall be submitted in accordance with the requirements of Section 1.6 F.
  - 3. Final Clearance Air Sampling
    - a. When required, the clearance air monitoring shall be completed in accordance with 10A NCAC 41C .0607, results shall be considered satisfactory when samples demonstrate an airborne concentration that complies with 10A NCAC 41C .0607 (a).



- b. The Contractor shall pay for all additional costs incurred by the Owner, including additional air monitoring, project monitoring, engineering fees, and sample analysis required if clearance air monitoring fails, or if completion of abatement work is not in accordance with approved progress schedule.

## 1.6 GENERAL PROCEDURES

- A. Comply with Asbestos Hazard Management Program (AHMP) requirements for entry, exit, logging in, showering, personal protective equipment, tools, clothing, etc., throughout the asbestos abatement. Respiratory equipment shall be as required by OSHA and air monitoring results (Except for authorized visitors). Non-Licensed workers will not be allowed in the work area.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

- A. General Requirements: AHMP requirements for materials and equipment shall apply.
- B. Miscellaneous protective materials
  - 1. Provide plywood sheathing, hardboard, etc., as required to provide protective cover over surfaces of existing construction and finishes to eliminate damage resulting from work of this section, including impact and water damage. Poly shall comply with AHMP, including fire retardant requirements.
- C. Water and electricity shall be furnished by Owner without charge. The Contractor shall provide sufficient temporary electric power to complete the abatement project in a timely manner. The Contractor shall provide Ground Fault Circuit Interrupters (GFCI) located at the source for all electric requirements within the asbestos work area.
- D. Contractor shall provide an in-line backflow preventer at water source, and utilize non-leaking hoses.
- E. The Contractor shall supply the air monitor with sufficient temporary wiring and “weatherproof” receptacles to operate all high volume air monitoring pumps as may be required during the course of the project.

## PART 3 - EXECUTION

### 3.1 REMOVAL REQUIREMENTS

- A. Perform work under this contract in accordance with the standards referenced in Part 1 of this Section.

- B. Work that results in the disturbance of asbestos-containing materials shall be performed by a North Carolina licensed general contractor, licensed in the appropriate category, who employs accredited workers in accordance with all applicable standards referenced herein. If additional suspect ACM is discovered during the course of abatement, the Contractor shall notify the Owner or Owner's Representative immediately.
- C. The Contractor shall protect all items/existing construction intended to remain.
- D. Should the area beyond the asbestos work area(s) become contaminated with asbestos-containing dust or debris as a consequence of the work, immediately institute emergency procedures established for asbestos removal. All costs incurred in decontaminating such non-work areas shall be borne by the Contractor at no additional cost to the Owner.

### 3.2 WORK AREA PROTECTION

- A. AHMP requirements for general work area preparation shall apply, including vacating, signs, power, timing, HVAC isolation, isolation barriers, objects, exits, toilets, etc.

### 3.3 PERSONAL AND WASTE DECONTAMINATION ENCLOSURE SYSTEMS

- A. Comply with AHMP requirements for enclosure, showers, room types and configuration, etc.

### 3.4 DECONTAMINATION ENCLOSURE SYSTEMS/WORK AREA BARRIERS

- A. Comply with AHMP requirements for maintenance of work area barriers (setting, inspection, repairs, cleaning, etc.).
- B. Marked areas depicting work areas are approximate only. Exact cutoff points shall be coordinated by the Contractor with Owner's Representative.

### 3.5 HANDLING AND REMOVAL PROCEDURES

- A. Comply with AHMP requirements regarding handling and removal procedures.
- B. Dry removal or disturbance
  - 1. No dry removal or disturbance of asbestos materials shall be permitted.
- C. Wetting requirements
  - 1. The asbestos material shall be wetted as necessary with amended water to keep asbestos fibers from becoming airborne. If any friable material is encountered, all of its surfaces shall be saturated.
- D. Cleaning of surfaces
  - 1. After completion of all stripping work, surfaces where asbestos material has been removed or handled shall be HEPA vacuumed and wet wiped.

### 3.6 CLEANING PROCEDURES

- A. AHMP requirements for containerization, dust cleanup, tools and enclosure cleanup, etc., shall apply. Cleanup shall be by HEPA vacuum and wet wipe.
- B. Post-abatement requirements
  - 1. AHMP requirements shall apply (tool/equipment cleanup, general cleanup, waste removal, clearance air monitoring, etc.).

### 3.7 ASBESTOS WASTE TRANSPORTATION AND DISPOSAL

- A. Contractor shall transport and dispose of all asbestos waste material according to correct applicable state and federal transportation requirements.
- B. If any removed material is "friable", Contractor shall handle it as such and transport and dispose of as "friable" asbestos waste per regulations referenced in Part 1 of this Section.
- C. All waste generated as a result of this work shall be removed from the site within 10 days of completion.
- D. All loading, transportation, and disposal shall also comply with NESHAPS 40 CFR 61-150, Paragraphs C, D and E, including all requirements for loading signs, shipment records, content certificate, record receipts, notifications, etc.
- E. Maintain copies of shipping and disposal documents for submission to the Owner or Owner's Representative.
- F. All wastewater produced from the decontamination process or excess from the work area shall be passed through a 5-micron or smaller pore size filter designed for the removal of asbestos-containing particles from water prior to final disposal. Water disposal to sanitary sewer may require municipal approval and permitting, and is the responsibility of the Contractor.
- G. Coordinate the location of decons and ACM disposal dumpster will be between the Contractor and the Owner's Representative.
- H. It is the responsibility of the Contractor to determine current waste handling, transportation and disposal regulations for the work. The Contractor must dispose of all asbestos and other regulated materials removed and comply fully with all applicable federal, state, and local regulations.

### 3.8 TEMPORARY PROTECTION OF FACILITIES

- A. Contractor shall provide temporary enclosure as required to protect the existing facilities from adverse weather conditions and maintain the interior environment in its normal condition. The contractor shall maintain the building secure from intrusion at all times and exits shall be operational during construction whenever the building is occupied. Temporary door and window enclosures shall be secure, weather resistant and lockable, if operable.

### 3.9 RESTORATION

- A. Remove temporary decontamination facilities and restore area designated for these facilities to its original condition or better.
- B. After final clearance, the Contractor shall replace all filters of the associated portions of the existing building HVAC system that were affected by the abatement operations, remove locks and restore power. All temporary power supplies shall be disconnected, power lockouts removed and building power restored. All temporary plumbing shall be removed.
- C. Finishes damaged by asbestos removal operation including, but not limited to, plaster/paint damage due to taping of polyethylene sheeting and floor tile lifted due to humid conditions, shall be restored prior to final payment. Finishes unable to be restored shall be replaced under this Contract.

### 3.10 PROJECT COMPLETION REQUIREMENTS

- A. Submission by the Contractor to the Owner Representative of the daily logbook as described in Section 1.6.F.
- B. The Contractor's Project Manager(s) and the Owner's Representative will conduct an inspection of the work sites for substantial completion of the Scope of Work.
- C. If additional suspect ACM is discovered during the course of the work, the Contractor shall stop work and notify the Owner's Representative immediately.
- D. Submission by the Contractor to the Owner of the waste disposal documents verifying that all waste generated at the project site has been disposed of at an EPA approved waste site. A 10% payment retainage shall be withheld by the Owner until receipt of copies of all waste documents.

**END OF SECTION 020800**

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## SECTION 024119 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Demolition and removal of selected portions of building or structure.
  - 2. Demolition and removal of selected site elements.
  - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
  - 1. Division 01 Section "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
  - 2. Division 31 Section "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

#### 1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

#### 1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
  - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- D. Schedule of Selective Demolition Activities: Indicate the following:
  - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
  - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
  - 3. Coordination for shutoff, capping, and continuation of utility services.
  - 4. Use of elevator and stairs.
  - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- E. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces that might be misconstrued as damage caused by demolition operations. Submit before Work begins.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

#### 1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

#### 1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

- C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: Present in buildings and structures to be selectively demolished.
  - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
  - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
  - 3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

## 1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

## 1.9 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
  - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
  - 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
  - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

### 3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. Arrange to shut off utilities with utility companies.
  - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
  - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
  - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
  - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

### 3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
  1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

### 3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  5. Maintain fire watch during and for at least 2 hours after flame-cutting operations.
  6. Maintain adequate ventilation when using cutting torches.
  7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  10. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers.
  3. Store items in a secure area until delivery to Owner.
  4. Transport items to Owner's storage area on-site.
  5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least ¾-inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."
- F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.
  1. Remove existing roof membrane, flashings, copings, and roof accessories.
  2. Remove existing roofing system down to substrate.

### 3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
  1. Do not allow demolished materials to accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  4. Provide tickets or other documented proof of proper disposal of debris.
- B. Burning: Do not burn demolished materials.

### 3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

**END OF SECTION 024119**

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## SECTION 033000 – CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements: Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.
  - 1. Division 03 Section "Architectural Concrete" for general building applications of specially finished formed concrete.
  - 2. Division 31 Section "Earth Moving" as related to concrete work.
  - 3. Division 31 Section "Concrete Paving" for concrete pavement and walks.

#### 1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.
- C. Watertight Concrete: Concrete in which a liquid or gas will not flow freely through.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete Subcontractor.
    - e. Special concrete finish Subcontractor.
  - 2. Review testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
  - 1. Location of construction joints is subject to approval of the Engineer.
- E. Samples: For waterstops and vapor retarder.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Form materials and form-release agents.
  - 4. Steel reinforcement and accessories.
  - 5. Fiber reinforcement.
  - 6. Waterstops.
  - 7. Curing compounds.
  - 8. Floor and slab treatments.
  - 9. Bonding agents.
  - 10. Adhesives.
  - 11. Vapor retarders.
  - 12. Semirigid joint filler.
  - 13. Joint-filler strips.
  - 14. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency:
  - 1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.
  - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

- F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
  - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
  - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.
- E. Mockups: Cast concrete formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
  - 1. Build panel approximately 100 sq. ft. (9.3 sq. m) for formed surface Insert area in the location indicated or, if not indicated, as directed by Engineer.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.



## 1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When average high and low temperature is expected to fall below 40°F (4.4°C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
  - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows:
  - 1. Maintain concrete temperature below 90° F (32°C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301 (ACI 301M).
  - 2. ACI 350 (ACI 350M).
  - 3. ACI 117 (ACI 117M).

### 2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Plywood, metal, or other approved panel materials.
  - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
  - 3. Overlaid Finnish birch plywood.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding

specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- F. Chamfer Strips: Wood, metal, PVC, or rubber strips,  $\frac{3}{4}$ - by  $\frac{3}{4}$ - inch (19 by 19 mm), minimum.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish ties that, when removed, leave holes no larger than 1-inch (25 mm) in diameter in concrete surface.

## 2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, assembled with clips.
- D. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.
- E. Deformed-Steel Wire: ASTM A 1064/A 1064M.
- F. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- G. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

## 2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel

wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

## 2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
1. Portland Cement: ASTM C 150/C 150M, Type I/II, gray.
  2. Fly Ash: ASTM C 618, Class F.
  3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
  4. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4S coarse aggregate or better, graded. Provide aggregates from a single source.
1. Maximum Coarse-Aggregate Size: 1½-inches (38 mm) for slabs on grade, 1-inch (25 mm) nominal for all other locations.
  2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C 260/C 260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- F. Crystalline Waterproofing Admixture: Concrete waterproofing and protection system shall be of the crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure within the pores and capillary tracts of the concrete. This crystalline system causes the concrete to become sealed against the penetration of liquids from any direction, and protects the concrete from deterioration due to harsh environmental conditions. The system is used for above or below-grade walls and slabs, including liquid retaining structures and where enhanced chemical resistance is required.
1. Permeability 1: Independent testing shall be performed according to a U.S. Army Corps of Engineers CRD-C48 (Mod.) "Permeability of Concrete". Concrete samples shall be pressure tested to 150 psi (350 foot head of water) or 1.05 MPa (106 m head of water). After 5 days the untreated samples shall leak and the treated samples shall exhibit no measurable leakage.
- G. Water: ASTM C 94/C 94M and potable.

## 2.6 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers (containing no reprocessed olefin materials) engineered and designed for use as secondary reinforcing in concrete, complying with ASTM C 1116/C 1116M, Type III, 1¼- to 2¼-inches (25 to 57 mm) long, varying fiber thickness, and no water absorption.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. 3M; Scotchcast Polyolefin Fibers 2”.
    - b. BASF Construction Chemicals, “MasterFiber MAC” Series
    - c. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
    - d. FORTA Corporation; FORTA FERRO.
    - e. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
    - f. Nycon, Inc.; XL.
    - g. Propex Concrete Systems Corp.; Fibermesh 650.
    - h. Sika Corporation; Sika Fiber MS10.

## 2.7 WATERSTOPS

- A. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.
1. Available 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. JP Specialties, Inc.
    - b. Sika Corporation.
    - c. BoMetals, Inc.
  2. Profile: Ribbed with center bulb.
  3. Dimensions: 6- by 3/16-inch thick (150 mm by 4.75 mm thick); nontapered.

## 2.8 VAPOR RETARDERS

- A. Sheet Vapor Barrier at building slabs with adhered finishes: ASTM E 1745, Class A, except with maximum water-vapor permeance of less than 0.015 perms (gr/ft<sup>2</sup>/hr/in-Hg). Include manufacturer's recommended adhesive and/or pressure-sensitive tape.
1. Available Products: Subject to compliance with requirements, provide one of the following:
    - a. Layfield Construction Materials; VaporFlex 15.
    - b. Reef Industries, Inc.; Griffolyn Vaporguard.
    - c. Stego Industries, LLC; Stego Wrap 15 mil Class A.
- B. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick.

## 2.9 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50% aluminum oxide and not less than 20% ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100% passing No. 4 (4.75-mm) sieve.

## 2.10 SEALED CONCRETE

- A. Sealer: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
  - 1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ChemMasters; Chemisil Plus.
    - b. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
    - c. Edoco by Dayton Superior; Titan Hard.
    - d. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
    - e. Kaufman Products, Inc.; SureHard.
    - f. L&M Construction Chemicals, Inc.; Seal Hard.
    - g. Meadows, W. R., Inc.; LIQUI-HARD.
    - h. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.

## 2.11 STAIN MATERIALS

- A. Reactive Stain: Acidic-based stain with wetting agents and high-grade, UV-stable metallic salts that react with calcium hydroxide in cured concrete to produce permanent, variegated, or translucent color effects.
  - 1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. H & C Infusion, H&C Decorative Concrete Products, Cleveland, OH.
    - b. Lithochrome Chemstain Classic, L.M. Scofield Co., Douglasville, GA.

## 2.12 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
  - 1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation-Construction Systems.

- b. ChemMasters, Inc.
- c. Dayton Superior.
- d. Euclid Chemical Company (The); an RPM company.

## 2.13 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Slab Control Joint Sealer at Stained floor finish locations: One-component, self-leveling, flexible, polyurethane with a Type A shore durometer hardness of 80 per ASTM D 2240, conforming to ACI 302.1R (5.12-Joint Materials) and the ability to color.
  - 1. Color: to be selected by Engineer.
- A. Slab Control Joint Sealer at all other non-water retention structure locations: Two-component, self-leveling, flexible, 100% solids, epoxy resin and adhesive with a Type A shore durometer hardness of 80 per ASTM D 2240 and conforming to ACI 302.1R (5.12-Joint Materials).
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Chem Masters; PolyTops 480.
    - b. Euclid Chemical Company (The); Euco 800.
    - c. Sika Corporation; Sikadur 51 SL.
- B. Joint Sealer at water-retaining structure locations: provide sealant per typical details and Joint Sealant specification.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
  - 1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034-inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

## 2.14 REPAIR UNDERLAYMENT OR OVERLAYMENT MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8-inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8-to 1/4-inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4,100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from ¼-inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8- to ¼-inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
  4. Compressive Strength: Not less than 5,000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- C. Crack injection repair for watertight concrete structures: Epoxy injection of cracked concrete structures with epoxy resin adhesive using manual pressure injection method. Provide 2 component injection system and associated gel for sealing with the following properties:
1. Tensile Strength, Minimum: 7,100 psi (50.4 MPa), per ASTM D 638.
  2. Elongation: 2.3% per ASTM D 638.
  3. Compressive Strength, Minimum (7 Days): 12,300 psi (84.8 MPa), per ASTM D 695.
  4. Compressive Modulus of Elasticity (28 Days): 250,000 psi (1,724 MPa) per ASTM D 695.
  5. Flexural Strength (14 Days): 8,600 psi (59.3 MPa) minimum, per ASTM D 790.
  6. Bond Strength, 2 Days Dry Cure (Hardened Concrete to Hardened Concrete): 2,380 psi (26.4 MPa) per ASTM C 882.
  7. Bond Strength, 14 Days Wet Cure (Hardened Concrete to Hardened Concrete): 4,000 psi (27.6 MPa) per ASTM C 882.
  8. Water Absorption (24 Hour Immersion): 0.84% per ASTM D 570.
  9. Conform to ASTM C 881, Type I, II, IV, V, Grade 1, Classes B and C.

## 2.15 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- A. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 25%.
  2. Combined Fly Ash and Pozzolan: 25%.
  3. Slag Cement: 50%.
  4. Combined Fly Ash or Pozzolan and Slag Cement: 50% portland cement minimum, with fly ash or pozzolan not exceeding 25%.
  5. Silica Fume: 10%.
  6. Combined Fly Ash, Pozzolans, and Silica Fume: 35% with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10%.
  7. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50% with fly ash or pozzolans not exceeding 25% and silica fume not exceeding 10%.

- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.30% by weight of cement.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
  1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
  2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

## 2.16 CONCRETE MIXTURES FOR BUILDING AND TANK ELEMENTS

- A. Foundation footings and walls, building walls and frame members: Normal-weight concrete.
  1. Minimum Compressive Strength: 4,000 psi at 28 days.
  2. Maximum W/C Ratio: 0.50.
  3. Minimum Cementitious Materials Content: 470 lb/cu. yd..
  4. Slump Limit: 8-inches for concrete with verified slump of 2- to 4-inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1-inch.
  5. Air Content: 4.5%, plus or minus 1.5% at point of delivery for 1-inch nominal maximum aggregate size.
- B. Slabs-on-Grade: Normal-weight concrete.
  1. Minimum Compressive Strength: 4,000 psi at 28 days.
  2. Maximum W/C Ratio: 0.50.
  3. Minimum Cementitious Materials Content: 470 lb/cu. yd..
  4. Slump Limit: 4-inches, plus or minus 1-inch.
  5. Air Content: 4.5%, plus or minus 1.5% at point of delivery for 1-inch nominal maximum aggregate size.
  6. Air Content: Do not allow air content of trowel-finished floors to exceed 3%.
  7. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture, at concrete batch facility, at manufacturer's recommended rate, but not less than 3.0 lb/cu. yd. (2.4 kg/cu. m).
- C. Tank walls and floors, Mat Slab: Normal-weight concrete.
  1. Minimum Compressive Strength: 4,500 psi at 28 days.
  2. Maximum W/C Ratio: 0.450.
  3. Minimum Cementitious Materials Content: 535 lb/cu. yd..
  4. Slump Limit: 8-inches for concrete with verified slump of 2- to 4-inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1-inch.
  5. Air Content: 6% percent, plus or minus 1.5% percent at point of delivery for 1-inch nominal maximum aggregate size.
  6. Admixture: Provide Crystalline Waterproofing Admixture at all tank locations.
  7. Fiber Reinforcement
    - a. Sludge Mixing Tank
      - 1) Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.5 lb/cu. yd. (0.90 kg/cu. m)
    - b. Existing Filters



- 1) Synthetic Macro-Fiber: Uniformly disperse in concrete mixture, at concrete batch facility, at manufacturer's recommended rate, but not less than 3.0 lb/cu. yd. (2.4 kg/cu. m).

## 2.17 CONCRETE MIXTURES FOR EXTERIOR CONCRETE

- A. Exterior Concrete Elements And Retaining Walls: Proportion normal-weight concrete mixture as follows:
  1. Minimum Compressive Strength: 4,500 psi (31 MPa) at 28 days.
  2. Maximum Water-Cementitious Materials Ratio: 0.45.
  3. Slump Limit: 4-inches, (100 mm) plus or minus 1-inch (25 mm); or 8-inches (200 mm) for concrete with verified slump of 2- to 4-inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1-inch (25 mm).
  4. Air Content: 6%, plus or minus 1.5% at point of delivery for 1-inch (25 mm) nominal maximum aggregate size.
- B. Exterior Slabs (concrete pads, walks and curbs): Proportion normal-weight concrete mixture as follows:
  1. Minimum Compressive Strength: 4,500 psi (31 MPa) at 28 days.
  2. Maximum Water-Cementitious Materials Ratio: 0.45.
  3. Slump Limit: 4 inches, (100 mm) plus or minus 1-inch (25 mm); or 8-inches (200 mm) for concrete with verified slump of 2- to 4-inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1-inch (25 mm).
  4. Air Content: 5.5%, plus or minus 1.5% at point of delivery for 1½-inch (38 mm) nominal maximum aggregate size.
  5. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture, at concrete batch facility, at manufacturer's recommended rate, but not less than 3.0 lb/cu. yd. (2.4 kg/cu. m).

## 2.18 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.19 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
  1. When air temperature is between 85 and 90°F (30 and 32°C), reduce mixing and delivery time from 1½ hours to 75 minutes; when air temperature is above 90°F (32°C), reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
  1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1½ minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

## PART 3 - EXECUTION

### 3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M).
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
  1. Class A, 1/8-inch (3.2 mm) for smooth-formed finished surfaces.
  2. Class B, 1/4-inch (6 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  1. Install keyways, reglets, recesses, and the like, for easy removal.
  2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
  - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
  - 3. Install dovetail anchor slots in concrete structures as indicated.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50°F (10°C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70% of its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

### 3.4 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 (ACI 318M) and ACI 301 (ACI 301M) for design, installation, and removal of shoring and reshoring.
  - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### 3.5 VAPOR-RETARDER/BARRIER INSTALLATION

- A. Sheet Vapor Retarder/Barriers: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Lap joints 6-inches (150 mm) and seal with manufacturer's recommended tape.

### 3.6 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

### 3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 2. Form keyed joints as indicated. Embed keys at least 1½-inches (38 mm) into concrete.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 8. All joints in watertight structures require waterstops.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8-inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2 mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
  2. Terminate full-width joint-filler strips not less than ½-inch (13 mm) or more than 1-inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.8 WATERSTOP INSTALLATION

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

### 3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
  2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).
  3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6-inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of

concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 2. Maintain reinforcement in position on chairs during concrete placement.
  - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 4. Slope surfaces uniformly to drains where required.
  - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

### 3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces not exposed to public view.
- B. Architectural Concrete finishes, refer to specification Division 03 Section "Architectural Concrete".
  - 1. Apply to all concrete surfaces exposed to public view.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of ¼-inch (6 mm) in one direction.
  - 1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces to receive trowel finish.

- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighthen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
  - 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
    - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.
  - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and any exterior walking surface.
  - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

### 3.12 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
  - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  - 2. Construct concrete bases 6-inches (150 mm) high unless otherwise indicated, and extend base not less than 6-inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
  - 3. Minimum Compressive Strength: 4,000 psi (27.6 MPa) at 28 days.
  - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450 mm) centers around the full perimeter of concrete base.
  - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
  - 6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

### 3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 (ACI 301M) for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water, continuous water-fog spray or absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300 mm) lap over adjacent absorptive covers.
    - b. All watertight structures to be moisture cured.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12-inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
  3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.



- a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.14 JOINT FILLING

- A. Prepare, clean, and install joint sealant according to manufacturer's written instructions and as indicated in the contract documents.
  1. Defer installation of joint sealant until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

### 3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2½ parts fine aggregate passing a No. 16 (1.18 mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than ½-inch (13 mm) in any dimension to solid concrete. Limit cut depth to ¾-inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01-inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  2. After concrete has cured at least 14 days, correct high areas by grinding.
  3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4-inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1-inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1-inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

### 3.16 WATERTIGHT CONCRETE LEAK REPAIRS

- A. Leaking concrete: Follow manufacturer's recommendations for activating crystalline waterproofing admixture as well as testing procedures for leaks to meet manufacturer's warranty requirements.
- B. Defective Concrete: Repair and patch defective areas that fail to pass the leak test criteria with crack injection and concrete patch material as noted above. Follow manufacturer's recommendations for installation. Concrete that cannot be repaired shall be removed and replaced.

### 3.17 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections
  - 1. Steel reinforcement placement.
  - 2. Steel reinforcement welding.
  - 3. Headed bolts and studs.
  - 4. Verification of use of required design mixture.
  - 5. Concrete placement, including conveying and depositing.
  - 6. Curing procedures and maintenance of curing temperature.
  - 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
  - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
  - 2. Testing Frequency: Obtain at least one composite sample for each 50 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  - 3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  - 4. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - 5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40°F (4.4°C) and below or 80°F (27°C) and above, and one test for each composite sample.
  - 6. Compression Test Specimens: ASTM C 31/C 31M.
    - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    - b. Cast and field cure an additional two sets of two standard cylinder specimens for each composite sample.
  - 7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
  - 8. When strength of field-cured cylinders is less than 85% of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
  - 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength

and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

10. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
  11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
  12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
  13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Leak Test: Testing of all watertight structures shall be tested according to ACI 350.1-10 Tightness Testing of Environmental Engineering Concrete Containment Structures.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

**END OF SECTION 033000**

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## SECTION 033300 – ARCHITECTURAL CONCRETE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes cast-in-place architectural concrete, including form facings, reinforcement and accessories, concrete materials, concrete mixture design, placement procedures, and finishes.
  - 1. Requirements in Division 03 Section "Cast-in-Place Concrete" apply to architectural concrete.
- B. Related Requirements:
  - 1. Division 03 Section "Cast-in-Place Concrete" for concrete not designated as architectural concrete.

#### 1.2 DEFINITIONS

- A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.
- D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.
- E. W/C Ratio: The ratio by weight of water to cementitious materials.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Formwork Shop Drawings: Show formwork construction, including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

- D. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints, including construction joints.
- E. Samples: For each of the following materials:
  - 1. Form-facing panels.
  - 2. Form ties.
  - 3. Form liners.
  - 4. Exposed aggregates.
  - 5. Coarse- and fine-aggregate gradations.
  - 6. Chamfers and rustications.
- F. Samples for Verification: Architectural concrete Samples, cast vertically, approximately 18- by 18- by 2-inches, of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Form materials and form-release agents.
  - 4. Repair materials.
- C. Material Test Reports: For the following, by a qualified testing agency:
  - 1. Aggregates.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
  - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
  - 2. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- C. Field Sample Panels: After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, cast vertically,

approximately 48- by 48- by 6-inches minimum, to demonstrate the expected range of finish, color, and texture variations.

1. Locate panels as indicated or, if not indicated, as directed by Architect.
2. Demonstrate methods of curing, aggregate exposure, sealers, and coatings, as applicable.
3. In presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
4. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
5. Demolish and remove field sample panels when directed.

D. Mockups: Before casting architectural concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Build mockups of typical exterior wall of cast-in-place architectural concrete as shown on Drawings.
3. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
4. In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
5. Obtain Architect's approval of mockups before casting architectural concrete.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

## 1.7 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40°F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
4. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.

B. Hot-Weather Placement: Comply with ACI 301 and as follows:



1. Maintain concrete temperature below 90°F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  1. ACI 301.
  2. ACI 303.1.

### 2.2 FORM-FACING MATERIALS

- A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for formwork and other form-facing material requirements.
- B. Source Limitations: Obtain each type form-facing material from single source from single manufacturer.
- C. Form-Facing Panels for As-Cast Finishes: Exterior-grade plywood panels, nonabsorptive, that will provide continuous, true, and smooth architectural concrete surfaces, medium-density overlay, Class 1, or better, mill-applied release agent and edge sealed, complying with DOC PS 1.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Rustication Strips: Metal, dressed wood, or rigid plastic, or with sides beveled and back kerfed; nonstaining; in longest practicable lengths.
- F. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4- by 3/4-inch, minimum; nonstaining; in longest practicable lengths.
- G. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800; minimum 1/4-inch thick.
- H. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or Type S, Grade NS, that adheres to form joint substrates.
- I. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.
- J. Form-Release Agent: Commercially formulated, colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- K. Form Ties: Factory-fabricated, internally disconnecting ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish ties with tapered tie cone spreaders that, when removed, will leave holes 1½-inches in diameter on concrete surface.

## 2.3 STEEL REINFORCEMENT AND ACCESSORIES

- A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufactured according to CRSI's "Manual of Standard Practice."
1. Where legs of wire bar supports contact forms, use gray, all-plastic bar supports.

## 2.4 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
1. Portland Cement: ASTM C 150/C 150M, Type I/II, gray.
  2. Fly Ash: ASTM C 618, Class F.
  3. Slag Cement: ASTM C 989/C 989M, Grade 100 or Grade 120.
  4. Silica Fume: ASTM C 1240 amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 5S coarse aggregate or better, graded. Provide aggregates from single source.
1. Maximum Coarse-Aggregate Size: 1-inch.
  2. Gradation: Uniformly graded.
- D. Normal-Weight Fine Aggregate: ASTM C 33/C 33M or ASTM C 144, manufactured or natural sand, from same source for entire Project.
- E. Air-Entraining Admixture: ASTM C 260/C 260M.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that does not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

- G. Water: Potable, complying with ASTM C 94/C 94M, except free of wash water from mixer washout operations.

## 2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
  - 1. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

## 2.6 REPAIR MATERIALS

- A. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C 881/C 881M two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.
  - 1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.7 CONCRETE MIXTURES

- A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.
- B. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.
- C. Cementitious Materials: For cast-in-place architectural concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- E. Admixtures: Use admixtures according to manufacturer's written instructions.
- F. Concrete Mixtures:
  - 1. Requirements in Division 03 Section "Cast-in-Place Concrete".

## 2.8 CONCRETE MIXING

- A. Ready-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
  - 1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
  - 2. When air temperature is between 85°F and 90°F, reduce mixing and delivery time from 1½ hours to 75 minutes; when air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 FORMWORK INSTALLATION

- A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for formwork, embedded items, and shoring and reshoring.
- B. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.
- C. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
  - 1. Class A, 1/8-inch.
- D. Construct forms to result in cast-in-place architectural concrete that complies with ACI 117 (ASI 117M).
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.
  - 1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
  - 2. Do not use rust-stained steel form-facing material.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exterior corners and edges of cast-in-place architectural concrete with ½" minimum chamfer.
- H. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- M. Coat contact surfaces of forms with surface retarder, according to manufacturer's written instructions, before placing reinforcement.
- N. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form-liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

### 3.2 REINFORCEMENT AND INSERT INSTALLATION

- A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.
- B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

### 3.3 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50°F for 24 hours after placing concrete if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
  - 1. Schedule form removal to maintain surface appearance that matches approved mockups.
  - 2. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.
- B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70% of 28 day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

### 3.4 JOINTS

- A. Construction Joints: Install construction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
  2. Form keyed joints as indicated. Embed keys at least 1½-inches into concrete. Align construction joint within rustications attached to form-facing material.
  3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  6. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- B. Contraction Joints: Form weakened-plane contraction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

### 3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
  3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6-inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.

### 3.6 FINISHES, GENERAL

- A. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.

1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.
- C. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

### 3.7 AS-CAST FORMED FINISHES

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Repair and patch tie holes and defects.
1. Provide at internal surfaces of tank structures.
- B. Rubbed Finish: Apply the following to smooth-form-finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
    - a. Provide at all exposed to view locations except as noted otherwise.

### 3.8 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.
- B. Begin curing cast-in-place architectural concrete immediately after removing forms from concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12-inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
  3. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

### 3.9 FIELD QUALITY CONTROL

- A. General: Comply with field quality-control requirements in Division 03 Section "Cast-in-Place Concrete."

### 3.10 REPAIR, PROTECTION, AND CLEANING

- A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
  - 1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.
- B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
- C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.
- D. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
- E. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.
  - 1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

**END OF SECTION 033300**



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## **042000 – UNIT MASONRY**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Concrete masonry units.
  - 2. Face brick.
  - 3. Building (common) brick.
  - 4. Mortar and grout.
  - 5. Steel reinforcing bars.
  - 6. Masonry joint reinforcement.
  - 7. Ties and anchors.
  - 8. Embedded flashing.
  - 9. Miscellaneous masonry accessories.
  
- B. Products Installed but not Furnished under This Section:
  - 1. Cast-stone trim in unit masonry.
  - 2. Steel lintels in unit masonry.
  - 3. Steel shelf angles for supporting unit masonry.
  - 4. Cavity wall insulation.

#### **1.2 DEFINITIONS**

- A. CMU(s): Concrete masonry unit(s).
  
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### **1.3 SUBMITTALS, GENERAL**

- A. General: Submit all action submittals (except Samples for Verification) and informational submittals required by this Section concurrently.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
  - 1. CMUs.
  - 2. Face brick.
  - 3. Building (common) brick.
  - 4. Portland cement.
  - 5. Hydrated lime.
  - 6. Portland cement-lime mix.
  - 7. Aggregate for mortar.
  - 8. Aggregate for grout.
  - 9. Masonry joint reinforcement for single-wythe masonry.

10. Masonry joint reinforcement for multiwythe masonry.
11. Individual wire ties.
12. Adjustable anchors for connecting to structural steel framing.
13. Adjustable anchors for connecting to structural steel columns at isolated pilasters.
14. Adjustable anchors for connecting to concrete.
15. Joint stabilization anchors.
16. Wire mesh ties.
17. Adjustable masonry-veneer anchors.
18. Flexible flashing.
19. Termination bars.
20. Compressible filler.
21. Preformed control-joint gaskets.
22. Bond-breaker strips.
23. Weep/vent products.
24. Cavity drainage material.
25. Reinforcing bar positioners.
26. Proprietary acidic cleaner.

B. Shop Drawings: For the following:

1. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls. Show all anchorage and top-of-wall wind clips.
2. Concrete Masonry Control Joint Layout Plans: Submit plans, at minimum 1/8 inch = 1 foot scale, showing all concrete masonry control joint locations.
  - a. For each joint indicate type of control joint; i.e. at columns indicate if joint is provided by the masonry grouted into the column web, or by a joint-stabilization anchor.
  - b. Indicate control joint location and type in accordance with the typical masonry plan details shown on the Drawings and as specified.

C. Samples for Initial Selection:

1. Face brick, in the form of portable display panels.
2. Colored mortar.

D. Samples for Verification: For each type and color of the following:

1. Face brick, in the form of straps of five or more bricks.
2. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.
  - a. Include material test reports substantiating compliance with requirements.
  - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
  - c. For exposed brick, include test report for efflorescence according to ASTM C 67.

- d. For masonry units, include data and calculations establishing average net-area compressive strength of units.
  2. Cementitious materials. Include name of manufacturer, brand name, and type.
  3. Mortar Admixtures.
  4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  5. Grout mixes. Include description of type and proportions of ingredients.
  6. Reinforcing bars.
  7. Joint reinforcement.
  8. Anchors, ties, and metal accessories.
- C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
  2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects.
1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48-inches long by 48-inches high.
  2. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
  3. Clean one-half of exposed faces of panels with masonry cleaner indicated.
  4. Protect approved sample panels from the elements with weather-resistant membrane.
  5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
    - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.
1. Build mockup of typical wall area as shown on Drawings.
  2. Build mockups for typical exterior wall in sizes approximately 60-inches long by 48-inches high by full thickness, including face and backup wythes and accessories.
    - a. Include metal studs, sheathing, air barrier, veneer anchors, and flashing in exterior masonry-veneer wall mockup.
  3. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
  4. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.

5. Protect accepted mockups from the elements with weather-resistant membrane.
6. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
  - a. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.

D. Preinstallation Conference: Conduct conference at Project site.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms; in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

#### 1.8 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  1. Extend cover a minimum of 24-inches down both sides of walls and hold cover securely in place.
  2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24-inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## PART 2 - PRODUCTS

### 2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20-feet (6 m) vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

### 2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  2. Provide bullnose units for exposed outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.
  1. Density Classification: Lightweight unless otherwise indicated.
  2. Size (Width): Manufactured to dimensions 3/8-inch less than nominal dimensions.
  3. Exposed Faces: Provide fine texture units suitable for painting.
  4. Faces To Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

## 2.3 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
  - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
  - 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
  - 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: Facing brick complying with ASTM C 216.
  - 1. Grade: MW or SW.
  - 2. Type: FBS.
  - 3. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
  - 4. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
  - 5. Size (Actual Dimensions): 3-5/8-inches wide by 2¼-inches high by 7-5/8-inches long.
  - 6. Application: Use where brick is exposed unless otherwise indicated.
  - 7. Color and Texture: As selected by Architect.
- C. Building (Common) Brick: ASTM C 62, Grade MW or SW.
  - 1. Size: Match size of face brick.
  - 2. Application: Use where brick is indicated for concealed locations.

## 2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150/C 150 M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
  - 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Aggregate for Mortar: ASTM C 144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  - 2. For joints less than ¼-inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
  - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
  - 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

- E. Aggregate for Grout: ASTM C 404.
- F. Water: Potable.

## 2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
    - b. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
    - c. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
- D. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
  - 1. Interior Walls: Mill- galvanized, carbon steel.
  - 2. Exterior Walls: Hot-dip galvanized carbon steel.
  - 3. Wire Size for Side Rods: 0.148-inch diameter.
  - 4. Wire Size for Cross Rods: 0.148-inch diameter.
  - 5. Wire Size for Veneer Ties: 0.187-inch diameter.
  - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
  - 7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- E. Masonry Joint Reinforcement for Single-Wythe Masonry: Truss type with single pair of side rods.
  - 1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hohmann & Barnard, Inc.; #120 Truss-Mesh Reinforcement.
    - b. Wire-Bond; Series 300 Truss 2 Wire Mesh Reinforcement.
- F. Masonry Joint Reinforcement for Multiwythe Masonry:
  - 1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hohmann & Barnard, Inc.; #170 Lox-All Truss Adjustable Eye-Wire.
    - b. Wire-Bond; Series 900 Level Eye Truss (Hook and Eye).
  - 2. Adjustable (two-piece) type, truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16-inch and maximum vertical adjustment of 1/4-inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.



## 2.6 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1½-inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 641/A 641M, Class 1 coating.
  2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
  3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
  4. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4-inches wide.
1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Heckmann Building Products, Inc.; #262/263 Double Eye Rod Anchor and Double Pintle Tie.
    - b. Hohman & Barnard, Inc.; Adjustable Wall Tie.
    - c. Wire-Bond; Adjustable Rectangular Tie 1800/1801.
  2. Where wythes do not align or are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1¼-inches.
  3. Wire: Fabricate from 3/16-inch-diameter, hot-dip galvanized steel wire.
- D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hohmann & Barnard, Inc.; #359-C Weld-On Tie with Vee Byna-Tie.
    - b. Wire-Bond; Type I Weld-On Anchor with Triangular Tie 1100.
  2. Anchor Section for Welding to Steel Frame: Crimped minimum ¼-inch diameter, hot-dip galvanized steel wire.
  3. Tie Section: Triangular-shaped wire tie made from 0.187-inch diameter, hot-dip galvanized steel wire.
- E. Adjustable Anchors for Connecting to Structural Steel Columns at Isolated Pilasters: Provide anchors that allow vertical adjustment.
1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Heckmann Building Products Inc.; #103-C Dovetail Triangular Veneer Anchor.
    - b. Hohmann & Barnard, Inc.; #345-BT Flexible Tie.
    - c. Wire-Bond; Dovetail Triangular Tie 2102.
  2. Anchor Section: Tab formed from 0.105-inch-thick, hot-dip galvanized steel sheet.
  3. Tie Section: Triangular-shaped wire tie, sized to extend within 1-inch of masonry face, made from 0.187-inch diameter, hot-dip galvanized steel wire.
- F. Adjustable Anchors for Veneer Connecting to Concrete: Provide anchors that allow vertical or

- G. Joint Stabilization Anchors: Provide anchors allowing lateral movement, made from hot-dip galvanized steel.
  - 1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Heckmann Building Products Inc.; #353 Debonded Shear Anchor.
    - b. Hohmann & Barnard, Inc.; Slip-Set Stabilizer.
    - c. Wire-Bond; #1700 Control Joint Anchor.
  
- H. Adjustable Masonry-Veneer Anchors for use at CFMF/Metal Stud backup:
  - 1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16-inch.
  - 2. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed washer head that covers hole in sheathing.
    - a. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Heckmann Building Products Inc.; Pos-I-Tie with Pos-I-Tie ThermalClip and Double Pintle Wire Tie.
      - 2) Hohmann & Barnard, Inc.; 2-Seal Thermal Wing Nut AnchorTie with Adjustable Wall Tie (pintle).
      - 3) Wire-Bond; SureTie 4520 and SureTie triangle 4510.
    - b. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch diameter, hot-dip galvanized steel wire.

## 2.7 EMBEDDED FLASHING MATERIALS

- A. Flexible Flashing: Use the following unless otherwise indicated:
  - 1. Copper-Laminated Flashing: 5-oz./sq. ft. copper sheet bonded between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
    - a. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Advanced Building Products Inc.; Copper Sealtite 2000.
      - 2) York Manufacturing, Inc.; Multi-Flash 500.
  
- B. Termination Bars: Stainless steel bar 1/8-inch by minimum 1-inch, for attachment at 8-inch centers with stainless steel fasteners.
  - 1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dayton Superior Corporation, Dur-O-Wal Division; DA1510 Termination Bar.
    - b. Hohmann & Barnard, Inc.; #T1 Termination Bar.
  
- C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

## 2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35%; of width and thickness indicated; formulated from neoprene.
  - 1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hohmann & Barnard, Inc.; NS Closed Cell Neoprene Sponge.
    - b. Wire-Bond; Expansion Joint 3300.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
  - 1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hohmann & Barnard, Inc.; RS Series Rubber Control Joint.
    - b. Wire-Bond; Rubber Control Joint.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).
- D. Weep/Cavity Vent Products: Use the following unless otherwise indicated:
  - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8-inch less than depth of outer wythe, in color selected from manufacturer's standard.
    - a. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Advanced Building Products Inc.; Mortar Maze Cell Vents.
      - 2) Heckmann Building Products Inc.; #85 Cell Vent.
      - 3) Hohmann & Barnard, Inc.; QV Quadro-Vent.
      - 4) Wire-Bond; Cell Vent 3601.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity. See the Evaluations.
  - 1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advanced Building Products Inc.; Mortar Break.
    - b. Hohmann & Barnard, Inc.; Mortar Web.
    - c. Mortar Net USA, Ltd.; Mortar Net.
  - 2. Configuration: Provide one of the following:
    - a. Strips, full-depth of cavity and 10-inches high, with dovetail shaped notches 7-inches deep that prevent clogging with mortar droppings.
    - b. Strips, not less than 3/4-inch thick and 10-inches high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.

## 2.9 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without

discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Available 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. Diedrich Technologies, Inc.
  - b. EaCo Chem, Inc.
  - c. ProSoCo, Inc.

## 2.10 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  1. Do not use calcium chloride in mortar or grout.
  2. Use portland cement-lime mortar unless otherwise indicated.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, either the Proportion Specification or the Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.
  1. For concrete masonry unit backup in exterior walls, masonry bearing walls, shear walls and masonry below grade or in contact with earth, use Type S. Not for use in masonry veneer construction.
  2. Use Type N mortar in all masonry veneer construction and in all masonry construction other than noted in the requirements for Type S mortar above.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
  1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
  2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2,000 psi.
  3. Provide grout with a slump of 8-inches to 11-inches as measured according to ASTM C 143/C 143M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  1. Verify that foundations are within tolerances specified.
  2. Verify that reinforcing dowels are properly placed.
  5. Verify that substrates are free of substances that impair mortar bond.

- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

### 3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

### 3.3 TOLERANCES

- A. Dimensions and Locations of Elements
  1. For dimensions in cross section or elevation do not vary by more than plus ½-inch or minus ¼-inch.
  2. For location of elements in plan do not vary from that indicated by more than plus or minus ½-inch.
  3. For location of elements in elevation do not vary from that indicated by more than plus or minus ¼-inch in a story height or ½-inch total.
- B. Lines and Levels
  1. For bed joints and top surfaces of bearing walls, do not vary from level by more than ¼-inch in 10 feet, or ½-inch maximum.
  2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8-inch in 10 feet, ¼-inch in 20 feet, or ½-inch maximum.
  3. For vertical lines and surfaces, do not vary from plumb by more than ¼-inch in 10 feet, 3/8-inch in 20 feet, or ½-inch maximum.

4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8-inch in 10 feet, ¼-inch in 20 feet, or ½-inch maximum.
5. For lines and surfaces, do not vary from straight by more than ¼-inch in 10 feet, 3/8-inch in 20 feet, or ½-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than ¼-inch in 10 feet, or ½-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16-inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8-inch, with a maximum thickness limited to ½ -nch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8-inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8-inch or minus ¼-inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8-inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8-inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16-inch from one masonry unit to the next.

### 3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2-inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24-inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
  - 1. Install compressible filler in joint between top of partition and underside of structure above.
  - 2. Fasten top-of-wall wind clips to structure above and build wall into clips. Grout cells of CMUs solidly and space clips as indicated on Drawings.

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
  - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
  - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
  - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
  - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
  - 5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
  - 1. For glazed masonry units, use a nonmetallic jointer  $\frac{3}{4}$ -inch or more in width.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- E. Cut joints flush where indicated to receive air barriers unless otherwise indicated.

### 3.6 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
  - 1. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
    - a. Use adjustable (two-piece) type reinforcement.
  - 2. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.
- B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

- C. Apply air barrier to face of backup wythe to comply with Division 07 Section " Fluid-Applied Membrane Air Barriers."
- D. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12-inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
  - 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

### 3.7 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
  - 1. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
  - 2. Embed tie sections in masonry joints.
  - 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  - 7. Space anchors as indicated, but not more than 16-inches o.c. vertically and 16-inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12-inches of openings and at intervals, not exceeding 8-inches, around perimeter.
- B. Provide not less than 2-inches of airspace between back of masonry veneer and face of insulation.
  - 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

### 3.8 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8-inch on exterior side of walls, 1/2-inch elsewhere. Lap reinforcement a minimum of 6-inches.
  - 1. Space reinforcement not more than 16-inches o.c.
  - 2. Space reinforcement not more than 8-inches o.c. in parapet walls.
  - 3. Provide reinforcement not more than 8-inches above and below wall openings and extending 12-inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.



### 3.9 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
  - 1. Provide an open space not less than 2-inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
  - 3. Space anchors as indicated, but not more than 16-inches o.c. vertically and 16-inches o.c. horizontally.

### 3.10 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
  - 1. Locate joints as indicated on Drawings; however, locate vertical joints not more than 30 feet o.c. for expansion joints in masonry veneer and 24 feet o.c. for control joints in concrete masonry.
- B. Form control joints in concrete masonry as follows:
  - 1. Install preformed control-joint gaskets designed to fit standard sash block.
  - 2. At steel columns construct control-joint according to Drawings.
- C. Form expansion joints in brick as follows:
  - 1. Build in compressible joint fillers where indicated.
  - 2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8-inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

### 3.11 LINTELS

- A. Install steel lintels where indicated.
- B. Provide minimum bearing of 8-inches at each jamb unless otherwise indicated. Jambs below bearing to be grouted solid from base of wall to underside of lintel bearing.

### 3.12 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal

- penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8-inches, and at least 2-inches above top of cavity drainage material.
  3. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8-inches; and at least 2-inches above the top of cavity drainage material.
  4. Secure top of flashing with metal termination bar attached to wall framing 8-inches on center. Apply a continuous bead of compatible sealant to the top of the bar.
  5. At lintels and shelf angles, extend flashing a minimum of 6-inches into masonry at each end. At heads and sills, extend flashing 6-inches at ends and turn up not less than 2-inches to form end dams.
  6. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
1. Use specified weep/cavity vent products to form weep holes.
  2. Space weep holes 24-inches o.c. unless otherwise indicated.
- D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- E. Install cavity vents in head joints in exterior wythes at 48-inches o.c., unless otherwise indicated. Use specified weep/cavity vent products to form cavity vents.

### 3.13 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  2. Limit height of vertical grout pours to not more than 60-inches.

### 3.14 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Testing Prior to Construction: One set of tests.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- D. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- E. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- G. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days. Only required if mortar or grout compressive strength testing does not meet specifications.
- H. Inspect reinforcing for size and placement prior to pouring of grout.
- I. Inspect grout and mortar mixing operations to ensure mix proportions and procedures comply with specified requirements.
- J. Inspect ties and anchors for type, spacing, and proper installation.
- K. Inspect flashing and accessories for type and proper installation.
- L. Inspect all aspects of masonry construction operations for compliance with specified cold weather and/or hot weather procedures.

### 3.15 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
8. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

**END OF SECTION 042000**

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## SECTION 055000 - METAL FABRICATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel supports for conveyor.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Structural-steel door frames.
6. Miscellaneous steel trim including steel angle corner guards and steel edgings.
7. Metal bollards.
8. Downspout guards
9. Metal downspout boots
10. Loose lintels
11. Loose bearing and leveling plates for applications where they are not specified in other Sections.

##### B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

##### C. Related Requirements:

1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Division 04 Section "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.

#### 1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
  - 2. Paint products.
  - 3. Grout.
  - 4. Metal bollards
  - 5. Downspout guards
  - 6. Metal downspout boots
  
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
  - 1. Steel framing and supports for overhead doors.
  - 2. Steel framing and supports for mechanical and electrical equipment.
  - 3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  - 4. Structural-steel door frames.
  - 5. Miscellaneous steel trim including steel angle corner guards and steel edgings.
  - 6. Metal bollards.
  - 7. Loose lintels.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
  
- B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
  
- C. Welding certificates.
  
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
  
- E. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

## 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 316L.
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L.
- E. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- F. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- G. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- H. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- I. Zinc-Coated Steel Wire Rope: ASTM A 741.
  - 1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- J. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: As indicated.
  - 2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 (Z275) coating; 0.108-inch (2.8 mm) nominal thickness.
  - 3. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0966-inch (2.5 mm) minimum thickness; hot-dip galvanized after fabrication.
- K. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- L. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- M. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- N. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- O. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.



## 2.2 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  - 1. Provide stainless-steel fasteners for fastening aluminum.
  - 2. Provide stainless-steel fasteners for fastening stainless steel.
  - 3. Provide stainless-steel fasteners for fastening nickel silver.
  - 4. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 1 (A1).
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- H. Post-Installed Anchors: Chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
  - 3. Chemical Anchor Adhesives: Heavy duty, two component injectable adhesive designed to be dispensed using double chamber gun with mixing nozzle. Adhesives in capsule form will not be accepted.
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Hilti, Inc.; Hit HY 150; Hit-Ice, Hit HY 150 Max.

- 2) ITW Redhead; Epcon C6.
- 3) Powers Fasteners, Inc.; AC100+ Gold.

- I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8- by- 7/8-inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3-inches (75 mm) long at not more than 8-inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

## 2.3 MISCELLANEOUS MATERIALS

- A. Alkyd Primer: Modified-alkyd primer compatible with topcoat. Manufacturer's certificate test reports showing product's performance in following tests (products performance must be equivalent to, or greater than the results noted) :
  1. Abrasion: ASTM D4060 CS17 Wheel 500 grams load: no more than 30 mg loss after 500 cycles.
  2. Elongation: ASTM D 522 Method B: Passes 1/8-inch mandrel with no less than 31% elongation.
  3. Exterior Exposure: Exposure at 45° south wind in mild industrial exposure: No blistering, cracking, rusting, or delamination of film after four years exposure.
  4. Salt Spray: Method ASTM B 117: No blistering, cracking, rusting, or delamination of film. No rust creepage at scribe after 500 hours exposure.
  5. Adhesion: Method ASTM D 3359, Method B, 5mm crosshatch: No less than a rating of 5.
- B. Urethane Primer: Moisture-cured, aromatic urethane primer compatible with topcoat. Manufacturer's certificate test reports showing product's performance in following tests (products performance must be equivalent to, or greater than the results noted) :
  1. Adhesion: ASTM D 3359, Method B, 5mm crosshatch: No less than a rating of 5. ASTM D4541: No less than 1000 psi pull, average of 3 tests.
  2. Exterior Exposure: Exposure at 45° south wind in mild industrial exposure: No blistering, cracking, rusting, or delamination of film after four years exposure.
  3. Salt Spray: Method ASTM B 117: No blistering, cracking, rusting, or delamination of film. No rust creepage at scribe after 1500 hours exposure.
  4. Humidity: ASTM D4585: No blistering, cracking, rusting, or delamination of film. No rust creepage at scribe after 1500 hours exposure.
  5. Abrasion: ASTM D4060 CS17 Wheel 1000 grams load: no more than 77 mg average loss after 1000 cycles.
- C. Zinc-Rich Primer: Zinc-rich, aromatic urethane primer compatible with topcoat. Manufacturer's certificate test reports showing product's performance in following tests (products performance must be equivalent to, or greater than the results noted) :
  1. Adhesion: ASTM D 3359, Method B, 5mm crosshatch: No less than a rating of 5. ASTM D4541: No less than 800 psi pull, average of 3 tests.
  2. Humidity: ASTM D4585: No blistering, cracking, rusting, or delamination of film after 1000 hours exposure.
  3. Exterior Exposure: Saltwater, splash and spray: No blistering, cracking, rusting, or delamination of film after one year exposure.
  4. Salt Spray: Method ASTM B 117: No blistering, cracking, rusting, or delamination of film. No rust creepage at scribe after 4000 hours exposure.

5. Static Fatigue (Slip Coefficient and Tension Creep): Must meet the requirements of a Class B surface with a mean slip coefficient no less than 0.50 and a tension creep not in excess of 0.005 inch.
  6. Non-Lead Certification: ASTM D 520 Type III, Part 1303 of Consumer Product Safety Act Regulations
- D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
  - E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
  - F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
  - G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
  - H. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3,000 psi (20 MPa).

#### 2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32-inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8- by 1½-inches (3.2 by 38 mm), with a minimum 6-inch (150 mm) embedment and 2-inch (50 mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24-inches (600 mm) o.c., unless otherwise indicated.

## 2.5 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
  - 1. Fabricate units from slotted channel framing where indicated.
  - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
  - 1. Provide bearing plates welded to beams where indicated.
  - 2. Drill or punch girders and plates for field-bolted connections where indicated.
  - 3. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24-inches (600 mm) o.c.
- E. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.
  - 1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
  - 2. Unless otherwise indicated, provide ½-inch (12.7 mm) baseplates with four 5/8-inch (16 mm) anchor bolts and ¼-inch (6.4 mm) top plates.
- F. Galvanize miscellaneous framing and supports where indicated.
- G. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

## H. FABRICATION

1. Fabricated work true to dimension, square, plumb, level and free from distortions or defects detrimental to appearance and performance.

### 2.6 STRUCTURAL-STEEL DOOR FRAMES

- A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1½-inch (16-by-38-mm) steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10-inches (250 mm) o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.
  1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.
- B. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.

### 2.7 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
  1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

### 2.8 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe steel shapes, as indicated.
  1. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
  2. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.

### 2.9 DOWNSPOUT GUARDS

- A. Fabricate downspout guards from 3/8-inch- (9.5 mm-) thick by 12-inch- (300 mm-) wide, steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch (50 mm) clearance between pipe and pipe guard. Drill each end for two ¾-inch (19 mm) anchor bolts.

## 2.10 METAL DOWNSPOUT BOOTS

- A. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.

## 2.11 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

## 2.12 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8-inches (200 mm) unless otherwise indicated.

## 2.13 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

## 2.14 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

## 2.15 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Metal Fabrications: For all iron and steel items (except those noted below), shop prime with alkyd primer.

2. Exterior Wall Metal Fabrications: For all iron and steel items occurring in exterior walls, shop prime with urethane primer.
  3. Exposed Exterior Metal Fabrications: For all iron and steel items exposed on the exterior, shop prime with zinc-rich primer.
- D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
- 2.16 ALUMINUM FINISHES
- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.
- C. MATERIALS
1. As-Fabricated Finish: Aluminum: products are to be Grade 6082 T6, & T4. Provide U-bracket with U-bolt for mounting.
- D. Spring testing: Cycle test exceeding 50,000 cycles.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for

use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.

### 3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions, overhead doors and overhead grilles securely to, and rigidly brace from, building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
  - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
  - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

### 3.3 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
- B. Anchor bollards in place with concrete footings. Center and align bollards in holes 3-inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- C. Anchor internal sleeves for removable bollards in concrete by inserting in pipe sleeves preset into concrete. Fill annular space around internal sleeves solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8-inch (3 mm) toward internal sleeve.
- D. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3-inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.



- E. Place removable bollards over internal sleeves and secure with ¾-inch (19 mm) machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.
- F. Fill bollards solidly with concrete, mounding top surface to shed water.
  - 1. Do not fill removable bollards with concrete.

### 3.4 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.5 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05 mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

**END OF SECTION 055000**

## **SECTION 055100 - METAL STAIRS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Industrial-type aluminum stairs with bar grating treads and landings.
- B. Related Sections:
  - 1. Division 05 Section "Pipe and Tube Railings" for pipe and tube railings.

#### **1.2 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs.
  - 1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
  - 2. Deliver such items to Project site in time for installation.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For metal stairs and the following:
  - 1. Nonslip aggregates and nonslip-aggregate finishes.
  - 2. Abrasive nosings.
  - 3. Metal bar grating treads and landings.
  - 4. Paint products.
  - 5. Grout.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes:
  - 1. Grating treads.
  - 2. Abrasive nosings.
- E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for stairs.
  - 1. Test railings according ASTM E 894 and ASTM E 935.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
  - 1. Preassembled Stairs: Service class.
  - 2. Industrial-Type Stairs: Industrial class.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
  - 1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
  - 2. Protect steel members and packaged materials from corrosion and deterioration.
  - 3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
    - a. Repair or replace damaged materials or structures as directed.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
  - 1. Uniform Load: 200 lbf/sq. ft.
  - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
  - 3. Uniform and concentrated loads need not be assumed to act concurrently.

4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
  5. Limit deflection of treads, platforms, and framing members to L/360 or ¼-inch, whichever is less.
- C. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Component Importance Factor is 1.5.

## 2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

## 2.3 NONFERROUS METALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6061-T6 or 6063-T6.
- B. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

## 2.4 ABRASIVE NOSINGS

- A. Cast-Metal Units: Cast aluminum, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
1. Available 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. American Safety Tread Co., Inc.
    - b. Balco Inc.
    - c. Barry Pattern & Foundry Co., Inc.
    - d. Granite State Casting Co.
    - e. Safe-T-Metal Company, Inc.
    - f. Wooster Products Inc.
  2. Configuration: Cross-hatched units, 3 inches wide without lip.
  3. Configuration: Cross-hatched angle-shaped units, same depth as bar-grating treads and 1- to 1½-inches wide.
- B. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
1. Available 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. ACL Industries, Inc.
    - b. American Safety Tread Co., Inc.
    - c. Amstep Products.

- d. Armstrong Products, Inc.
  - e. Balco Inc.
  - f. Granite State Casting Co.
  - g. Wooster Products Inc.
  - 2. Provide ribbed units, with abrasive filler strips projecting 1/16-inch above aluminum extrusion.
  - 3. Provide solid-abrasive-type units without ribs.
  - 4. Nosings: Square-back units, 3-inches wide, without lip.
- C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
  - D. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.
  - E. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

## 2.5 FASTENERS

- A. General: Provide stainless steel fasteners. Select fasteners for type, grade, and class required.
- B. Anchor Bolts: Provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633.
- C. Machine Screws: ASME B18.6.3.
- D. Lag Screws: ASME B18.2.1.
- E. Plain Washers: Round, ASME B18.22.1.
- F. Lock Washers: Helical, spring type, ASME B18.21.1.
- A. Post-Installed Anchors: Chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Material for all Locations: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
  - 2. Chemical Anchor Adhesives: Heavy duty, two component injectable adhesive designed to be dispensed using double chamber gun with mixing nozzle. Adhesives in capsule form will not be accepted.
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Hilti, Inc.; Hit HY 200; Hit-Ice, Hit HY 200 Max.
      - 2) ITW Redhead; Epcon C6.
      - 3) DeWalt, Inc.; AC100+ Gold.

## 2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.7 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
  - 1. Join components by welding unless otherwise indicated.
  - 2. Use connections that maintain structural value of joined pieces.
  - 3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32-inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Weld exposed corners and seams continuously unless otherwise indicated.
  - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.

- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- I. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
  - 1. Fabricate treads and platforms from pressure-locked aluminum grating with 2-by-3/16-inch (32-by-5 mm) bearing bars at 15/16-inch (24 mm) o.c. and crossbars at 4-inches (100 mm) o.c.
  - 2. Surface: Serrated.
  - 3. Finish: Anodized.
  - 4. Fabricate grating treads with cast abrasive nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
  - 5. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.

## 2.8 ALUMINUM FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Mill Finish: AA-M12, nonspecular as fabricated.
- C. Clear Anodic Finish: AAMA 611, AA-M12C22A31.
- D. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- G. Provide bituminous paint at all locations where aluminum comes in contact with concrete or cement products.

### 3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.
- B. Set stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
  - 1. Use nonmetallic, nonshrink grout unless otherwise indicated.
  - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

**END OF SECTION 055100**



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## SECTION 055213 - PIPE AND TUBE RAILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Aluminum pipe railings.
- B. Related Requirements:
  - 1. Division 05 Section "Metal Stairs" for coordination associated with aluminum stairs with bar grating treads and landings.

#### 1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of mechanically connected railings.
  - 2. Railing brackets.
  - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
  - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
  - 2. Fittings and brackets.
  - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
    - a. Show method of connecting and finishing members at intersections.
- D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- E. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- F. Evaluation Reports: For post-installed anchors, from ICC-ES.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

#### 1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Aluminum Pipe and Tube Railings:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
    - a. ATR Technologies, Inc.
    - b. Blum, Julius & Co., Inc.
    - c. Braun, J. G., Company; The Wagner Companies.
    - d. CraneVeyor Corp.
    - e. Hollaender Manufacturing Company.
    - f. Kee Industrial Products, Inc.

- g. Moultrie Manufacturing Company.
- h. Sterling Dula Architectural Products, Inc.
- i. Superior Aluminum Products, Inc.
- j. Thompson Fabricating, LLC.
- k. Tri Tech, Inc.
- l. Tubular Specialties Manufacturing, Inc.
- m. Tuttle Railing Systems.
- n. Wagner, R & B, Inc.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120°F (67°C), ambient; 180°F (100°C, material surfaces).

## 2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
  - 1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1½-inch (38-mm) clearance from inside face of handrail to finished wall surface.

## 2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

- B. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
  - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- C. Drawn Seamless Tubing: ASTM B 210 (ASTM B 210M), Alloy 6063-T832.
- D. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- E. Die and Hand Forgings: ASTM B 247 (ASTM B 247M), Alloy 6061-T6.
- F. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

## 2.5 FASTENERS

- A. General: Provide the following:
  - 1. Aluminum Railings: Type 316 stainless-steel fasteners.
  - 2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
  - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
  - 2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
  - 3. Provide square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
  - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
  - 3. Chemical Anchor Adhesives: Heavy duty, two component injectable adhesive designed to be dispensed using double chamber gun with mixing nozzle. Adhesives in capsule form will not be accepted.
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Hilti, Inc.; Hit HY 200; Hit-Ice, Hit HY 200 Max.
      - 2) ITW Redhead; Epcon C6.
      - 3) Powers Fasteners, Inc.; AC100+ Gold.

## 2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
  - 1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
  - 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

## 2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32-inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
  3. Remove flux immediately.
  4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
  - J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
    1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
  - K. Form Changes in Direction as Follows:
    1. As detailed.
    2. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.
  - L. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
  - M. Close exposed ends of railing members with prefabricated end fittings.
  - N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is ¼-inch (6 mm) or less.
  - O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
  - Q. For railing posts set in concrete, provide sleeves not less than 6-inches (150 mm) long with inside dimensions not less than ½-inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.
  - R. For removable railing posts, fabricate slip-fit sockets from PVC tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
    1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
  - S. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

## 2.8 ALUMINUM FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16-inch in 3-feet (2 mm in 1 m).
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed ¼-inch in 12-feet (6 mm in 3.5 m).
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.



- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2-inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6-inches (150 mm) of post.

### 3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than 5-inches (125 mm) deep and 3/4-inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Leave anchorage joint exposed with 1/8-inch (3 mm) buildup, sloped away from post.
- C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
  - 1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
- D. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

### 3.5 ATTACHING RAILINGS

- A. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Secure wall brackets and railing end flanges to building construction as follows:
  - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  - 2. For hollow masonry anchorage, use toggle bolts.
  - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

### 3.6 ADJUSTING AND CLEANING

- A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05 mm) dry film thickness.

3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

**END OF SECTION 055213**

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## SECTION 055300 - METAL GRATINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Metal bar gratings.
  - 2. Metal frames and supports for gratings.
- B. Related Sections:
  - 1. Division 05 Section "Metal Stairs" for grating treads and landings of steel-framed stairs.
  - 2. Division 05 Section "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

#### 1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Metal bar gratings.
  - 2. Clips and anchorage devices for gratings.
  - 3. Paint products
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

## 1.5 QUALITY ASSURANCE

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual" and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.3, "Structural Welding Code - Sheet Steel."
  - 4. AWS D1.6, "Structural Welding Code - Stainless Steel."

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer for type of use indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Shapes: ASTM B 221 (ASTM B 221M), alloys as follows:
  - 1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
  - 2. 6061-T1, for grating crossbars.

### 2.2 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  - 1. Provide stainless-steel fasteners for fastening aluminum.
- B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, anchor bolts, nuts, and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1).
- C. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- D. Post-Installed Anchors: Chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed

when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
3. Chemical Anchor Adhesives: Heavy duty, two component injectable adhesive designed to be dispensed using double chamber gun with mixing nozzle. Adhesives in capsule form will not be accepted.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Hilti, Inc.; Hit HY 200; Hit-Ice, Hit HY 200 Max.
    - 2) ITW Redhead; Epcon C6.
    - 3) Powers Fasteners, Inc.; AC100+ Gold.

## 2.3 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.4 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32-inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: Comply with AWS recommendations and the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
- F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
2. Fabricate toeplates for attaching in the field.
3. Toeplate Height: 4-inches (100 mm) unless otherwise indicated.

## 2.5 METAL BAR GRATINGS

- A. Available 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:
1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
  2. All American Grating.
  3. BarnettBates Corporation.
  4. Borden Metal Products (Canada) Limited.
  5. Fisher & Ludlow; Division of Harris Steel Limited.
  6. Grating Pacific, Inc.
  7. IKG Industries; a division of Harsco Corporation.
  8. Ohio Gratings, Inc.
  9. Seidelhuber Metal Products; Division of Brodhead Steel Products.
- A. Swaged, Rectangular Bar Aluminum Grating MBG-1: Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars or swaging crossbars between bearing bars.
1. Bearing Bar Spacing: 1-3/16-inches (30 mm) orc.
  2. Bearing Bar Depth: 1½-inches (51 mm).
  3. Bearing Bar Thickness: 3/16-inch (4.8 mm).
  4. Crossbar Spacing: 2-inches (51 mm) orc.
  5. Traffic Surface: Serrated.
  6. Aluminum Finish: Class I, clear, anodized finish.
- B. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
  2. Provide no fewer than four saddle clips for each grating section composed of rectangular bearing bars 3/16-inch (4.8 mm) or less in thickness and spaced 15/16-inch (24 mm) or more o.c., with each clip designed and fabricated to fit over two bearing bars.
  3. Provide no fewer than four weld lugs for each grating section composed of rectangular bearing bars 3/16-inch (4.8 mm) or less in thickness and spaced less than 15/16-inch (24 mm) o.c., with each lug shop welded to three or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.
  4. Furnish self-drilling fasteners with washers for securing grating to supports.
  5. Furnish flange clamp with bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.
- C. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

- D. Do not notch bearing bars at supports to maintain elevation.

## 2.6 GRATING FRAMES AND SUPPORTS

- A. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
  - 1. Unless otherwise indicated, fabricate from same basic metal as gratings.

## 2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- D. Fit exposed connections accurately together to form hairline joints.
  - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
- E. Attach toeplates to gratings by welding at locations indicated.
- F. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
- G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.



### 3.2 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

**END OF SECTION 055300**

## **SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Wood blocking and nailers.
  - 2. Wood furring and grounds.
  - 3. Utility shelving.
  - 4. Locations for Pressure-treated Wood: Provide where indicated on the Drawings and the following:
    - a. Preservative-treated: All exterior miscellaneous rough carpentry within 18-inches of grade.

#### **1.2 DEFINITIONS**

- A. Boards or Strips: Lumber of less than 2-inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2-inches nominal (38 mm actual) or greater size but less than 5-inches nominal (114 mm actual) size in least dimension.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Evaluation Reports: For the following, from ICC-ES:
  - 1. Preservative-treated wood.
  - 2. Fire-retardant-treated wood.
  - 3. Power-driven fasteners.

#### **1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19% unless otherwise indicated.

### 2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19%. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat all miscellaneous carpentry unless otherwise indicated.

### 2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
  - 3. Rooftop equipment bases and support curbs.
  - 4. Cants.
  - 5. Furring.
  - 6. Grounds.
  - 7. Utility shelving.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

- C. Utility Shelving: Lumber with 15% maximum moisture content of any of the following species and grades:
  - 1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium grade; NeLMA, NLGA, WCLIB, or WWPA.
  - 2. Mixed southern pine or southern pine No. 1 grade; SPIB.
  - 3. Hem-fir or hem-fir (north), Select Merchantable or No. 1 Common grade; NLGA, WCLIB, or WWPA.
  - 4. Spruce-pine-fir (south) or spruce-pine-fir, Select Merchantable or No. 1 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
- D. Concealed Boards: 19% maximum moisture content of species and grades:
- E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

#### 2.4 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 5/8-inch nominal thickness.

#### 2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.
- D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16-inches o.c.
- G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
  - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96-inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
  - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96-inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
  - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
- H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- I. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.

- J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

### 3.2 WOOD BLOCKING AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1½-inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

### 3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

**END OF SECTION 061053**

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## SECTION 061643 – EXTERIOR GYPSUM WALL SHEATHING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes Fiberglass-mat faced, moisture and mold resistant gypsum sheathing:
  - 1. Wall sheathing.
  - 2. Sheathing joint and penetration treatment.
- B. Related Requirements:
  - 1. Division 07 Section "Fluid-Applied Membrane Air Barriers" for water-resistive barrier applied over wall sheathing.

#### 1.2 REFERENCES

- A. ASTM International (ASTM):
  - 1. ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products.
  - 2. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 3. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  - 4. ASTM C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  - 5. ASTM C1280 Standard Specification for Application of Gypsum Sheathing.
  - 6. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
  - 7. ASTM D6329 Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers.
  - 8. ASTM E72 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
  - 9. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.
  - 10. ASTM C1396 Standard Specification for Gypsum Board
- B. Gypsum Association (GA): GA-253 Application of Gypsum Sheathing

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that



periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

#### 1.5 WARRANTY

- A. Provide products that offer twelve months of coverage against in-place exposure decay (delamination, deterioration and decay) commencing with the date of installation of the product in such structure.
- B. Provide Manufacturer's warranty of five years against manufacturing defects from the date of purchase of the product for installation

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

### PART 2 - PRODUCTS

#### 2.1 WALL SHEATHING

- A. Fire-Rated Fiberglass-Mat Faced Gypsum Sheathing: ASTM C1177, Type X:
  - 1. Type and Thickness: Type X, 5/8-inch thick
  - 2. Width: 4-feet.
  - 3. Length: 8-feet, 9-feet, or 10-feet.

#### 2.2 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
  - 1. For steel framing less than 0.0329-inch thick, use screws that comply with ASTM C 1002.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Coordinate wall and parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- E. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### 3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253, ASTM C1280 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
  - 2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
  - 3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

**END OF SECTION 061643**

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## **SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Vapor-retarding, fluid-applied air barriers.
  - 2. Vapor-permeable, fluid-applied air barriers.
- B. Related Requirements:
  - 1. Division 06 Section "Exterior Gypsum Wall Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

#### **1.2 DEFINITIONS**

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

#### **1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at project site.
  - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.
- B. Shop Drawings: For air-barrier assemblies.
  - 1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
  - 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
  - 3. Include details of interfaces with other materials that form part of air barrier.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- B. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- C. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
  - 1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
  - 1. Protect substrates from environmental conditions that affect air-barrier performance.
  - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Products: Provide air barrier products manufactured by Tremco, Inc., Commercial Sealants and Waterproofing Division, An RPM Company, Beachwood OH; (866) 321-6357; email: techresources@tremcoinc.com; www.tremcosealants.com,.

### 2.2 MATERIALS, GENERAL

- A. Source Limitations: Obtain air-barrier materials from single source from single manufacturer.
- B. VOC Content: 250 g/L maximum per 40 CFR 59, Subpart D (EPA Method 24) and complying with requirements of authorities having jurisdiction.

- C. Compatibility: Provide membrane air barrier materials that are compatible with one another and with adjacent materials under conditions of service and application required, as demonstrated by membrane air barrier manufacturer based on testing and field experience.

## 2.3 PERFORMANCE REQUIREMENTS

- A. General: Membrane air barrier shall be capable of performing as a continuous vapor- permeable air barrier and as a moisture drainage plane transitioned to adjacent flashings and discharging water to the building exterior. Membrane air barriers shall accommodate substrate movement and seal expansion and control joints, construction material transitions, opening transitions, penetrations, and perimeter conditions without moisture deterioration and air leakage exceeding performance requirements.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E 2357.
- C. Fire Propagation Characteristics: Provide air barrier system qualified as a component of a comparable wall assembly that has been tested and passed NFPA 285.

## 2.4 MEMBRANE AIR BARRIER

- A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, UV-resistant, synthetic membrane, formulated for application in a range of 48 - 70 mils (wet), 25 - 35 mils (dry)
  - 1. Basis of Design Product: Tremco, Inc., ExoAir 230.
  - 2. Air Permeance, ASTM E 2178: 0.004 cfm/sq. ft of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference, maximum.
  - 3. Vapor Permeance, ASTM E 96/E96M: Minimum 12 perms (690 ng/Pa x s x sq. m).
  - 4. Elongation, Ultimate, ASTM D 412, Die C: 600 percent, minimum.
  - 5. Combustion Characteristics: Class A, flame spread, not greater than 25; smoke developed, not greater than 450, per ASTM E 84.
  - 6. UV Resistance, QUV-B: Over 160 cycles of UV and water spray with no observable deterioration.
  - 7. VOC Content: Less than 50 g/L.

## 2.5 ACCESSORY MATERIALS

- A. General: Accessory materials as described in manufacturer's written installation instructions, recommended to produce complete air barrier assembly meeting performance requirements, and compatible with air barrier membrane material and adjacent materials.
- B. Primer: Liquid primer meeting VOC limitations, recommended for substrate by membrane air barrier manufacturer, when installing modified bituminous self-adhered membranes.
  - 1. Basis of Design Product: Tremco, Inc., ExoAir Primer
- C. Transitions:
  - 1. Counterflashing Strip: Modified bituminous, 40 mils (1.0 mm) thick self-adhering composite sheet consisting of 32 mils (0.8 mm) of SBS rubberized asphalt laminated to an 8 mils (0.2 mm) high-density, cross-laminated polyethylene film, for counterflashing of metal flashings and for substrate transitions and for termination of air barrier to bituminous roof membranes and to air barrier terminations at openings.
    - a. Basis of Design Product: Tremco, Inc., ExoAir TWF Thru-Wall Flashing.

2. High Temperature Flashing Strip and Underlayment: Butyl, 24 mil thick self-adhering composite sheet consisting of 20 mils of butyl laminated to 4 mil polyethylene film; thermally stable under intermittent, non-continuous exposure up to 240°F (115°C).
    - a. Basis of Design Product: Tremco, Inc., ExoAir 111.
  3. Foil Flashing Strip: Butyl, 24 mil thick self-adhering composite sheet consisting of 20 mils of butyl laminated to 4 mil polyethylene film; thermally stable under intermittent, non-continuous exposure up to 240°F (115°C)
    - a. Basis of Design Product: Tremco, Inc., ExoAir 111.
  4. Butyl Strip: Butyl, 24 mil thick self-adhering composite sheet consisting of 20 mils of butyl laminated to 4 mil polyethylene film; thermally stable under intermittent, non-continuous exposure up to 240°F (115°C), for termination of air barrier to EPDM or TPO roof membranes.
    - a. Basis of Design Product: Tremco, Inc., ExoAir 111.
  5. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch (0.5 mm) thick, and Series 300 stainless-steel fasteners.
  6. Opening Transition Assembly: Cured low-modulus silicone extrusion, with reinforcing ribs, sized to fit opening widths, [with aluminum race for insertion into aluminum framing extrusions,] with the following characteristics:
    - a. Basis of Design Product: Tremco, Inc., Proglaze ETA Engineered Transition Assembly. Tear Strength: 110 lb/in (19.3 kN/m)
  7. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with manufacturer's recommended silicone sealant for bonding extrusions to substrates.
    - a. Basis of Design Product: Tremco, Inc.; Spectrem SimpleSeal.
- D. Reinforcing Fabric: High strength mesh fabric consisting of open-weave glass fiber saturated with synthetic resins formulated for high moisture resistance, for reinforcing of liquid applications; not less than 2.5 oz/sq. yd (85 g/sq. m).
1. Basis of Design Product: Tremco, Inc., Tremco 2011.
- E. Liquid Joint Sealants:
1. ASTM C 920, single-component polyurethane, approved by air barrier manufacturer for adhesion and compatibility with membrane air barrier and accessories.
    - a. Basis of Design Product: Tremco, Inc., Dymonic 100.
  2. ASTM C 920, single-component, neutral-curing silicone, approved by air barrier manufacturer for adhesion and compatibility with membrane air barrier and accessories post installation of the membrane.
    - a. Basis of Design Product: Tremco, Inc., Spectrem 1.
- F. Sprayed Polyurethane Foam Sealant: Sprayed Polyurethane Foam Sealant: Foamed-in-place, 1.5- to 2.0-lb/cu. ft. (24- to 32-kg/cu. m) density, with flame-spread index of 25 or less per ASTM E 162, for filling of gaps at openings and penetrations.
1. Basis of Design; Tremco Inc., Flexible Low Expanding Foam (LEF)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
  - 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
  - 3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D 4263.
  - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- H. Bridge isolation joints, expansion joints, and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

### 3.3 ACCESSORIES INSTALLATION

- A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.



1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
  2. Install transition strip on roofing membrane or base flashing so that a minimum of 3-inches (75 mm) of coverage is achieved over each substrate.
  3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, storefronts, and doors. Apply transition strip or preformed silicone extrusion so that a minimum of 3-inches (75 mm) of coverage is achieved over each substrate. Maintain 3-inches (75 mm) of full contact over firm bearing to perimeter frames, with not less than 1-inch (25 mm) of full contact.
1. Transition Strip: Roll firmly to enhance adhesion.
  2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150 mm-) wide, transition strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6-inches (150 mm) beyond repaired areas in strip direction.

### 3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
  - 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
  - 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
- B. Install product and accessories in details as directed in manufacturer's literature.
- C. Sheathing joints, use any of the following methods:
  - 1. Sheathing joint tape, centered over joint
  - 2. 4-inch foil-faced tape, centered over joint
  - 3. 4-inch detail flashing centered over joint.
  - 4. 4-inch reinforcing fabric imbedded in product and centered over joint.
  - 5. Paintable sealant or fill compound, tooled as shown in details.
- D. Sheathing inside and outside corners. Flashing or reinforcement shall bear 3-inches minimum onto either side of angle change. Use any of the following methods:
  - 1. Minimum 9-inch detail flashing centered over angle change
  - 2. Minimum 9-inch foil-faced tape, centered over angle change
  - 3. 12-inch reinforcing fabric centered over angle change and imbedded in roller-applied product
  - 4. 12-inch glass mat centered over angle change and imbedded in rollerapplied product
- E. Pipe or duct penetrations. Flashing or reinforcement shall bear onto wall 3-inches minimum and shall bear onto pipe or duct 3-inches, or according to Project drawings. Select any:
  - 1. Detail flashing
  - 2. Glass mat imbedded in roller-applied product
- F. Expansion or deflection joints. Flashing shall bear 3-inches minimum onto either side of joint. Select any:
  - 1. Detail flashing bellows or expansion bulb
  - 2. Transition membrane expansion bulb
- G. Interface of dissimilar substrates: Flashing or reinforcement shall bear 3-inches minimum onto either side of joint. Select any:
  - 1. Minimum 9-inch detail flashing
  - 2. 12-inch reinforcing fabric imbedded in roller-applied product
  - 3. 12-inch glass mat imbedded in roller-applied product
- H. Do not cover air barrier until it has been tested and inspected by testing agency.
- I. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

### 3.5 FIELD QUALITY CONTROL

- A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
  - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
  - 2. Air-barrier dry film thickness.
  - 3. Continuous structural support of air-barrier system has been provided.
  - 4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
  - 5. Site conditions for application temperature and dryness of substrates have been maintained.
  - 6. Maximum exposure time of materials to UV deterioration has not been exceeded.
  - 7. Surfaces have been primed, if applicable.
  - 8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
  - 9. Termination mastic has been applied on cut edges.
  - 10. Strips and transition strips have been firmly adhered to substrate.
  - 11. Compatible materials have been used.
  - 12. Transitions at changes in direction and structural support at gaps have been provided.
  - 13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
  - 14. All penetrations have been sealed.
- D. Tests: As determined by testing agency from among the following tests:
  - 1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers or ASTM E 1186, chamber depressurization using detection liquids.
  - 2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E 783 or ASTM E 2357.
  - 3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D 4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.
- E. Air barriers will be considered defective if they do not pass tests and inspections.
  - 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
  - 2. Remove and replace deficient air-barrier components for retesting as specified above.
- F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- G. Prepare test and inspection reports.

### 3.6 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
  - 1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
  - 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

**END OF SECTION 072726**

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## **SECTION 076200 – SHEET METAL FLASHING AND TRIM**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes the following sheet metal flashing and trim:
  - 1. Manufactured reglets and counterflashings.
  - 2. Formed roof drainage system.
  - 3. Formed low-slope roof flashing, trim and coping.

#### **1.2 PERFORMANCE REQUIREMENTS**

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Fabricate and install copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 and Wind Zone indicated.
- C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120°F(67°C), ambient; 180°F (100°C), material surfaces.
- D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:
  - 1. Identify material, thickness, weight, and finish for each item and location in Project.
  - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
  - 3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
  - 4. Details of expansion-joint covers, including showing direction of expansion and contraction.

- C. Samples for Initial Selection: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.
  - 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
  - 1. Sheet Metal Flashing: 12-inches (300 mm) long. Include fasteners, cleats, closures, and other attachments.
  - 2. Trim: 12-inches (300 mm) long. Include fasteners and other exposed accessories.
  - 3. Accessories: Full-size Sample.

#### 1.4 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
  - 1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
  - 2. Review methods and procedures related to sheet metal flashing and trim.
  - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
  - 4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
- C. Warranty: Roof metal edge flashings including copings, fascia and all other accessories are to be provided in full compliance with roof system Total System Warranty.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

#### 1.6 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

## PART 2 - PRODUCTS

### 2.1 SHEET METALS

- A. Aluminum Sheet: ASTM B 209(ASTM B 209M), Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14, finished as follows:
  - 1. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
      - 1) Color: Match owners standard colors.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
  - 1. Finish: No. 2B (bright, reflective).

### 2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
- C. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealing Tape: Pressure-sensitive, 100% solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4 mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.



## 2.3 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions.
  - 1. Available 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. Cheney Flashing Company, Inc.
    - b. Fry Reglet Corporation.
    - c. Hickman, W. P. Company.
    - d. Keystone Flashing Company, Inc.
  - 2. Material: Stainless steel, 0.0187-inch (0.5 mm) thick.
  - 3. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.

## 2.4 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Copings: Fabricate in minimum 96-inch- (2,400 mm-) long, but not exceeding 10-foot- (3 m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, seal, and solder or weld watertight.
  - 1. Joint Style: Butt, with 12-inch- (300 mm-) wide concealed backup plate.
- B. Counterflashing: Fabricate from the following material:
  - 1. Stainless Steel: 0.0187-inch (0.5 mm) thick.

## 2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
  - 1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1-inch (25 mm) deep, filled with elastomeric sealant concealed within joints.

- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
  - 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured.

## 2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
  - 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  - 1. Space cleats not more than 12-inches (300 mm) apart. Anchor each cleat with two (2) fasteners. Bend tabs over fasteners.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10-feet (3 m) with no joints allowed within 24-inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1-inch (25 mm) deep, filled with elastomeric sealant concealed within joints.
- G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1¼-inches (32 mm) for nails and not less than ¾-inch (19 mm) for wood screws.
  - 1. Aluminum: Use aluminum or stainless-steel fasteners.
  - 2. Stainless Steel: Use stainless-steel fasteners.
- H. Seal joints with elastomeric sealant as required for watertight construction.
  - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1-inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70°F (4 and 21° C), set joint members for 50% movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40°F (4°C).
  - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

### 3.3 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

### 3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
- B. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
  - 1. Interlock bottom edge of coping with continuous cleats anchored to substrate at 16-inch (400 mm) centers.

- C. Counterflashing: Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4-inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4-inches (100 mm) and bed with elastomeric sealant.
  - 1. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant.

### 3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of metal wall flashing with installation of masonry and wall-opening components such as windows, doors, and louvers.

### 3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- C. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION 076200**

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## **SECTION 079200 - JOINT SEALANTS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Silicone joint sealants.
  - 2. Mildew-resistant joint sealants.
  - 3. Latex joint sealants.
  - 4. Immersible Joint Sealants

#### **1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.
- C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
  - 1. Joint-sealant location and designation.
  - 2. Manufacturer and product name.
  - 3. Type of substrate material.
  - 4. Proposed test.
  - 5. Number of samples required.
- D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- E. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Field-Adhesion-Test Reports: For each sealant application tested.
- G. Sample Warranties: For special warranties.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

## 1.5 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40°F (5°C).
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## 1.6 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.
- C. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following:
  - 1. Architectural sealants shall have a VOC content of 250 g/L or less.
  - 2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
  - 3. Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.

## 2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100% and minus 50% movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Pecora Corporation; 890.
    - b. Dow Corning Corporation; 790
    - c. Tremco Incorporated; Spectrum 1.
- B. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Pecora Corporation; 864.
    - b. GE Advanced Materials - Silicones; SilPruf SCS2000.
    - c. Dow Corning Corporation; 791
- C. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Corning Corporation; 786
    - b. Pecora Corporation; 898.
    - c. Tremco Incorporated: Termsil 200

## 2.3 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex, ASTM C 834, Type OP, Grade NF. (Interior Applications)
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Pecora Corporation; AC-20+.
    - b. BASF Building Systems; Sonolac.
    - c. Bostik, Inc.; Chem-Calk 600.
    - d. Tremco Incorporated; Tremflex 834.

## 2.4 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.



## 2.5 IMMERSIBLE JOINT SEALANTS

- A. Immersible Joint Sealants. Suitable for immersion in liquids; ASTM C 1247, tested in de-ionized water unless otherwise indicated
- B. Urethane, Immersible, multicomponent, nonsag Urethane Sealant for working joints in concrete work.
  - 1. Products: Available products include the following:
    - a. Dynatrol I-XL; Pecora Corporation.
    - b. SikaFlex-2c NS EZ Mix; Sika Corporation.
    - c. Or approved equal.
  - 2. Type and Grade: MC (multi component) and NS (nonsag) Class: 25
  - 3. Used Related to Exposure: T (traffic)
  - 4. Must meet the requirements of NSF/ANSI Standards 61
  - 5. Applications: Concrete Joints- Vertical Surfaces.
- C. Urethane, Immersible, multicomponent, pourable Urethane Sealant for working joints in concrete work.
  - 1. Products: Available products include the following:
    - a. Dynatrol I-XL; Pecora Corporation.
    - b. SikaFlex 1a; Sika Corporation.
    - c. Or approved equal.
  - 2. Type and Grade: MC (multi component) and P (pourable) Class: 25
  - 3. Used Related to Exposure: T (traffic) – Provide suitable wearing surface for foot traffic if required.
  - 4. Must meet the requirements of NSF/ANSI Standards 61
  - 5. Applications: Concrete Joints- Flat Surfaces.

## 2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, 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 of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
    - d. Exterior insulation and finish systems.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

### 3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
  - 1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform 10 tests for the first 1,000 feet (300 m) of joint length for each kind of sealant and joint substrate.
  - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  - 3. Inspect tested joints and report on the following:
    - a. Whether sealants filled joint cavities and are free of voids.

- b. Whether sealant dimensions and configurations comply with specified requirements.
    - c. Whether 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 kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
  - 4. Record test results in a field-adhesion-test log. 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 material, sealant configuration, and sealant dimensions.
  - 5. 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.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered 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.

### 3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.6 PROTECTION

- A. Protect joint sealants during and after curing period 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

**END OF SECTION 079200**

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## SECTION 079500 – EXPANSION CONTROL

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Exterior wall expansion control systems.
- B. Related Requirements:
  - 1. Division 07 Section "Joint Sealants" for liquid-applied joint sealants and for elastomeric sealants without metal frames.

#### 1.2 ACTION SUBMITTALS

- A. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, blockout requirement, attachments to other work, and line diagrams showing entire route of each expansion control system. Where expansion control systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- B. Samples: For each exposed expansion control system and for each color and texture specified, full width by 6-inches (150 mm) long in size.
- C. Samples for Initial Selection: For each type of expansion control system indicated.
  - 1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric seal material.
- D. Samples for Verification: For each type of expansion control system indicated, full width by 6-inches (150 mm) long in size.
- E. Product Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
  - 1. Manufacturer and model number for each expansion control system.
  - 2. Expansion control system location cross-referenced to Drawings.
  - 3. Nominal joint width.
  - 4. Movement capability.
  - 5. Classification as thermal or seismic.
  - 6. Materials, colors, and finishes.
  - 7. Product options.
  - 8. Fire-resistance ratings.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each fire barrier provided as part of an expansion control system, for tests performed by a qualified testing agency.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
  - 1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
  - 2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.
- B. Coordination: Coordinate installation of exterior wall expansion control systems with roof expansion control systems to ensure that wall transitions are watertight. Roof expansion joint assemblies are specified elsewhere.

### 2.2 EXTERIOR WALL EXPANSION CONTROL SYSTEMS

- A. Available 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:
  - 1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
  - 2. Balco, Inc.
  - 3. Chase Construction Products; Division of Chase Corporation.
  - 4. Construction Specialties, Inc.
  - 5. D. S. Brown Company (The).
  - 6. EMSEAL Corporation.
  - 7. Erie Metal Specialties, Inc.
  - 8. JointMaster/InPro Corporation.
  - 9. LymTal International, Inc.
  - 10. Michael Rizza Company, LLC.
  - 11. MM Systems Corporation.
  - 12. Nystrom, Inc.
  - 13. RJ Watson, Inc.
  - 14. Schul International Company, Inc.
  - 15. Tremco Incorporated.
  - 16. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
  - 17. Williams Products, Inc.
- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.
- C. Wall-to-Wall :
  - 1. Design Criteria:
    - a. Nominal Joint Width: 1-inch.
    - b. Minimum Joint Width: ½-inch.
    - c. Maximum Joint Width: 1½-inch.
  - 2. Type: Preformed cellular foam.

- a. Foam Material: Manufacturer's standard.
  - 1) Color: As selected by Architect from manufacturer's full range.

## 2.3 MATERIALS

- A. Compression Seals: ASTM E 1612; preformed elastomeric extrusions having an internal baffle system and designed to function under compression.
- B. Cellular Foam Seals: Extruded, compressible foam designed to function under compression.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces where expansion control systems will be installed for installation tolerances and other conditions affecting performance of work.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to expansion control system manufacturer's written instructions.
- B. Coordinate and furnish installation accessories, setting drawings and instructions for installing expansion control systems. Provide materials to suit type of construction indicated and to provide for secure attachment of expansion control systems.

### 3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.
- B. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both sides of wall substrates before installing compression seals.
- C. Foam Seals: Install with adhesive recommended by manufacturer.
- D. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.



### 3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

**END OF SECTION 079500**

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Standard hollow-metal steel doors.
  - 2. Standard hollow-metal steel frames.
- B. Related Requirements:
  - 1. Division 08 Section "Door Hardware" for door hardware for doors.
  - 2. Division 09 Section "Exterior Painting" for field painting hollow metal frames.

#### 1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

#### 1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal 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.

#### 1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, and finishes for each type of steel door and frame specified.
- A. Shop Drawings: Include the following:
  - 1. Elevations of each door type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
  - 7. Details of anchorages, joints, field splices, and connections.
  - 8. Details of accessories.
  - 9. Details of moldings, removable stops, and glazing.
- B. Samples for Initial Selection: For hollow-metal doors and frames with factory-applied color finishes.

- C. Samples for Verification:
  - 1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3- by 5-inches (75 by 127 mm).
  - 2. Fabrication: Prepare Samples approximately 12- by 12-inches (305 by 305 mm) to demonstrate compliance with requirements for quality of materials and construction:
    - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
    - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.
- D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102 mm-) high wood blocking. Avoid using non-vented plastic or canvas shelters that could create a humidity chamber.
  - 1. If wrappers on doors become wet, remove cartons immediately. Provide minimum ¼-inch (6 mm) space between each stacked door to permit air circulation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available 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:
  - 1. Ceco Door Products; an ASSA ABLOY Group Company.
  - 2. Curries Company; an ASSA ABLOY Group Company.

3. Steelcraft; an Allegion Brand.

## 2.2 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Standard-Duty Frames: SDI A250.8, Level 1. At locations indicated in the Door and Frame Schedule.
  1. Physical Performance: Level C according to SDI A250.4.
- C. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.
  1. Fabricate frames with mitered or coped corners.
  2. Fabricate frames as full profile welded unless otherwise indicated.
  3. Frames for Level 3 Steel Doors: 0.053-inch thick steel sheet.
  4. Frames for Wood Doors: 0.053-inch thick steel sheet.
  5. Frames for Borrowed Lights: 0.053-inch thick steel sheet.

## 2.3 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3.
  1. Physical Performance: Level A according to SDI A250.4.
  2. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1¾-inches.
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053-inch, with minimum A40 coating.
    - d. Edge Construction: Model 2, Seamless.
    - e. Core: Manufacturer's standard polystyrene, polyurethane, polyisocyanurate, mineral-board or vertical steel stiffeners.
  3. Frames:
    - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053-inch, with minimum A40 coating.
    - b. Transom Frames: Fabricated from same thickness material as adjacent door frame.
    - c. Construction: Full profile welded.
  4. Exposed Finish: Prime.

## 2.4 FRAME ANCHORS

- A. Jamb Anchors:
  1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042-inch (1.0 mm) thick, with corrugated or perforated straps not less than 2-inches (51 mm) wide by 10-inches (254 mm) long; or wire anchors not less than 0.177-inch (4.5 mm) thick.
  2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042-inch (1.0 mm) thick.

3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
  4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5 mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042-inch (1.0 mm), and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
  2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51 mm) height adjustment. Terminate bottom of frames at finish floor surface.

## 2.5 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032-inch thick, same material as door face sheet.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8-inch high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032-inch thick, same material as frames.

## 2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
  1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4-inches (102 mm), as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-

developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

- I. Glazing: Comply with requirements in Division 08 Section "Glazing."
- J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.7 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
  - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026-inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 5-inches (152 mm) apart. Spot weld to face sheets no more than 5-inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
  - 2. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  - 1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  - 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
  - 5. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Provide a minimum of 3 anchors for each jamb for frames 84-inches high and under and one additional anchor for each 30-inches or less frame height. Locate anchors opposite top and bottom hinges and midway between, with a maximum spacing of 24-inches between anchors.
  - 6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
  - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
  
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
  - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
  - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  - 4. Provide loose stops and moldings on inside of hollow-metal work.
  - 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

## 2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## 2.9 ACCESSORIES

- A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- (0.5 mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8 mm-) thick steel frame.
  - 1. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.
  
- B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
  
- C. Grout Guards: Formed from same material as frames, not less than 0.016-inch (0.4 mm) thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-rated openings, install frames according to NFPA 80.
    - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - c. Install frames with removable stops located on secure side of opening.
    - d. Install door silencers in frames before grouting.
    - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.



2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
  4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
  5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
  6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
  8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16-inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16-inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16-inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16-inch (1.6 mm), measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
    - a. Between Door and Frame Jambs and Head: 1/8-inch (3.2 mm) plus or minus 1/32-inch (0.8 mm).
    - b. Between Edges of Pairs of Doors: 1/8-inch (3.2 mm) to 1/4-inch (6.3 mm) plus or minus 1/32-inch (0.8 mm).
    - c. At Bottom of Door: 3/4-inch (19.1 mm) plus or minus 1/32-inch (0.8 mm).
    - d. Between Door Face and Stop: 1/16-inch (1.6 mm) to 1/8-inch (3.2 mm) plus or minus 1/32-inch (0.8 mm).
  2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
  3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow-metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9-inches (230 mm) o.c. and not more than 2-inches (51 mm) o.c. from each corner.

### 3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

**END OF SECTION 081113**

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## **SECTION 083323 – OVERHEAD COILING DOORS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Insulated service doors.
- B. Related Requirements:
  - 1. Division 05 Section "Metal Fabrications" for miscellaneous steel supports.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type and size of overhead coiling door and accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
  - 2. Include rated capacities, operating characteristics and furnished accessories.
  - 3. Preparation instructions and recommendations
  - 4. Storage and handling requirements and recommendations.
  - 5. Details of construction and fabrication.
  - 6. Installation methods.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
  - 5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
  - 6. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
  - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
  - 1. Curtain slats, including full vision window secured to slat.
  - 2. Bottom bar with sensor edge.
  - 3. Guides.
  - 4. Brackets.
  - 5. Hood.

6. Locking device(s).
7. Include similar Samples of accessories involving color selection.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

B. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
2. Authorized representative of the manufacturer with minimum five years documented experience.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified with minimum of five years documented experience.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling door manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: As indicated on Drawings.
2. Testing: According to ASTM E 330.
3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

4. Operability under Wind Load: Design overhead coiling doors to remain operable under design uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa) wind load, acting inward and outward.
- B. Windborne-Debris Impact Resistance: Provide impact-protective overhead coiling doors that pass missile-impact and cyclic-pressure tests according to ASTM E 1996 for Wind Zone 1.
  1. Large-Missile Test: For overhead coiling doors located within 30 feet (9.144 m) of grade.
- C. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.
- E. Electric Motors shall be alternating-current squirrel-cage motors conforming with NEMA MG-1.
- F. Wiring Connections: Requirements for electrical characteristics.
  1. 120 volts, 60 Hz single phase.

## 2.3 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
- B. Manufacturers:
  1. Cookson
  2. Raynor
  3. Overhead Door Corp.
  4. Or approved equal.
- C. Heavy Duty Rolling Door and Grille Operator: Model RHX True Gear Head Type Door Operator or equal:
  1. Application:
    - a. Rolling Steel Doors.
  2. Electric Motor: UL listed.
    - a. Rating:
      - 1) ½ horsepower single phase or three phase with automatic thermal reset overload.
    - b. Motor frame comply with:
      - 1) NEMA 48 for ½ hp single phase.
    - c. Construction:
      - 1) Totally Enclosed Fan Cooled – TEFC construction.
    - d. The operator shall be suited for:
      - 1) NEMA ICS 6 Type 1 general purpose environment.
    - e. Reduction: Primary reduction is worm gear in oil bath.
    - f. Duty cycle: Accommodate heavy usage, up to 60 cycles per hour under a large constant load.

- 1) Brake: DC Disc type with selectable Progressive Braking for smooth stopping.
  - 2) Clutch: Adjustable torque-limiter type.
  - 3) Limit System: LimitLock limit system, magnetic type providing absolute positioning with push to set and remote setting capabilities. Limit system shall remain synchronized with the door during manual operation and supply power interruptions.
3. Control System: Microprocessor based with relay motor controls on a single board. System incorporates a 16 character Liquid Crystal Display (LCD) to display the system status. System shall include the following:
- a. Capable of monitoring and reporting on a variety of operating conditions, including: Current operating status, Current command status, Motor movement status, Current error status (if applicable), Hoist Interlock status (if applicable), External Interlock status, and 24VDC status.
  - b. A delay-on-reverse operating protocol.
  - c. Maximum run timers in both directions of travel that limit motor run time in the event a clutch slips or some other problem occurs.
  - d. Provisions for the connection of a 2-wire monitored photo-eye or a 2-wire monitored edge sensor, as well as non-monitored 2-wire sensing edges, photo-eyes or other entrapment protection devices.
  - e. Control action will be constant contact close until a monitored entrapment device is installed, allowing for selection of momentary contact.
  - f. Provisions for connection of an external 3-wire radio controls and related control devices.
  - g. On board open, close and stop control keys for local operation.
  - h. CodeDodger radio receiver that is dual frequency cycling at 315 Mhz and 390 Mhz capable of storing 250 single button and/or 250 Open-Close-Stop transmitters with the ability to add and/or delete transmitters individually, identify and store activating transmitter IDs.
4. Mounting:
- a. Rolling Steel doors:
    - 1) Front of hood and chain/sprocket coupling to door.
5. Release:
- a. Release shall be a pull and hold type mechanism with single cable operation and an integrated interlock switch on hoist units.
6. Hoist: Chain hoist consists of chain pocket wheel, chain guard and smooth hand chain on hoist units.
7. Entrapment Protection:
- a. Control system shall have provisions to connect monitored entrapment protection devices such as monitored electric sensing edge, or monitored photo-eye and to provide constant contact close control operation in lieu of such devices.
8. Control accessories:
- a. Operator Controls:
    - 1) Push-button operated control stations with open, close, and stop buttons.
    - 2) Controls for interior location.
    - 3) Controls surface mounted.
  - b. Special Operation:
    - 1) Card reader control.
    - 2) Commercial photo-eyes

- 3) Timer Close Module for unattended timed door closing. Auxiliary control inputs, safety inputs, timer hold input and automatic door closing feature with selectable time delay. Safety inputs can be configured using on board keypad.
- D. Retain one of five options in "Operation Cycles" Paragraph below. First option is standard with some manufacturers; second option is more commonly used. Last three options are for high-cycle operation, corrosive environments, and severe or abusive use. Consult manufacturer for recommendations.
  - E. Operation Cycles: Door components and operators capable of operating for not less than 100,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
    1. Include tamperproof cycle counter.
  - F. Curtain R-Value:  $4.5^{\circ}\text{F} \times \text{h} \times \text{sq. ft.}/\text{Btu}$  ( $0.792 \text{ K} \times \text{sq. m}/\text{W}$ ) .
  - G. Door Curtain Material: Steel.
  - H. Door Curtain Slats: Flat profile slats.
    1. Insulated-Slat Interior Facing: Metal.
    2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
  - I. Bottom Bar: Two angles, each not less than 1½- by 1½- by 1/8-inch (38 by 38 by 3 mm) thick; fabricated from stainless steel or aluminum extrusions and finished to match door.
  - J. Curtain Jamb Guides: Stainless steel with exposed finish matching curtain slats.
  - K. Hood: Match curtain material and finish Stainless steel Aluminum.
    1. Shape: Round or Square.
    2. Mounting: Between jambs.
  - L. Locking Devices: Equip door with locking device assembly.
    1. Locking Device Assembly: Single-jamb side locking bars, operable from inside and outside with cylinders.
  - M. Curtain Accessories: Equip door with weather seals. Exterior mounted coil doors housing must be furnished with Lintel Brush Weather Seal.
  - N. Door Finish:
    1. Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations.

## 2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:



1. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
  2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum aluminum thickness of 0.032-inch (0.80 mm).
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks. On exterior mounted Coil Box Housing, provide additional Lintel Brush Weather Seal.

## 2.5 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Aluminum: 0.040-inch- (1.02 mm-) thick aluminum sheet complying with ASTM B 209 (ASTM B 209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.

## 2.6 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
1. Lock Cylinders: Cylinders standard with manufacturer and keyed to building keying system.
  2. Keys: Three for each cylinder.
- C. Chain Lock Keeper: Suitable for padlock.
- D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

## 2.7 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
1. At door head, use 1/8-inch- (3 mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.

2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3 mm-) thick seals of flexible vinyl, rubber, or neoprene nylon brushes Insert material.
- B. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- C. Pull-Down Strap: Provide pull-down straps for doors more than 84-inches (2,130 mm) high.
- D. Poll Hooks: Provide pole hooks and poles for doors more than 84-inches (2,130 mm) high.

## 2.8 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.9 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.10 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrate areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Verify door sizes, configuration, tolerances and conditions are acceptable.

### 3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Use anchorage devices to securely fasten assembly without distortion or stress.
- E. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

### 3.3 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
  - 1. Adjust exterior doors and components to be weather-resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

### 3.4 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.

2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

**END OF SECTION 083323**

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## SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Exterior storefront framing.

#### 1.2 DEFINITIONS

- A. 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."

#### 1.3 PERFORMANCE REQUIREMENTS

- A. 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. Glazing-to-glazing contact.
    - e. Noise or vibration created by wind and by thermal and structural movements.
    - f. Loosening or weakening of fasteners, attachments, and other components.
    - g. Sealant failure.
    - h. Failure of operating units.
- B. Structural Loads:
1. Wind Loads: As indicated on Drawings and in NCBC 2012 for 90 mph winds exposure category C.
  2. Seismic Loads: As indicated on Drawings.
  3. Blast Loads: As indicated on Drawings.
- C. 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 (19 mm), whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8-inch (3.2 mm), whichever is smaller.
- D. 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% 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% of span.
    3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
  - E. 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 or AAMA 506.
    1. Large-Missile Impact: For aluminum-framed systems located within 30-feet (9.1 m) of grade.
  - F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa) 6.24 lbf/sq. ft. (300 Pa).
  - G. For water-penetration tests, static-air-pressure difference of 20% of wind-load design pressure provides satisfactory performance in most parts of the U.S. Locations where high winds and heavy rains frequently occur simultaneously require higher test-pressure differences. Lower test-pressure differences are acceptable for some locations. Revise first paragraph below to suit Project.
  - H. 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 20% of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
  - I. 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 20% of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
    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.
  - J. 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°F (67°C), ambient; 180°F (100°C), 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°F (82°C).
    - b. Low Exterior Ambient-Air Temperature: 0°F (minus 18°C).
  3. Interior Ambient-Air Temperature: 75°F (24°C).
- K. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.
- L. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) when tested according to AAMA 1503.
- M. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:
  1. Sound Transmission Class (STC): Minimum 35 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
  2. Outdoor-Indoor Transmission Class (OITC): Minimum 34 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.
- N. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by aluminum-framed systems without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
  1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
  2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.
- O. Structural-Sealant Joints: Designed to produce tensile or shear stress of less than 20 psi (138 kPa).
- 1.4 SUBMITTALS
- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
  1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.



- D. Preconstruction Test Reports: For sealant.
- E. Source quality-control reports.
- F. Quality-Control Program for Structural-Sealant-Glazed System: Include reports.
- G. Warranties: Sample of special warranties.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- D. Quality-Control Program for Structural-Sealant-Glazed System: Develop quality control program specifically for Project. Document quality-control procedures and verify results for aluminum-framed systems. Comply with ASTM C 1401 recommendations including, but not limited to, system material-qualification procedures, preconstruction sealant-testing program, procedures for system fabrication and installation, and intervals of reviews and checks.
- E. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
  - 1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- F. Preconstruction Sealant Testing: For structural-sealant-glazed systems, perform sealant manufacturer's standard tests for compatibility with and adhesion of each material that will come in contact with sealants and each condition required by aluminum-framed systems.
  - 1. Test a minimum five samples each of metal, glazing, and other material.
  - 2. Prepare samples using techniques and primers required for installed systems.
  - 3. For materials that fail tests, determine corrective measures necessary to prepare each material to ensure compatibility with and adhesion of sealants including, but not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.
- G. 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. Enforcement of ADA is the responsibility of the Department of Justice. Any discrepancies between ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1, the most restrictive shall apply.

- H. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- I. Structural-Sealant Glazing: Comply with ASTM C 1401, "Guide for Structural Sealant Glazing" for design and installation of structural-sealant-glazed systems.
- J. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.
- K. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."
- L. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical wall area as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Owner's Acceptance.
- M. Preinstallation Conference: Conduct conference at Project site.

#### 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 Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems 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 caused by thermal movements.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - d. Adhesive or cohesive sealant failures.
    - e. Water leakage through fixed glazing and framing areas.
    - f. Failure of operating components.
  - 2. Warranty Period: 10 years from date of Owner Acceptance.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
  - 1. Warranty Period: 20 years from date of Owner Acceptance.

## 1.8 MAINTENANCE SERVICE

- A. Structural-Sealant-Glazed Systems:
1. Initial Maintenance Service: Beginning at Owner Acceptance, provide 12 months' full maintenance by skilled employees of structural-sealant-glazed system Installer. Include quarterly preventive maintenance, repair or replacement to ensure long-term performance and durability of structural-sealant-glazed system as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original system.
  2. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available 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:
1. Arcadia, Inc.
  2. Arch Aluminum & Glass Co., Inc.
  3. CMI Architectural.
  4. Commercial Architectural Products, Inc.
  5. EFCO Corporation.
  6. Kawneer North America; an Alcoa company.
  7. Leed Himmel Industries, Inc.
  8. Pittco Architectural Metals, Inc.
  9. TRACO.
  10. Tubelite.
  11. United States Aluminum.
  12. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
  13. YKK AP America Inc.

### 2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
  2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
  3. Extruded Structural Pipe and Tubes: ASTM B 429.
  4. Structural Profiles: ASTM B 308/B 308M.
  5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and

pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

## 2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  1. Storefront Systems
    - a. Construction: Thermally broken.
    - b. Glazing System: Retained mechanically with gaskets on four sides.
    - c. Glazing Plane: Front.
  2. Bridges
    - a. Bridge system shall be single glazed on rear as detailed on drawings
- B. Size: As indicated.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.
  3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- F. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- G. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

## 2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
- E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:
  - 1. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.
    - a. Color: As selected by Architect from manufacturer's full range of colors.
  - 2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.
    - a. Color: Matching structural sealant.

## 2.5 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762 mm) thickness per coat.

## 2.6 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
  - 4. Physical and thermal isolation of glazing from framing members.
  - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 6. Provisions for field replacement of glazing from exterior.
  - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

- E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
- F. Storefront Framing: Fabricate components for assembly using screw-spline system.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.7 ALUMINUM FINISHES

- A. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70% PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General:
  - 1. Comply with manufacturer's written instructions.
  - 2. Do not install damaged components.
  - 3. Fit joints to produce hairline joints free of burrs and distortion.
  - 4. Rigidly secure non-movement joints.
  - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
  - 6. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
  - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
  - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing as specified in Division 08 Section "Glazing."
  - 1. Structural-Sealant Glazing:
    - a. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
    - b. Install weatherseal sealant according to Division 07 Section "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- G. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

### 3.3 ERECTION TOLERANCES

- 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 (3 mm in 3.7 m); 1/4-inch (6 mm) over total length.
  - 2. Alignment:
    - a. Where surfaces abut in line, limit offset from true alignment to 1/16-inch (1.5 mm).
    - b. Where surfaces meet at corners, limit offset from true alignment to 1/32-inch (0.8 mm).
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8-inch (3 mm).

### 3.4 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
  - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

**END OF SECTION 084113**

## **SECTION 087100 – DOOR HARDWARE**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes commercial door hardware for the following:
  - 1. Swinging doors.
  - 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
  - 1. Mechanical door hardware.
  - 2. Cylinders specified for doors in other sections.
- C. Related Sections:
  - 1. Division 08 Section “Hollow Metal Doors and Frames”.
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
  - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  - 2. ICC/IBC - International Building Code.
  - 3. NFPA 70 - National Electrical Code.
  - 4. NFPA 80 - Fire Doors and Windows.
  - 5. NFPA 101 - Life Safety Code.
  - 6. NFPA 105 - Installation of Smoke Door Assemblies.
  - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards:
  - 1. ANSI/BHMA Certified Product Standards - A156 Series
  - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies

#### **1.2 SUBMITTALS**

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals



that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:
  - a. Type, style, function, size, label, hand, and finish of each door hardware item.
  - b. Manufacturer of each item.
  - c. Fastenings and other pertinent information.
  - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
  - e. Explanation of abbreviations, symbols, and codes contained in schedule.
  - f. Mounting locations for door hardware.
  - g. Door and frame sizes and materials.
  - h. Warranty information for each product.
4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

- C. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified installer of Windstorm assemblies.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals
  1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01 Section "Closeout Submittals".

### 1.3 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that

indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

- D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
- E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- F. Keying Conference: Keying conference to incorporate the following criteria into the final keying schedule document:
  - 1. Function of building, purpose of each area and degree of security required.
  - 2. Plans for existing and future key system expansion.
  - 3. Requirements for key control storage and software.
  - 4. Installation of permanent keys, cylinder cores and software.
  - 5. Address and requirements for delivery of keys.
- G. Pre-Submittal Conference: Conduct coordination with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
  - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
  - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
  - 3. Review sequence of operation narratives for each unique access controlled opening.
  - 4. Review and finalize construction schedule and verify availability of materials.
  - 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

## 1.5 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

## 1.6 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Faulty operation of the hardware.
  - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
  - 1. Seven years for heavy duty cylindrical (bored) locks and latches.
  - 2. Five years for exit hardware.
  - 3. Twenty five years for manual surface door closer bodies.

## 1.7 MAINTENANCE SERVICE

- A. 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.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
- C. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01 Section "Product Requirements". Approval of requests is at the discretion of the architect, owner, and their designated consultants.

## 2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
  - 1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
    - a. Two Hinges: For doors with heights up to 60-inches.
    - b. Three Hinges: For doors with heights 61- to 90-inches.
    - c. Four Hinges: For doors with heights 91- to 120-inches.
    - d. For doors with heights more than 120-inches, provide 4 hinges, plus 1 hinge for every 30-inches of door height greater than 120 inches.
  - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    - a. Widths up to 3'0": 4½-inches standard or heavy weight as specified.
    - b. Sizes from 3'1" to 4'0": 5-inches standard or heavy weight as specified.
  - 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
    - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
  - 4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
    - a. 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; for the all out-swinging lockable doors.
  - 5. Acceptable Manufacturers:
    - a. Hager Companies (HA).
    - b. McKinney Products (MK).
    - c. Stanley Hardware (ST).
- B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4-inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
  - 1. Acceptable Manufacturers
    - a. Bommer Industries (BO).

- b. McKinney Products (MK).
  - c. Pemko Manufacturing (PE).
- C. Pin and Barrel Continuous Hinges: ANSI/BHMA A156.26 Grade 1-600 certified pin and barrel continuous hinges with minimum 14 gauge Type 304 stainless steel hinge leaves, concealed teflon coated stainless pin, and twin self lubricated nylon bearings at each knuckle separation. Factory trim hinges to suit door height and prepare for electrical cut-outs.
- 1. Acceptable Manufacturers
    - a. Hager Companies (HA).
    - b. Markar Products (MR).
    - c. McKinney Products (MK).

### 2.3 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
- 1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
  - 2. Furnish dust proof strikes for bottom bolts.
  - 3. Surface bolts to be minimum 8-inches in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
  - 4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
  - 5. Acceptable Manufacturers
    - a. Door Controls International (DC).
    - b. Rockwood Manufacturing (RO).
    - c. Trimco (TC).
- B. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
- 1. Push/Pull Plates: Minimum 0.050-inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
  - 2. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
  - 3. Acceptable Manufacturers
    - a. Hiawatha, Inc. (HI).
    - b. Rockwood Manufacturing (RO).
    - c. Trimco (TC).

### 2.4 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
- C. Cylinders: Original manufacturer cylinders complying with the following:
- 1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.

2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
  4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  5. Keyway: Match Facility Standard.
- D. Keying System: Each type of lock and cylinders to be factory keyed.
1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
  2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
  3. Existing System: Key locks to Owner's existing system.
- E. Key Quantity: Provide the following minimum number of keys:
1. Change Keys per Cylinder: Two (2)
  2. Master Keys (per Master Key Level/Group): Five (5).
  3. Construction Keys (where required): Ten (10).
- F. Construction Keying: Provide construction master keyed cylinders.
- G. Key Registration List (Bitting List)
1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
  2. Provide transcript list in writing or electronic file as directed by the Owner.
- H. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
1. Acceptable Manufacturers
    - a. Lund Equipment (LU).
    - b. MMF Industries (MM).
    - c. Telkee (TK).

## 2.5 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified.
1. Furnish with solid cast levers, standard 2¾-inch backset, and ½-inch (¾-inch at rated paired openings) throw brass or stainless steel latchbolt.
  2. Locks are to be non-handed and fully field reversible.
  3. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.2 requirements to 2 million cycles.
  4. Acceptable Manufacturers:
    - a. Corbin Russwin Hardware (RU) – CL3300 Series.
    - b. Sargent Manufacturing (SA) – 10 Line.
    - c. Stanley Best (BE) – 9K Series.

## 2.6 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
  4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
1. Strikes for Mortise Locks and Latches: BHMA A156.13.
  2. Strikes for Bored Locks and Latches: BHMA A156.2.
  3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
  4. Dustproof Strikes: BHMA A156.16.

## 2.7 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
  2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
  3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
  4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
  5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
    - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
  6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
  7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2-inches wide stiles.
  8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
  9. Rail Sizing: Provide exit device rails factory sized for proper door width application.

10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
  1. Available 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. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
    - b. Sargent Manufacturing (SA) - 80 Series.
    - c. Von Duprin (VD) - 35A/98 XP Series.
- C. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish.
  1. Provide keyed removable feature where specified in the Hardware Sets.
  2. Provide stabilizers and mounting brackets as required.
  3. Provide electrical quick connection wiring options as specified in the hardware sets.
  4. Acceptable Manufacturers:
    - a. Corbin Russwin Hardware (RU) - 700/900 Series.
    - b. Sargent Manufacturing (SA) - 980S Series.
    - c. Von Duprin (VD) - 9954 Series.

## 2.8 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
  1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
  2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
  3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
  4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
  5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
  6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
  7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt and security type fasteners as required for proper installation.
- B. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 certified surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.



1. Acceptable Manufacturers
  - a. Norton Door Controls (NO) - 7500 Series.
  - b. Sargent Manufacturing (SA) - 1431 Series.
  - c. Corbin Russwin (RU) – DC-6000 Series.
  - d. LCN Closers – 4040XP Series.

## 2.9 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
  1. Available 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. Hager Companies (HA).
    - b. Rockwood Manufacturing (RO).
    - c. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
  1. Available 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. Glynn Johnson (GJ).
    - b. Rixson Door Controls (RF).
    - c. Sargent Manufacturing (SA).

## 2.10 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
  1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
  - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Available 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:
  - 1. National Guard Products (NG).
  - 2. Pemko Manufacturing (PE).
  - 3. Reese Enterprises, Inc. (RE).

## 2.11 ELECTRONIC ACCESSORIES

## 2.12 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

## 2.13 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### 3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

### 3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
  - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
  - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

### 3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

### 3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

### 3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

### 3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

### 3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. Manufacturer's Abbreviations:
  - 1. MK – McKinney
  - 2. PE – Pemko
  - 3. MR – Markar
  - 4. RO – Rockwood
  - 5. SA – Sargent
  - 6. RF – Rixson
  - 7. 00 – Other

## HARDWARE SETS

### HW SET # 1.0

Hinge	T4A3386 x NRP	US32D	MK
1 Electric Hinge	T4A3386 x QC	US32D	MK
1 Elect Rim Exit Device	55 56 8804 ETJ LB	US32D	SA
1 Door Closer	351 CPS	EN	SA
1 Kick Plate	K1050 8" CSK 3BE	US32D	RO
1 Threshold	1716A		PE
1 Set Weatherstrip	303AS		PE
1 Rain Guard	346C		PE
1 Door Bottom Sweep	3452CNB		PE
1 ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
1 ElectroLynx Harness	QC-C003P		MK
1 Wiring Diagram	AS REQUIRED		00
1 Card Reader	FURNISHED IN OTHER SECTION		00
1 Power Supply	BY SECURITY CONTRACTOR		SU

OPERATION: DOOR TO BE CLOSED AND LOCKED AT ALL TIMES. PRESENTATION OF A VALID CARD SIGNALS ELECTRIC LATCH RETRACTION ALLOWING INGRESS. EGRESS AT ALL TIMES BY EXIT DEVICE PUSH BAR.

### HW SET # 2.0

Hinge	T4A3386 x NRP	US32D	MK
2 Electric Hinge	T4A3386 x QC	US32D	MK
1 Elect CVR Exit Device	55 56 MD8606 ETJ LB	US32D	SA
1 Elect CVR Exit Device	55 56 MD8610 ETJ	US32D	SA
2 Door Closer	351 CPS	EN	SA
2 Kick Plate	K1050 8" CSK 3BE	US32D	RO
1 Threshold	1716A		PE
1 Set Weatherstrip	303AS		PE
1 Rain Guard	346C		PE
2 Door Bottom Sweep	3452CNB		PE
1 Set Astragal	18041CNB		PE
2 ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
2 ElectroLynx Harness	QC-C003P		MK
1 Wiring Diagram	AS REQUIRED		00
1 Card Reader	FURNISHED IN OTHER SECTION		00
1 Power Supply	BY SECURITY CONTRACTOR		SU

OPERATION: DOORS TO BE CLOSED AND LOCKED AT ALL TIMES. PRESENTATION OF A VALID CARD SIGNALS ELECTRIC LATCH RETRACTION ALLOWING INGRESS. EGRESS AT ALL TIMES BY EXIT DEVICE PUSH BARS.

HW SET # 3.0

1 Continuous Hinge	FM300	630	MR
1 Magnetic Lock	EP17624	628	SD
1 Set Push Pull	111x73C/73CL	US32D	RO
1 Door Closer	351 CPS	EN	SA
1 Kick Plate	K1050 8" CSK 3BE	US32D	RO
1 Threshold	1716A		PE
1 Set Weatherstrip	303AS		PE
1 Rain Guard	346C		PE
1 Door Bottom Sweep	3452CNB		PE
1 Wiring Diagram	AS REQUIRED		00
1 Card Reader	FURNISHED IN OTHER SECTION		00
1 Exit Push Button	EXP-1		AK
1 Power Supply	BY SECURITY CONTRACTOR		SU

OPERATION: DOOR TO BE CLOSED AND LOCKED AT ALL TIMES BY MAGNETIC LOCK. PRESENTATION OF A VALID CARD RELEASES MAGNETIC LOCK ALLOWING INGRESS. EGRESS AT ALL TIMES BY EXIT PUSH BUTTON. MAGNETIC LOCK TO BE TIED INTO FIRE ALARM SYSTEM.

NOTE: ALL ELECTRIFIED HARDWARE SHALL BE ANTI-SPARK HARDWARE.

HW SET # 4.0

Hinge	TA2314	US32D	MK
1 Privacy Set	49 8265 LNJ	US32D	SA
1 Door Closer	351 PS	EN	SA
1 Kick Plate	K1050 8" CSK 3BE	US32D	RO
1 Set Door Seals/Silencers	S88D/608 AS REQUIRED		PE

HW SET # 5.0

NOTE: OVERHEAD DOOR - ALL HARDWARE FURNISHED IN OTHER SECTION BY DOOR/SECURITY MANUFACTURER.

MANUFACTURERS ABBREVIATIONS:

1. MK - McKinney
2. MR - Markar
3. SA - Sargent
4. SU - Securitron
5. SD - Security Door Controls
6. RO - Rockwood
7. PE - Pemko
8. AK - Alarm Controls

**END OF SECTION 087100**

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## SECTION 088000 – GLAZING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
  - 1. Windows.
  - 2. Doors.
- B. Related Sections:
  - 1. Division 08 Section "Hollow Metal Doors and Frames."
  - 2. Division 08 Section "Aluminum Framed Entrances and Storefronts"

#### 1.2 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 millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
  - 1. Temperature Change: 120°F (67°C), ambient; 180°F (100°C), material surfaces.

#### 1.4 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For the following products; 12-inches (300 mm) square.
  - 1. Insulating glass.
- C. Glazing Accessory Samples: For gaskets and colored spacers, in 12-inch (300 mm) lengths.



- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- E. Product Certificates: For glass and glazing products, from manufacturer.
- F. Preconstruction adhesion and compatibility test report.
- G. Warranties: Sample of special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- D. Source Limitations for Glass: Obtain laminated glass and insulating glass from single source from single manufacturer for each glass type.
- E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- F. 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. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- G. 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 or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- H. Insulating-Glass Certification Program: Permanently marked either on spacers or lite with appropriate certification label of IGCC.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

## 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°F (4.4°C).

## 1.8 WARRANTY

- A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. 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.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
  - 1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- 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 laminated-glass lites, properties are based on products of construction indicated.
  - 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  - 3. 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 (W/sq. m x K).
  - 4. 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.
  - 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

### 2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
  - 2. For uncoated glass, comply with requirements for Condition A.
  - 3. For coated vision glass, comply with requirements for Condition C (other coated glass).

## 2.3 INSULATING GLASS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - 1. AFG Industries, Kingsport, TN.
  - 2. Pilkington North America, Toledo, OH.
  - 3. PPG Industries, Inc., Pittsburgh, PA
- B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
  - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
  - 2. Spacer: Manufacturer's standard spacer material and construction.
  - 3. Desiccant: Molecular sieve or silica gel, or blend of both.
- C. Glass: Comply with applicable requirements in "Glass Products" Article and in "Laminated Glass" Article as indicated by designations in "Insulating-Glass Types" Article and in "Insulating-Laminated-Glass Types" Article.

## 2.4 GLAZING GASKETS

- A. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.
- B. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.

## 2.5 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- 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: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. 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.
- 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 GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

## 2.7 GLASS TYPES

- A. Reflective and Low-E Insulating-Glass Units G-1:
  - 1. Products:
    - a. 70XL Solar Control Low-e “Solarcool Caribia” by PPG, or equal by
    - b. Visteon, or
    - c. Pilkington Building Products North America.
  - 2. Overall Unit Thickness and Thickness of Each Lite: 25 and 6.0 mm
  - 3. Interspace Content: Air or Argon
  - 4. Outdoor Lite: Sputter-coated clear float glass.
    - a. Tint Color: Match existing building.
    - b. Kind HS (heat strengthened).
  - 5. Indoor Lite: Spectrally selective high-performance tinted glass
    - a. Kind HS (heat strengthened)
  - 6. Visible Light Transmittance: 18% minimum.
  - 7. Winter Nighttime U-Factor: 0.29 maximum.
  - 8. Summer Daytime U-Factor: 0.27 maximum.
  - 9. Solar Heat Gain Coefficient: 0.15% maximum.
- B. Insulating-Glass Units G-2:
  - 1. Same as G-1 except non-insulated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. 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 (1,270 mm).

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 (3 mm) 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 GASKET GLAZING (DRY)

- A. Insulated Glazing Unit shall be glazed into the appropriate fire-rated framing with an approved glazing compound (polysulfide sealant or closed cell PVC tape) as supplied by the installer. For 90 minute ratings that exceed 1, 393 in 2, FireLite IGU shall be glazed with fire-rated glazing tape. Note: Do not use pure silicone.

### 3.5 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.

**END OF SECTION 088000**

## SECTION 099113 – EXTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes surface preparation and field painting of exposed exterior items and surfaces as follows:
  - 1. Architecturally Exposed Structural Steel Framing.
  - 2. Concrete Masonry Units
  - 3. Hollow metal doors and frames
- B. Related Sections include the following:
  - 1. Division 08 Section “Hollow Metal Doors and Frames” for doors and frames.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Data for Low Emitting Materials, Paints and Coatings
  - 1. For paints and coatings, including printed statement of VOC content.
- C. Samples for Initial Selection: For each type of topcoat product indicated.
- D. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8-inches (200 mm) square.
  - 2. Step coats on Samples to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.

#### 1.3 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain primers for each coating system from the same manufacturer as the finish coats. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer’s original, unopened packages and containers bearing manufacturer’s name and label and the following information:
  - 1. Product name or title of material.



2. Manufacturer's stock number and date of manufacturer.
3. Contents by volume, for pigment and vehicle constituents.
4. Thinning instructions.
5. Application instructions.
6. Color name and number.
7. VOC content.

- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45°F (7°C).
1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

## 1.5 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50°F and 95°F (10°C and 35°C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5°F (3°C) above the dew point; or to damp or wet surfaces.

## 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
1. Quantity: Furnish an additional 5%, but not less than 1 gallon of each material and color applied.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available 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:
1. Sherwin Williams.
  2. Tnemec Performance Coatings Corporation
  3. ICI Paints.
  4. Or approved equal.

### 2.2 PAINT, GENERAL

- A. Material Compatibility:
1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

- B. Colors: As selected by Architect from manufacturer's full range.

## 2.3 EXTERIOR PAINTING SCHEDULE

- A. Exposed Steel
  - 1. Finish Coat: Tnemec Series 1075U-Color Endura Shield II (2.0-3.0 mils DFT)
- B. Concrete Masonry Units
  - 1. Block Filler: Block filler, latex, exterior, MPI #4.
    - a. Two Coats: Block Filler.
  - 2. Institutional Low-Odor/VOC Latex System MPI INT 4.2E:
    - a. Block Filler: Block filler, latex, exterior, MPI #4.
    - b. Intermediate Coat: Latex, exterior, institutional low odor/VOC, matching topcoat.
    - c. Topcoat: Latex, exterior, institutional low odor/VOC (MPI Gloss Level 3), MPI #15.
- C. Hollow Metal Doors and Frames System
  - 1. 1<sup>st</sup> Coat:Tnemec Series N69-Color Hi-Build Epoxoline II (3.0 – 4.0 mils DFT) If applied by roller, two coats may be required.
  - 2. Finish Coat: Tnemec Series 1075U-Color Endura Shield II (2.0-3.0 mils DFT)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

### 3.1 PREPARATION

- A. For renovation projects, consult "MPI Maintenance Repainting Manual" and revise first paragraph below and paint systems specified in the Exterior Painting Schedule.
- B. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- C. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

- D. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- E. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- F. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
- G. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- H. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer. Galvanized-metal substrates should not be chromate passivated (commercially known as "bonderized") if primers are field applied. If galvanized metal is chromate passivated, consult manufacturers for appropriate surface preparation and primers.

### 3.2 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
- B. Use applicators and techniques suited for paint and substrate indicated.
- C. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
- D. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- E. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- F. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### 3.3 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

**END OF SECTION 099113**

## **SECTION 099600 – HIGH-PERFORMANCE COATINGS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:
  - 1. Exterior Substrates:
    - a. Steel.
    - b. Galvanized metal.
    - c. Ductile and Steel Piping (non-immersion)
  - 2. Interior Substrates:
    - a. Steel.
    - b. Galvanized metal
    - c. Ductile and Steel Piping (non-immersion).

#### **1.2 DEFINITIONS**

- A. MPI Gloss Level 5: 35 to 70 units at 60°, according to ASTM D 523.
- B. MPI Gloss Level 6: 70 to 85 units at 60°, according to ASTM D 523.
- C. MPI Gloss Level 7: More than 85 units at 60°, according to ASTM D 523.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8-inches (200 mm) square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Coatings: 5%, but not less than 1 gal. (3.8 L) of each material and color applied.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45°F (7°C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### 1.6 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50°F and 95°F (10°C and 35°C).
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5°F (3°C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available 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:
  - 1. Corotech Coatings; Benjamin Moore & Co.
  - 2. PPG Architectural Finishes, Inc.
  - 3. Sherwin-Williams Company (The).
  - 4. Tnemec Inc.
- B. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.

#### 2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

- B. Material Compatibility:
  - 1. For materials that have a shop primer specified, the first coat of the coating system indicated below may be eliminated provided the shop primer is compatible with the remainder of the paints in the system.
  - 2. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 3. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
  - 4. Products shall be of same manufacturer for each coat in a coating system.
- C. Colors: As selected by Engineer from manufacturer's full range. Process Piping as described in color code table in Section 3.8.

### 2.3 SOURCE QUALITY CONTROL

- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
  - 1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  - 2. Testing agency will perform tests for compliance with product requirements.
  - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 6/NACE No. 3.
  - 2. SSPC-SP 10/NACE No. 2.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

### 3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
  - 1. Use applicators and techniques suited for coating and substrate indicated.
  - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.



### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
  - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

### 3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Steel Substrates:
  - 1. First Coat:
    - a. Sherwin-Williams Company (The); Corothane 1 Gal-Va-Pac Zinc Primer B65G00010 at 3.0-4.0 mils DFT.
    - b. Tnemec Inc.; Series 90-97 Tnemec-Zinc at 2.5 to 3.5 mils DFT.
  - 2. Second Coat:
    - a. Benjamin Moore & Co. Corotech V160 Epoxy Mastic Coating @4.6-7.2 DFT
    - b. Sherwin-Williams Company (The); Dura-Plate 235 Multi-Purpose Epoxy B67W235 at 4.0-8.0 mils DFT
    - c. Tnemec Inc.; Series N69 Hi-Build Epoxoline II at 3.0 to 5.0 mils DFT.
  - 3. Third Coat:
    - a. Benjamin Moore & Co. Corotech V500 Acrylic Aliphatic Urethane Coating Gloss or V510 Acrylic Aliphatic Urethane Coating Semi-Gloss at 3.2-4.6 mils DFT
    - b. Sherwin-Williams Company (The); Acolon 218 HS Polyurethane Gloss B65W611 at 3.0-6.0 DFT.
    - c. Tnemec Inc.; Series 1074 or 1075 Endura-Shield II at 2.0 to 5.0 mils DFT.
- B. Galvanized-metal :
  - 1. First Coat:
    - a. Benjamin Moore & Co. Corotech V160 Epoxy Mastic Coating @4.6-7.2 DFT
    - b. Sherwin-Williams Company (The); Dura-Plate 235 Multi-Purpose Epoxy B67W235 at 4.0-8.0 mils DFT

- c. Tnemec Inc.; Series N69 Hi-Build Epoxoline II at 3.0 to 5.0 mils DFT.
- 2. Second Coat:
  - a. Benjamin Moore & Co. Corotech V500 Acrylic Aliphatic Urethane Coating Gloss or V510 Acrylic Aliphatic Urethane Coating Semi-Gloss at 3.2-4.6 DFT
  - b. Sherwin-Williams Company (The); Acolon 218 HS Polyurethane Gloss B65W611 at 3.0-6.0 DFT.
  - c. Tnemec Inc.; Series 1074 or 1075 Endura-Shield II at 2.0 to 5.0 mils DFT.
- C. Ductile and Steel Pipe (non-immersion)
  - 1. First Coat:
    - a. NSF Approved Polyamidoamine Epoxy applied at 6.0 – 8.0 dry mils. Performance equal to Tnemec Series N140 Pota-Pox Plus.
  - 2. Second Coat:
    - a. NSF Approved Polyamidoamine Epoxy applied at 6.0 – 8.0 dry mils. Performance equal to Tnemec Series N140 Pota-Pox Plus.
  - 3. Third Coat:
    - a. Polyfunctional Hybrid Urethane applied at 2.0 – 3.0 dry mils. Performance equal to Tnemec Series 750 UVX

### 3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Steel, Galvanized-Metal, and Non-Ferrous Metal Substrates:
  - 1. First Coat: 2.0 to 3.0 mils DFT.
    - a. Benjamin Moore & Co. Corotech V160-1 Epoxy Mastic Coating @4.6-7.2 DFT
    - b. Sherwin-Williams Company (The); Dura-Plate 235-Multi-Purpose Epoxy B67-235 Series.
    - c. Tnemec Inc.; Series L69 Hi-Build Epoxoline II.
  - 2. Second Coats: 3.0 mils DFT each.
    - a. Benjamin Moore & Co. Corotech V160-1 Epoxy Mastic Coating @4.6-7.2 DFT
    - b. Sherwin-Williams Company (The); Dura-Plate 235-Multi-Purpose Epoxy B67-235 Series.
    - c. Tnemec Inc.; Series L69 Hi-Build Epoxoline II at 2.0 to 3.0 mils DFT.
  - 3. Third Coats: 3.0 mils DFT each.
    - a. Benjamin Moore & Co. Corotech V160-1 Epoxy Mastic Coating @4.6-7.2 DFT
    - b. Sherwin-Williams Company (The); Waterbased Acrolon 100 high Gloss Urathane B65W721 at 2.0-4.0 DFT.
    - c. Tnemec Inc.; Series 1081 Endura-shield at 2.0 to 3.0 mils DFT.
- B. Ductile and Steel Pipe (non-immersion)
  - 1. First Coat:
    - a. NSF Approved Polyamidoamine Epoxy applied at 6.0 – 8.0 dry mils. Performance equal to Tnemec Series N140-1255 Beige Pota-Pox Plus.
  - 2. Second Coat:
    - a. NSF Approved Polyamidoamine Epoxy applied at 6.0 – 8.0 dry mils. Performance equal to Tnemec Series N140 Pota-Pox Plus.
  - 3. Third Coat:
    - a. Polyfunctional Hybrid Urethane applied at 2.0 – 3.0 dry mils. Performance equal to Tnemec Series 750 UVX

3.8 DUCTILE AND STEEL PIPE COLOR SCHEDULE

- A. Exposed piping shall be painted according to the following table.
1. Indicated color bands shall be at 30-inch intervals.
  2. Chemical piping shall have the name of the chemical on the pipe.
  3. Arrows indicating the direction of flow shall be on the pipe at 60-inch intervals.

**Piping Color Code**

Type of Line	Content of Line	Color of Pipe
Water Line	Filtered	Light Blue
	Finished or Potable Water	Dark Blue
Chemical Lines	Polymer	Red-Orange with Blue Band
Waste Lines	Return Waste Line	Olive with Pink Band
	Sanitary Sewer	Dark Gray
	Storm Drain	Dark Burgundy

**END OF SECTION 099600**

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## **SECTION 104400 - FIRE PROTECTION SPECIALTIES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes:
  - 1. Portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

#### **1.2 QUALITY ASSURANCE**

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
- C. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

#### **1.3 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 Final Acceptance.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Operation and maintenance data.
- D. Warranty: Sample of special warranty.

### **PART 2 - PRODUCTS**

#### **2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS**

- A. Basis of Design: Larson MP 20:

1. F.E.1. Larsen's Manufacturing Company MP 20.
- B. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- C. Extinguisher Types: Provide extinguisher for each fire protection cabinet, mounting bracket, and elsewhere indicated.
  1. Typical Extinguishers: Multipurpose Chemical Type: Mono ammonium phosphate powder based dry chemical in manufacturer's standard enameled all-metal container including shell and head assembly.
    - a. Bracket-mounted extinguishers.
      - 1) UL Rating: 20A-120B:C.

## 2.2 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
  1. Bracket shall be supplied by the same manufacturer as extinguisher or as recommended by extinguisher's manufacturer
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
  1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
    - a. Orientation: Vertical.

## PART 3 - EXECUTION

### 3.1 EXTINGUISHER INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
  1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
  1. Mounting Brackets: Insert dimension above finished floor to top of fire extinguisher.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

**END OF SECTION 104400**

## SECTION 133419 - METAL BUILDING SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Structural-steel framing.
  - 2. Metal roof system.
  - 3. Metal soffit panels.
  - 4. Roof insulation system.
  - 5. Accessories.

#### 1.2 DEFINITIONS

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

#### 1.3 COORDINATION

- A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    - a. Metal roof panels.
    - b. Metal soffit panels.
    - c. Louvers.
- B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:
  - 1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.
  - 2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.

3. Metal Roof Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.

C. Delegated-Design Submittal: For metal building systems.

1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For erector and manufacturer.

B. Welding certificates.

C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

1. Name and location of Project.
2. Order number.
3. Name of manufacturer.
4. Name of Contractor.
5. Building dimensions including width, length, height, and roof slope.
6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
7. Governing building code and year of edition.
8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
10. Building-Use Category: Indicate category of building use and its effect on load importance factors.

D. Erector Certificates: For qualified erector, from manufacturer.

E. Material Test Reports: For each of the following products:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop primers.
5. Nonshrink grout.

F. Source quality-control reports.

G. Field quality-control reports.

H. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.



I. Sample Warranties: For special warranties.

#### 1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panel finishes to include in maintenance manuals.

#### 1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

#### 1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

## 1.10 WARRANTY

- A. Manufacturer's Standard Material and Workmanship Warranty.
  - 1. Warranty Period: 3 years from date of Shipment.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available 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:
  - 1. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
  - 2. Ceco Building Systems; an NCI company.
  - 3. Nucor Building Systems.
- B. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

### 2.2 SYSTEM DESCRIPTION

- A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
- B. Primary-Frame Type:
  - 1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns.
- D. Secondary-Frame Type: Manufacturer's standard purlins.
- E. Eave Height: As indicated by nominal height on Drawings.
- F. Bay Spacing: As indicated on Drawings.
- G. Roof Slope: 1-inch per 12-inches (1:12).
- H. Roof System: Manufacturer's standard standing-seam, vertical-rib, metal roof panels.

## 2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design metal building system.
- B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
  - 1. Design Loads: As indicated on Drawings.
  - 2. Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
  - 3. Deflection and Drift Limits: No greater than the following:
    - a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
    - b. Metal Roof Panels: Vertical deflection of 1/240 of the span.
    - c. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
    - d. Lateral Drift: Maximum of 1/600 of the building height.
- C. Seismic Performance: Metal building system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120°F (67°C), ambient; 180°F (100°C), material surfaces.
- E. Structural Performance for Metal Roof Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
  - 1. Wind Loads: As indicated on Drawings.
- F. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 1680 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).
- G. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).
- H. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
  - 1. Uplift Rating: UL 90.
- I. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

## 2.4 STRUCTURAL-STEEL FRAMING

- A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."
- B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
- D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
  - 1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
    - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.
  - 2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
  - 3. Frame Configuration: Single gable.
  - 4. Exterior Column: Tapered.
  - 5. Rafter: Tapered.
- E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
  - 1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
  - 2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
- F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:
  - 1. Purlins: Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2½-inch- (64 mm-) wide flanges.
    - a. Depth: As needed to comply with system performance requirements.
  - 2. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
  - 3. Flange Bracing: Minimum 2-by-2-by-1/8-inch (51-by-51-by-3 mm) structural-steel angles or 1-inch- (25 mm-) diameter, cold-formed structural tubing to stiffen primary-frame flanges.
  - 4. Sag Bracing: Minimum 1-by-1-by-1/8-inch (25-by-25-by-3 mm) structural-steel angles.
  - 5. Purlin Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
  - 6. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

- G. Bracing: Provide adjustable wind bracing as follows:
1. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
- H. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.
- I. Materials:
1. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
  2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
  3. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
  4. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55 (205 through 380), or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70 (310 through 480); or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades 25 through 80 (170 through 550), or HSLAS, Grades 45 through 70 (310 through 480).
  5. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, SS, Grades 33 through 80 (230 through 550), or HSLAS or HSLAS-F, Grades 50 through 80 (340 through 550); with G60 (Z180) coating designation; mill phosphatized.
  6. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
    - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, SS, Grades 33 through 80 (230 through 550), or HSLAS or HSLAS-F, Grades 50 through 80 (340 through 550); with G90 (Z275) coating designation.
    - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, SS, Grade 50 or 80 (340 or 550); with Class AZ50 (AZM150) coating.
  7. High-Strength Bolts, Nuts, and Washers: ASTM F 3125/F 3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436/F 436M, Type 1, hardened carbon-steel washers.
    - a. Finish: Hot-dip zinc coating, ASTM F 2329, Class C.
  8. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 3125/F 3125M, Grade F1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436/F 436M, Type 1 hardened carbon-steel washers.
    - a. Finish: Mechanically deposited zinc coating, ASTM B 695, Class 50.
  9. Headed Anchor Rods: ASTM F 1554, Grade 36.
    - a. Configuration: Straight.
    - b. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
    - c. Plate Washers: ASTM A 36/A 36M carbon steel.
    - d. Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.
    - e. Finish: Hot-dip zinc coating, ASTM F 2329, Class C.
- J. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
1. Clean and prepare in accordance with SSPC-SP2.

2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil (0.025 mm).
  - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil (0.013 mm) on each side.

## 2.5 METAL ROOF SYSTEM

- A. Metal Roof System: Butler Manufacturing “MR-24®” roof system.
- B. Roof System Design
  1. Design roof panels in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
  2. Design roof paneling system for a minimum roof slope of ¼-inch in 12-inches.
  3. Design roof paneling system to support design live, snow, and wind loads.
  4. Endwall Trim and Roof Transition Flashings: Allow roof panels to move relative to wall panels and/or parapets as roof expands and contracts with temperature changes.
- C. Roof System Performance Testing
  1. UL Wind Uplift Classification Rating, UL 580: Class 90.
  2. Structural Performance Under Uniform Static Air Pressure Difference: Test roof system in accordance with ASTM E 1592.
  3. Roof system has been tested in accordance with U.S. Army Corps of Engineers Unified Facilities Guide Specification Section 07 61 13.
  4. FM Global (Factory Mutual):
    - a. Roof system has been tested in accordance with FMRC Standard 4471 and approved as a Class 1 Panel Roof.
    - b. Metal Building System Manufacturer: Provide specific assemblies to meet required wind rating in accordance with FM Global.
    - c. Installation modifications or substitutions can invalidate FM Global approval.
- D. Roof Panels
  1. Factory roll-formed, 24-inches wide, with 2 major corrugations, 2 inches high (2¾-inches including seam), 24-inches on center.
  2. Flat of the Panel: Cross flutes 6-inches on center, perpendicular to major corrugations in entire length of panel to reduce wind noise.
  3. Variable Width Panels:
    - a. For roof lengths not evenly divisible by the 2'-0" panel width, factory-manufactured variable-width (9-inch, 12-inch, 15-inch, 18-inch, and 21-inch-wide) panels shall be used to ensure modular, weathertight roof installation.
    - b. Minimum Length: 15 feet.
    - c. Supply maximum possible panel lengths.
  4. Panel Material and Finish:
    - a. 24-gauge steel coated both sides with layer of acrylic-coated Galvalume aluminum-zinc alloy (approximately 55% aluminum, 45% zinc) applied by continuous hot-dip method.
    - b. Minimum 0.55-ounce coated weight per square foot as determined by triple-spot test, ASTM A 792.
    - c. Apply clear acrylic film for additional protection.
  5. Use panels of maximum possible lengths to minimize end laps.
  6. Extend eave panels beyond structural line of sidewalls.

7. Factory punch panels at panel end to match factory-punched holes in eave structural member.
8. Panel End Splices: Factory punched and factory notched.
9. Panel End Laps: Locate directly over, but not fastened to, a supporting secondary roof structural member and be staggered, to avoid 4-panel lap-splice condition.
10. End Laps: Floating. Allows roof panels to expand and contract with roof panel temperature changes.
11. Self-Drilling Fasteners: Not permitted.
12. Ridge Assembly:
  - a. Design ridge assembly to allow roof panels to move lengthwise with expansion and contraction as roof panel temperature changes.
  - b. Factory punch parts for correct field assembly.
  - c. Install panel closures and interior reinforcing straps to seal panel ends at ridge.
  - d. Do not expose attachment fasteners on weather side.
  - e. Use lock seam plug to seal lock seam portion of panel.
  - f. High-Tensile Steel Ridge Cover: Span from panel closure to panel closure and flex as roof system expands and contracts.

E. Provision for Expansion and Contraction:

1. Provision for Thermal Expansion Movement of Roof Panels: Clips with movable tab.
  - a. Stainless Steel Tabs: Factory centered on roof clip when installed to ensure full movement in either direction.
  - b. Maximum Force of 8 Pounds: Required to initiate tab movement.
  - c. Each Clip: Accommodates a minimum of 1.25-inch movement in either direction.
2. Roof: Provide for thermal expansion and contraction without detrimental effects on roof panels, with plus or minus 100°F temperature difference between interior structural framework of building and of roof panels.

F. Fasteners:

1. Make connections of roof panels to structural members, except at eaves, with clips with movable stainless steel tabs, seamed into standing seam side lap.
2. Fasten panel clips to structural members with “Scrubolt™” fasteners in accordance with erection drawings furnished by metal building system manufacturer, using factory-punched holes in structural members.
  - a. Fasteners: Metal-backed rubber washer to serve as torque indicator.
3. Exposed fasteners penetrating metal roof membrane at the following locations do not exceed the frequency listed:
  - a. Basic Panel System: 0 per square foot.
  - b. High Eave Trim, No Parapet: 2 per linear foot.
  - c. Exterior Eave Gutter: 2 per linear foot.
  - d. Panel Splices: 2 per linear foot.
  - e. Gable Trim: 0 per linear foot.
  - f. High Eave with Parapet: 0 per linear foot.
  - g. Ridge: 0 per linear foot.
  - h. Low Eave Structural: 1.5 per linear foot.

G. Accessories:

1. Accessories (i.e., ventilators, skylights, gutters, fascia): Standard with metal building system manufacturer, unless otherwise noted and furnished as specified.

2. Exterior Metal Coating on Gutters, Downspouts, Gable Trim, and Eave Trim: “Butler-Cote™ ” finish system, full-strength, 70 percent “Kynar 500” or “Hylar 5000” fluoropolymer (PVDF) coating.
3. Location of Standard Accessories: Indicated on erection drawings furnished by metal building system manufacturer.
4. Material used in flashing and transition parts and furnished as standard by metal building system manufacturer may or may not match roof panel material.
  - a. Parts: Compatible and not cause corrosive condition.
  - b. Copper and Lead Materials: Do not use with Galvalume panels.

## 2.6 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
- B. Metal Soffit Panels: Match profile and material of metal roof panels.
  1. Finish: Match finish and color of metal roof panels.
- C. Concealed-Fastener, Flush-Profile, Metal Soffit Panels Formed with vertical panel edges and a single wide recess, centered between panel edges; with flush joint between panels; with 1-inch-(25-mm-) wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps.
  1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch (0.61-mm) nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
    - a. Exterior Finish: Fluoropolymer
    - b. Color: As selected by Architect from manufacturer's full range
  2. Panel Coverage: By Manufacturer
  3. Panel Height: By Manufacturer.

## 2.7 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
  1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
  1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.



2. Clips: Manufacturer's standard, formed from steel sheet, designed to withstand negative-load requirements.
  3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel sheet.
  4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25 mm-) thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
  6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch (25 mm) standoff; fabricated from extruded polystyrene.
- C. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch (0.46 mm) nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.
1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
  2. Opening Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch (0.46 mm) nominal uncoated steel thickness, prepainted with coil coating.
- D. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch (0.46 mm) nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2,438 mm-) long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
1. Gutter Supports: Fabricated from same material and finish as gutters.
  2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- E. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch (0.46 mm) nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- (3 m-) long sections, complete with formed elbows and offsets.
1. Mounting Straps: Fabricated from same material and finish as gutters.
- F. Louvers: Size and design indicated; self-framing and self-flashing. Fabricate welded frames from zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.048-inch (1.21 mm) nominal uncoated steel thickness; finished to match metal wall panels. Form blades from zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.036-inch (0.91 mm) nominal uncoated steel thickness; folded or beaded at edges, set at an angle that excludes driving rains, and secured to frames by riveting or welding. Fabricate louvers with equal blade spacing to produce uniform appearance.
1. Blades: Adjustable type, with weather-stripped edges, and manually operated by hand crank or pull chain.
  2. Free Area: Not less than 7.0 sq. ft. (0.65 sq. m) for 48-inch- (1,220-mm-) wide by 48-inch- (1,220-mm-) high louver.
  3. Bird Screening: Galvanized steel, ½-inch- (13 mm-) square mesh, 0.041-inch (1.04 mm) wire; with rewirable frames, removable and secured with clips; fabricated of same kind and form of metal and with same finish as louvers.
    - a. Mounting: Exterior face of louvers.

4. Vertical Mullions: Provide mullions at spacings recommended by manufacturer, or 72-inches (1,830 mm) o.c., whichever is less.

## 2.8 ROOF INSULATION SYSTEM

A. Roof Insulation System: Butler Manufacturing™ “ThermaLiner™” roof insulation system.

B. System Components

1. Metal Roof System: Butler Manufacturing™ “MR-24®” metal roof system.
2. Sub-Structural System:
  - a. 3-inch nominal zee-shaped members (nominal 0.060-inch-thick, acrylic-coated, galvanized steel), factory punched for specific roof system being installed.
  - b. Support Brackets:
    - 1) 3-inch, 5-inch, or 8-inch height support zee and provide space for various thicknesses of insulation.
    - 2) Install with self-drilling fasteners through interior liner panel and into building structure.
  - c. Attach zeos to support brackets with self-drilling fasteners.
3. Mod 36 Interior Liner Panels:
  - a. Form from 0.0149-inch minimum total coated thickness coated steel with minimum yield strength of 80,000 psi.
  - b. Nominal 36-inch-wide panel with corrugations ½-inch high, 3-inches on center.
  - c. Factory cut to required length.
  - d. Painted Liner Panels:
    - 1) Exposed Side: 0.15-mil min primer and 0.70-mil minimum interior white polyester paint.
    - 2) Unexposed Side: 0.1-mil minimum primer and 0.40-mil minimum polyester backer
4. Vapor Retarder:
  - a. Liner Panel, Sidelaps, and Endlaps: Seal with “Panlastic” sealant to prevent vapor transmission between sheets.
    - 1) Foam Closure: Use at terminating ends of liner panels to seal corrugations of panels.
5. Insulation:
  - a. Unfaced Insulation: NAIMA 202.
  - b. Top Layer of Blanket Insulation: 3-inch-thick insulation installed between roof panels and 3-inch zee.
    - 1) Furnish insulation in rolls of 3-foot, 4-foot, 5-foot, or 6-foot width.
  - c. Bottom Layer of Blanket Insulation: Furnish in rolls of 3-foot, 4-foot, 5-foot, or 6-foot width or 5-foot by 5-foot batts.
    - 1) Thickness of Bottom Layer: Vary dependent on overall thermal performance of system desired. Refer to the following chart.
  - d. Zee Member: Insulated using ¾-inch-nominal-thick extruded polystyrene foam insulation block along each zee location to minimize “thermal short circuit” between zee and roof panels.

## Insulation / U-Factor Chart

System Description	System Height	Roof System	Insulated/ Uninsulated Purlin	Lower Layer(s)	Upper Layer	Total R-value	U-factor	Effective R-value = 1/U
TL 6 MR	6"	MR-24	Uninsulated	R-11 (3.5")	R-11 (3.5")	22	0.051	19.5
TL 7 MR	7¼"	MR-24	Insulated	R-13 (4")	R-11 (3.5")	24	0.046	21.7
TL 8 MR	8"	MR-24	Uninsulated	R-19 (6")	R-11 (3.5")	30	0.039	25.8
TL 9 MR	9¼"	MR-24	Insulated	R-19 (6")	R-11 (3.5")	30	0.033	30.3
TL 11 MR	11"	MR-24	Uninsulated	R-16 + R11 (5"+3.5")	R-11 (3.5")	38	0.028	35.2
TL12 MR	12¼"	MR-24	Insulated	R-19 + R-11 (6"+3.5")	R-11 (3.5")	41	0.026	38.7
TL VSR 6	6"	VSR II	Uninsulated	R-11 (3.5")	R-11 (3.5")	22	0.052	19.2
TL VSR 7	7¼"	VSR II	Insulated	R-13 (4")	R-11 (3.5")	24	0.047	21.2
TL VSR 8	8"	VSR II	Uninsulated	R-16 (5")	R-11 (3.5")	27	0.040	25.0
TL VSR 9	9¼"	VSR II	Insulated	R-19 (6")	R-11 (3.5")	30	0.036	27.8
TL VSR 11	11"	VSR II	Uninsulated	R-13 + R13 (4"+4")	R-11 (3.5")	37	0.029	34.5
TL VSR12	12¼"	VSR II	Insulated	R-19 + R-11 (6"+3.5")	R-11 (3.5")	41	0.027	37.0
TL 6 BR	6"	Butlerib II	NA	R-11 (3.5")	R-11 (3.5")	22	0.052	19.2
TL 8 BR	8"	Butlerib II	NA	R-16 (5")	R-11 (3.5")	27	0.041	24.1
TL 11 BR	11"	Butlerib II	NA	R-13 + R-13 (4"+4")	R-11 (3.5")	37	0.029	34.5

**FEA Model U-Factor:** These values are based upon a calculated U-factor using Finite Element Analysis, which reflect in-place performance. This FEA method has been calibrated by thermal tests and is the currently accepted method for determining accurate thermal performance expectations. R-value = 1/U-factor.

**Insulation R-Value:** These values were calculated using typical published R-values of insulation. This method does NOT take into account compression of insulation and other possible thermal loss areas of installation.

C. Fasteners:

1. Sub-structurals and Liner Panels: Install with self-drilling screws for attachment
2. Roof Attachment Fasteners: As specified under Roof System in this specification section.

D. Provision for Expansion and Contraction:

1. Provision for Thermal Expansion and Contraction Movement: Accomplish in roof system.
2. As specified under Roof System in this specification section.

E. Performance Testing: As specified under Roof System in this specification section.

F. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

G. Materials:

1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
  - a. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
  - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
4. Metal Panel Sealants:
  - a. Sealant Tape: Pressure-sensitive, 100% solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
  - b. Joint Sealant: ASTM C 920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

## 2.9 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
  1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
  2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
  1. Make shop connections by welding or by using high-strength bolts.
  2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
  3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
  4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
  5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
  1. Make shop connections by welding or by using non-high-strength bolts.
  2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

## 2.10 SOURCE QUALITY CONTROL

- A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.
  1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.
    - a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
  1. Engage land surveyor to perform surveying.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

### 3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written instructions and drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 1. Level and plumb individual members of structure.
  - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
  - 1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
    - a. Joint Type: Snug tightened or pretensioned as required by manufacturer.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
  - 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
  - 2. Provide supplemental framing at entire perimeter of openings, including louvers, ventilators, and other penetrations of roof.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
  - 1. Tighten rod and cable bracing to avoid sag.
  - 2. Locate interior end-bay bracing only where indicated.
- I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

### 3.4 METAL PANEL INSTALLATION, GENERAL

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements

demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
  - 1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- D. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Field cut metal panels as required other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
    - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
  - 2. Install metal panels perpendicular to structural supports unless otherwise indicated.
  - 3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Locate metal panel splices over structural supports with end laps in alignment.
  - 6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- E. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- F. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
  - 1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
  - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

### 3.5 INSTALLATION – METAL ROOF SYSTEM

- A. Metal Roof System Installation: Butler Manufacturing™ “MR-24®” roof system.
  - 1. Install roof system in accordance with metal building system manufacturer’s instructions at locations indicated on the Drawings.
- B. Install roof system weathertight.

- C. Position panel clips by matching hole in clip with factory-punched holes in secondary structural members.
- D. Position and properly align panels by matching factory-punched holes in panel end with factory-punched holes in eave structural member and by aligning panel with panel clip.
- E. Field seam panel side laps by self-propelled and portable electrical lock-seaming machine.
  - 1. Machine field forms the final 180° of a 360° Pittsburgh double-lock standing seam.
  - 2. Factory apply side lap sealant.
- F. Panel End Laps: Minimum of 6-inches, sealed with sealant (weather sealing compound), and fastened together by clamping plates.
  - 1. Sealants: Contain hard nylon beads, which prevent mastic from flowing out due to clamping actions.
  - 2. Join panel laps by 2-piece clamped connection consisting of a bottom reinforcing plate and a top panel strap.
  - 3. Locate panel end laps directly over, but not fastened to, supporting secondary roof structural member and stagger, to avoid 4-panel lap-splice condition.
- G. Minimum Blanket Insulation Thickness: 2-inches.
- H. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
  - 1. Install ridge caps as metal roof panel work proceeds.
  - 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- I. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
  - 1. Install clips to supports with self-drilling or self-tapping fasteners.
  - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  - 3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
  - 4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.
  - 5. Provide metal closures at peaks rake edges and each side of ridge caps.
- J. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.
- K. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of ¼-inch in 20-feet (6 mm in 6 m) on slope and location lines and within 1/8-inch (3 mm) offset of adjoining faces and of alignment of matching profiles.



### 3.6 METAL SOFFIT PANEL INSTALLATION

- A. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.
- B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

### 3.6.INSTALLATION – ROOF INSULATION SYSTEM

- A. Roof Insulation System Installation: Butler Manufacturing™ “ThermaLiner™” roof insulation system.
  - 1. Install roof insulation system in accordance with metal building system manufacturer’s instructions at locations indicated on the Drawings.

### 3.7 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  - 2. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  - 1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
  - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10-feet (3 m) with no joints allowed within 24-inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1-inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36-inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

- D. Downspouts: Join sections with ½-inch (38 mm) telescoping joints. Provide fasteners designed to hold downspouts securely 1-inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60-inches (1524 mm) o.c. in between.
  - 1. Tie downspouts to underground drainage system indicated.
- E. Louvers: Locate and place louver units level, plumb, and at indicated alignment with adjacent work.
  - 1. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
  - 2. Provide perimeter reveals and openings of uniform width for sealants and joint fillers.
  - 3. Protect galvanized- and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of corrosion-resistant paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
  - 4. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.
- F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

### 3.8 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.
- B. Product will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.9 ADJUSTING

- A. Adjustable Louvers: After completing installation, including work by other trades, lubricate, test, and adjust units to operate easily, free of warp, twist, or distortion as needed to provide fully functioning units.
  - 1. Adjust louver blades to be weathertight when in closed position.

### 3.10 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.

1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
  2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- D. Touchup Painting: Cleaning and touchup painting are specified in Division 09 Section "Exterior Painting".
- E. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- F. Louvers: Clean exposed surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
1. Restore louvers damaged during installation and construction period so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
    - a. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

**END OF SECTION 133419**

## SECTION 259001 – SEQUENCE OF OPERATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section describes operation, logic and features of the **modifications to the existing** Supervisory Control And Data Acquisition (SCADA) systems for controlling and monitoring the various items of equipment which are affected by the Project. Hardware, software, and equipment required for the accomplishment of the tasks specified in this Section are specified elsewhere. Nothing in this Section shall be construed so as to eliminate the requirement for any physical item.
- B. The programmer of the MASTER SCADA Programmable Logic Controller (PLC), non-packaged Local Control Panels (LCPs) and the PC-Based SCADA Operator Interface (the Human-Machine Interface, or SCADA HMI) is referred to herein as the Systems Integrator, or “SI”, **which is a direct agent of the City, not under the Contractor’s Contract**. References to the SI herein do not absolve the Contractor for full responsibility for providing all hardware specified in the Contract Documents which are required to support programming by the SI.
- C. The Contractor shall coordinate with the SI to have all Work related to pertinent SCADA systems complete, tested and fully operational prior to the start of Commissioning (see Division 46 Section “Commissioning”).
- D. Where systems are described as “packaged” in this Section, specification Sections elsewhere in these Contract Documents detail the operation and performance requirements of the system and its accompanying LCPs. Where input or output information is required of such units in this Section, it shall be the Contractor’s responsibility to ensure that the Packaged System is supplied with the appropriate I/O devices, whether or not such I/O requirements are specified in the package units’ respective specification Section.

#### 1.2 SYSTEM RESPONSIBILITY

- A. The Contractor shall be responsible for installation and operation of control and data acquisition devices, and for end-to-end testing to ensure necessary signals can be received/transmitted to/from them. Coordinate with the SI for:
  - 1. Compatibility coordination of signals between field devices, local control panels, and the SCADA systems
  - 2. Physical terminal connections to SCADA components
- B. The Contractor shall provide support (monitoring operation of devices, device-side troubleshooting and issues resolution) to the SI during the following:
  - 1. Testing to assure proper system operation
  - 2. Commissioning (see Division 46 Section “Commissioning”)
  - 3. Device and system calibration

### 1.3 SUBMITTALS

- A. Within 60 days of Notice to Proceed, provide the following:
  - 1. List of all input and output connections, with signal/power type, and range of signal related to display engineering units
  - 2. Hardware cut sheets

### 1.4 SCADA GENERAL REQUIREMENTS

- A. Equipment shall be provided and installed with the following Status and Alarm indications, as available (per individual item of equipment):
  - 1. Pump, Screen, Blower (or Other) On/Off Status
  - 2. Fault – this Alarm group shall independently indicate (as appropriate based on the specific equipment) over-temperature, starter overload, seal leakage, and breaker trip/off. If independent fault indications are not available from a particular piece of equipment, approval of the Engineer for a common fault signal shall be required.
  - 3. Equipment Fail to Run – this Alarm signal shall occur when a motor is called for but does not operate. Pumps with check valves shall provide this indication by the check valve position indicator. Other equipment (screen, blowers, fans, etc.) shall provide this indication by sensing the absence of power (current) being drawn by the motor. For motor actuated valves, this Alarm signal shall also occur when a valve position is called for but is not reached within an expected time, which shall be operator adjustable as an Alarm Delay Time.
  - 4. Loss of control signal – this Alarm shall occur when no signal is being received from an analog field device.
  - 5. NOT IN AUTO Warning.
  - 6. When a motor disconnect is turned off, the LCP and SCADA HMI shall indicate a Warning that the respective HOA Selector Switch on the motor starter must be turned to the OFF position and back to the ON or AUTO position in order to resume motor operation.
- B. Input variables shall be completely retrievable and operator-adjustable. Such variables shall include but not be limited to those listed below. Some required operator-adjustable variables are indicated in this Section in [brackets].
  - 1. Cycle and Delay Times
  - 2. Flow and Level Setting Deadbands
  - 3. Level Settings
  - 4. Flowrate Targets and Ratios
- C. Motor Group Priorities
  - 1. Where redundant motors are provided for a given function as a Motor Group, they shall operate on a lead-lag (, lag2, ... as applicable) basis, unless otherwise noted.
    - a. Motors shall cycle on a first on, first off basis, and through all available motors of a Motor Group before returning the first to the Lead position.
    - b. Each Motor Group shall be provided with a [Lead Rotation Cycle Time]. If a Lead motor remains operating continuously for a period exceeding its corresponding Motor Group's [Lead Rotation Cycle Time], the Lead motor assignment shall be rotated (unless another motor of the Motor Group is not available) and the new Lead motor shall resume operation in its place.
    - c. In the event of any motor failure or removal of a motor from the AUTO position, all subsequent Lag motor(s) shall be promoted in rotation order. A failed motor shall

be removed from the rotation until the cause of the failure is corrected, and the motor's HOA is switched from and back into the AUTO position.

- D. Unless otherwise noted, loss of a control signal shall cause the controlled equipment to continue operating at the setpoints that were in effect at the time that the signal was lost. All other fail-safes shall remain in full effect.
- E. Unless otherwise noted, equipment operating at the time of a loss of main power shall, upon restoration of power, return to the mode of operation it was in at the time of power loss. Equipment operating on VFD or solid state motor starters shall return to its prior operating point only after passing through its starter-controlled ramp-up.

## PART 2 - INDIVIDUAL SYSTEMS OPERATION

### 2.1 FILTER BACKWASH SYSTEM

- A. Filters 5 through 8 are included in Phase 1A. Phases 1B (filters 9 through 12) and 1C (1 through 4) will remain in operation as-is, without any modifications, unless Alternate(s) are selected by the City to include subsequent Phase(s) as a part of this Contract. Modifications to HMI screens and internal logic are anticipated in order to accommodate differing modes of operation.
- B. Contributing Parameters
  - 1. [Air Purge Time], [Air BW Time], [Combined BW Time], [Water Only BW Time] are expressed in seconds. Any Time values of zero shall indicate not timed run cycle for the respective equipment. [Air Purge % Open], [Air BW % Open], [Air Shutoff % Open], [Combined Water % Open] and [Water Only % Open] are expressed in percent.
- C. The two Filter Backwash Blowers are a Motor Group, and each Blower is a packaged system.
- D. When a Filter's Backwash is called for, the Filters' Backwash Sequences shall be as follows:
  - 1. Step 1: The following events occur to prepare for Backwash:
    - a. Unloading Valve opens fully
    - b. Filter Inlet Valve closes fully
    - c. After filter water level has dropped to within 6 inches of the top of the media,
      - 1) Filter Effluent Valve closes fully
      - 2) Waste Valve opens fully
      - 3) Filter Air Valve opens fully
  - 2. Step 2: Air Purge Cycle – Once Step 1 valve positions are confirmed, the following events occur simultaneously
    - a. Lead Blower is started
    - b. [Air Purge Time] begins
    - c. Unloading Valve modulates to [Air Purge % Open]
  - 3. Step 3: Air Backwash – After [Air Purge Time] expires:
    - a. [Air BW Time] begins
    - b. Unloading Valve modulates to [Air BW % Open]
  - 4. Step 4: Combined Backwash – After [Air BW Time] expires:
    - a. Filter Backwash Valve opens fully. Once the Filter Backwash Valve is confirmed open 100%,
      - 1) [Combined BW Time] begins

- 2) The Main Backwash Valve opens to [Combined Water % Open]
  5. Step 5: Water Backwash – After [Combined BW Time] expires,
    - a. The following events occur simultaneously:
      - 1) Unloading Valve modulates to [Air Shutoff % Open]
      - 2) Filter Air Valve begins to close
    - b. After Filter Air Valve is confirmed 100% closed,
      - 1) Unloading Valve opens
    - c. Once the Filter's Air Valve is closed fully, the following events occur simultaneously
      - 1) The operating blower is stopped
      - 2) The Unloading Valve begins to close fully
      - 3) [Water Only BW Time] begins
      - 4) The Main Backwash Valve begins to open to [Water Only % Open]
  6. After [Water Only BW Time] expires,
    - a. The remainder of the backwash sequence (i.e., Filter-to-Waste) shall remain as-is, without modification.
- E. All available output variables from the Filter Backwash Blower manufacturer-supplied LCP shall be transmitted to the SCADA system.

## 2.2 CENTRIFUGE SYSTEM

- A. Controls for the Centrifuge and the associated Polymer Feed System, Sludge Pumps, Inline Electric Grinder, and Solids Conveyor are a packaged system (by the Centrifuge manufacturer). See Division 47 Section “Centrifuge” for associated operational logic.
- B. No SCADA system control or alteration of settings within the Centrifuge System controls is intended. The SCADA system shall monitor the following information and provide indication of the same at the SCADA HMI:
  1. For each motor controlled by the Centrifuge System controls:
    - a. ON/OFF Status
    - b. Alarm (common per each motor, as available from the motor)
  2. Sludge Feed Flowrate
  3. Sludge Mixing Tank Level

## 2.3 SEDIMENTATION BASIN SYSTEM

- A. Controls for the Sedimentation Basin System, including the Chain and Scraper Sludge Collectors, and the Screw Conveyor Cross Collectors are a packaged system. See Division 46 Sections “Chain and Scraper Sludge Collector” and “Screw Conveyor Cross Collector” for associated operational logic.
- B. No SCADA system control or alteration of settings within the Sedimentation Basin system controls is intended. The SCADA system shall monitor the following information and provide indication of the same at the SCADA HMI:
  1. For each motor controlled by the Sedimentation Basin system controls:
    - a. ON/OFF Status
    - b. Alarm (common per each motor, as available from the motor)
  2. Sedimentation Basin Tank Levels (each tank)

## PART 3 - EXECUTION

### 3.1 Testing

- A. Assist SI in calibration of field instrument analog readings with the reading received and displayed at the Operator Interface.
- B. Confirm discrete signals accurately reflect the field Status of the device originating the signal. Confirm for every state monitored.

**END OF SECTION 259001**



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## SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS AND CABLES

- A. Available 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:
  - 1. Belden Inc.
  - 2. Prysmian.
  - 3. General Cable Technologies Corporation.
  - 4. Southwire Incorporated.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation:
  - 1. Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.
- D. Single and multiconductor MI Cable assemblies: Comply with NEMA WC 70/ICEA S-95-658 for mineral-insulated, metal-sheathed cable, Type MI with ground wire.

#### 2.2 CONNECTORS AND SPLICES

- A. Available 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:
  - 1. AFC Cable Systems, Inc.

2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. NSi Industries LLC.
6. O-Z/Gedney; a brand of the EGS Electrical Group.
7. 3M; Electrical Markets Division.
8. Tyco Electronics.

- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

### 2.3 SYSTEM DESCRIPTION

- A. 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.
- B. Comply with NFPA 70.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper and stranded all sizes.
- B. Branch Circuits: Copper. Stranded for all sizes.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- D. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

- B. Complete raceway installation between conductor and cable termination points according to Division 26 Section "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at wiring devices: Install conductor at each outlet, with at least 6-inches of slack.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Test and Inspection Reports: Prepare a written report to record the following:
1. Procedures used.
  2. Results that comply with requirements.
  3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

**END OF SECTION 260519**

## **SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes grounding and bonding systems and equipment.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

#### **1.4 QUALITY ASSURANCE**

- A. 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.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Available 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:
  1. Burndy; Part of Hubbell Electrical Systems.
  2. Fushi Copperweld Inc.
  3. Galvan Industries, Inc.; Electrical Products Division, LLC.
  4. ILSCO.
  5. O-Z/Gedney; A Brand of the EGS Electrical Group.
  6. Robbins Lightning, Inc.
  7. Siemens Power Transmission & Distribution, Inc.

#### **2.2 SYSTEM DESCRIPTION**

- A. 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.

- B. Comply with UL 467 for grounding and bonding materials and equipment.

## 2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Stranded Conductors: ASTM B 8.
  - 2. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, ¼-inch in diameter.
  - 3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 4. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8-inches wide and 1/16-inch thick.

## 2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

## 2.5 GROUNDING ELECTRODES

- A. The approved grounding electrode in the Kodak Office complex is the fire protection/sprinkler main. All service grounding connection shall be made to the welded portion of the main.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install stranded conductors for all sizes unless otherwise indicated.
- B. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus.

### 3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Armored and metal-clad cable runs.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

### 3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Grounding Resistor:
  - 1. Mount enclosure as indicated and anchor to concrete floor.
  - 2. Make connections with insulated, medium voltage cables.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal.
    - a. Perform tests by fall-of-potential method according to IEEE 81.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.



- E. Report measured ground resistances that exceed the following values:
  - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
  - 2. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
  - 3. Substations and Pad-Mounted Equipment: 5 ohms.
  
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

**END OF SECTION 260526**

## SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

#### 1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. RMC: Rigid metal conduit.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel slotted support systems.
  - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze hangers. Include Product Data for components.
  - 2. Steel slotted channel systems. Include Product Data for components.
  - 3. Nonmetallic slotted channel systems. Include Product Data for components.
  - 4. Equipment supports.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Available 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. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Atkore International.
    - g. Wesanco, Inc.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Available 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:
      - 1) Hilti, Inc.
      - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.
  - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Available 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:
      - 1) Cooper B-Line, Inc.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti, Inc.
      - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.
  - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  - 6. Toggle Bolts: All-steel springhead type.
  - 7. Hanger Rods: Threaded steel.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be ¼-inch in diameter.

- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25% in future without exceeding specified design load limits.
  - 1. Secure raceways to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1½-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  - 6. To Light Steel: Sheet metal screws.
  - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 CONCRETE BASES

- A. Unless otherwise indicated, construct concrete bases of dimensions indicated but not less than 4-inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION 260529**

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## **SECTION 260533 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

**A. Section Includes:**

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.

**B. Related Requirements:**

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

#### **1.2 DEFINITIONS**

**A. ARC:** Aluminum rigid conduit.

**B. GRC:** Galvanized rigid steel conduit.

#### **1.3 ACTION SUBMITTALS**

**A. Product Data:** For surface raceways, wireways and fittings, hinged-cover enclosures, and cabinets.

#### **1.4 INFORMATIONAL SUBMITTALS**

**A. Source quality-control reports.**

### **PART 2 - PRODUCTS**

#### **2.1 METAL CONDUITS, TUBING, AND FITTINGS**

**A. Available 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:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney.
6. Picoma Industries.



7. Republic Conduit.
  8. Robroy Industries.
  9. Southwire Company.
  10. Thomas & Betts Corporation.
  11. Western Tube and Conduit Corporation.
  12. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. EMT: Comply with ANSI C80.3 and UL 797.
- E. FMC: Comply with UL 1; zinc-coated steel.
- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Setscrew or compression.
- H. Joint Compound for GRC or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Available 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:
1. AFC Cable Systems, Inc.
  2. Anamet Electrical, Inc.
  3. Arnco Corporation.
  4. CANTEX Inc.
  5. CertainTeed Corporation.
  6. Condux International, Inc.
  7. Electri-Flex Company.
  8. Kraloy.
  9. Lamson & Sessions; Carlon Electrical Products.
  10. Niedax-Kleinhuis USA, Inc.
  11. RACO; Hubbell.
  12. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- A. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 as indicated.

- B. RNC: Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 as indicated.
- C. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- D. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Available 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:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman.
  - 3. Mono-Systems, Inc.
  - 4. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 4X as indicated by location, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type for Type 1. Flanged and gasketed for Type 4X
- E. Finish: Manufacturer's standard enamel finish.

### 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Available 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:
  - 1. Adalet.
  - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
  - 3. EGS/Appleton Electric.
  - 4. Erickson Electrical Equipment Company.
  - 5. FSR Inc.
  - 6. Hoffman.
  - 7. Hubbell Incorporated.
  - 8. Kraloy.
  - 9. Milbank Manufacturing Co.
  - 10. Mono-Systems, Inc.
  - 11. O-Z/Gedney.
  - 12. RACO; Hubbell.
  - 13. Robroy Industries.
  - 14. Spring City Electrical Manufacturing Company.
  - 15. Stahlin Non-Metallic Enclosures.

- 16. Thomas & Betts Corporation.
  - 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
  - C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
  - D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
  - E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
  - F. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
  - G. Device Box Dimensions: 4-inches square by 2-1/8-inches deep.
  - H. Gangable boxes are allowed.
  - I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 4X as indicated, with continuous-hinge cover with flush latch.
    - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
    - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
  - J. Cabinets:
    - 1. NEMA 250, Type 1 galvanized-steel box or Type 4X Stainless Steel as indicated, with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
    - 2. Hinged door in front cover with flush latch and concealed hinge.
    - 3. Key latch to match panelboards.
    - 4. Metal barriers to separate wiring of different systems and voltage.
    - 5. Accessory feet where required for freestanding equipment.

## 2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Aluminum with snap-on covers complying with UL 5.
  - 1. Available 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. MonoSystems, Inc.
    - b. Panduit Corp.
    - c. Wiremold / Legrand.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC.
  - 2. Concealed Conduit, Aboveground: GRC.
  - 3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.
  
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage (Office areas, Labs, Control room and similar): EMT.
  - 2. Exposed, Not Subject to Physical Damage (Process areas with moisture or chemical content): RNC, Type EPC-80-PVC.
  - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFNC in damp or wet locations.
  - 5. Damp or Wet Locations: RNC, Type EPC-80-PVC.
  - 6. Boxes and Enclosures (Dry Locations): NEMA 250, Type 1.
  - 7. Boxes and Enclosures (Process Areas and Wet Locations): NEMA 250, Type 4X.
  
- C. Minimum Raceway Size:  $\frac{3}{4}$ -inch trade size.
  
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
  - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
  
- E. Do not install nonmetallic conduit where ambient temperature exceeds 120°F.

### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
  
- B. Keep raceways at least 6-inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
  
- C. Complete raceway installation before starting conductor installation.
  
- D. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.

- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90° bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12-inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12-inches of enclosures to which attached.
- I. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1¼-inch trade size and insulated throat metal bushings on 1½-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- O. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- Q. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48-inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- R. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service raceway enters a building or structure.
  3. Where otherwise required by NFPA 70.
- S. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- T. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72-inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations.
- U. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
- V. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- W. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- X. Locate boxes so that cover or plate will not span different building finishes.
- Y. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- AA. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30°F (17°C), and that has straight-run length that exceeds 25-feet (7.6 m). Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100°F (55°C) and that has straight-run length that exceeds 100 feet (30 m).
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125°F (70°C) temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155°F (86°C) temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125°F (70°C) temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041-inch per foot of length of straight run per °F (0.06 mm per meter of length of straight run per °C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078-inch per foot of length of straight run per °F (0.0115 mm per meter of length of straight run per °C) of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

#### A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit.
2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12-inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
3. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3-inches of concrete for a minimum of 12-inches on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60-inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Division 26 Section "Identification for Electrical Systems."

### 3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- #### A.
- Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.5 PROTECTION

- #### A.
- Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION 260533**

## **SECTION 260543 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

- A. Section Includes:
  - 1. Direct-buried conduit, ducts, and duct accessories.
  - 2. Concrete-encased conduit, ducts, and duct accessories.

### **1.2 DEFINITIONS**

- A. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include duct-bank materials, including separators and miscellaneous components.
  - 2. Include ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  - 3. Include warning tape.

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
  - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
  - 2. Drawings shall be signed and sealed by a qualified professional engineer.
- B. Source quality-control reports.
- C. Field quality-control reports.

### **1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

### **1.6 FIELD CONDITIONS**

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
  - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical service.



2. Do not proceed with interruption of electrical service without Construction Manager's written permission.
- B. Ground Water: Assume ground-water level is 42inches below ground surface unless a higher water table is noted on Drawings.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

- A. Comply with ANSI C2.

### 2.2 CONDUIT

- A. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

### 2.3 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Available 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:
1. ARNCO Corp.
  2. Beck Manufacturing.
  3. Cantex, Inc.
  4. CertainTeed Corporation.
  5. Condux International, Inc.
  6. ElecSys, Inc.
  7. Electri-Flex Company.
  8. IPEX Inc.
  9. Lamson & Sessions; Carlon Electrical Products.
  10. Spiraduct/AFC Cable Systems, Inc.
- B. Underground Plastic Utilities Duct: NEMA TC 2, UL 651, ASTM F 512, with matching fittings complying with NEMA TC 3 by same manufacturer as the duct.
- C. Duct Accessories:
1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, and selected to provide minimum duct spacing indicated while supporting ducts during concreting or backfilling.
  2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

### 2.4 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Comply with ASTM C 858 for design and manufacturing processes.

- B. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
1. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
    - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
    - b. Cover Handle: Recessed.
  2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  3. Cover Legend: Molded lettering, As indicated on drawings for each service.
  4. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
  5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
    - a. Extension shall provide increased depth of 12-inches.
    - b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
  6. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
  7. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks, plus an additional 12-inches vertically and horizontally to accommodate alignment variations.
    - a. Windows shall be located no less than 6-inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
    - b. Window opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
    - c. Window openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
  8. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
    - a. Type and size shall match fittings to duct or conduit to be terminated.
    - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
  9. Handholes 24-inches wide by 24-inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.5 PRECAST MANHOLES

- A. Description: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.
- B. Available 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:
1. Carder Concrete Products.
  2. Christy Concrete Products.
  3. Oldcastle Precast, Inc.
  4. Rinker Group, Ltd.
  5. Utility Concrete Products, LLC.

- 6. Utility Vault Co.
- C. Comply with ASTM C 858.
- D. Structural Design Loading: Comply with requirements in "Underground Enclosure Application" Article.
- E. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12-inches vertically and horizontally to accommodate alignment variations.
  - 1. Center window location.
  - 2. Knockout panels shall be located no less than 6-inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
  - 3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
  - 4. Knockout panel shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
  - 5. Knockout panels shall be 1½- to 2-inches thick.
- F. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
  - 1. Type and size shall match fittings to duct to be terminated.
  - 2. Fittings shall align with elevations of approaching duct and be located near interior corners of manholes to facilitate racking of cable.
- G. Ground Rod Sleeve: Provide a 3-inch PVC sleeve in manhole floors 2-inches from the wall adjacent to, but not underneath, the duct entering the structure.
- H. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

## 2.6 UTILITY STRUCTURE ACCESSORIES

- A. Accessories for Utility Structures: Utility equipment and accessory items used for utility structure access and utility support, listed and labeled for intended use and application.
- B. Available 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:
  - 1. Bilco Company (The).
  - 2. Campbell Foundry Company.
  - 3. Carder Concrete Products.
  - 4. Christy Concrete Products.
  - 5. McKinley Iron Works, Inc.
  - 6. Quazite: Hubbell Power Systems, Inc.

7. Underground Devices, Inc.
  8. Utility Concrete Products, LLC.
  9. Utility Vault Co.
- C. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29-inches.
    - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
    - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
  2. Cover Legend: Cast in. Selected to suit system.
    - a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
    - b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
  3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
    - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.
    - b. Seal joints watertight using preformed plastic or rubber complying with ASTM C 990. Install sealing material according to sealant manufacturers' written instructions.
- D. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.
- E. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch-diameter eye, and 1-by-4-inch bolt.
1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.
- F. Pulling-in and Lifting Irons in Concrete Floors: 7/8-inch-diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.
- G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2 3/4-inches deep, flared to 1 1/4-inches minimum at base.
1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- H. Ground Rod Sleeve: 3-inch PVC sleeve in manhole floors 2-inches from the wall adjacent to, but not underneath, the ducts routed from the facility.

- I. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with ½-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.
- J. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
  - 1. Stanchions: Nominal 36-inches high by 4-inches wide, with minimum of nine holes for arm attachment.
  - 2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3-inches with 450-lb minimum capacity to 20-inches with 250-lb minimum capacity. Top of arm shall be nominally 4-inches wide, and arm shall have slots along full length for cable ties.
- K. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35°F. Capable of withstanding temperature of 300°F without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- L. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

## 2.7 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
  - 1. Tests of materials shall be performed by an independent testing agency.
  - 2. Strength tests of complete boxes and covers shall be by an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  - 3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with

other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

### 3.2 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables More than 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank unless otherwise indicated.
- B. Duct for Electrical Feeders 600 V and Less: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.
- C. Duct for Electrical Branch Circuits: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.

### 3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
  - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete, AASHTO HB 17, H-10 structural load rating.
  - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
  - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
  - 4. Cover design load shall not exceed the design load of the handhole or box.
- B. Manholes: Precast concrete.
  - 1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
  - 2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

### 3.4 EARTHWORK

- A. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- B. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work.
- C. Cut and patch existing pavement in the path of underground ducts and utility structures according to the "Cutting, Digging, Fitting and Patching" Article in Division 01 Section "Execution Requirements."

### 3.5 DUCT INSTALLATION

- A. Install ducts according to NEMA TCB 2.
- B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.
- C. Curves and Bends: Use 5° angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48-inches, both horizontally and vertically, at other locations unless otherwise indicated.
- D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- E. Duct Entrances to Manholes: Use end bells, spaced approximately 10-inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
  - 1. Begin change from regular spacing to end-bell spacing 10-feet from the end bell without reducing duct line slope and without forming a trap in the line.
  - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct banks with calculated expansion of more than ¼-inch.
  - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- F. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10-feet outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- G. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- H. Pulling Cord: Install 200-lbf-test nylon cord in empty ducts.
- I. Concrete-Encased Ducts: Support ducts on duct separators.
  - 1. Excavate trench bottom to provide firm and uniform support for duct bank.
  - 2. Width: Excavate trench 3-inches wider than duct bank on each side.
  - 3. Depth: Install top of duct bank at least 24-inches below finished grade in areas not subject to deliberate traffic, and at least 30-inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
  - 4. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
  - 5. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than four spacers per 20-feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6-inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or

- reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
6. Minimum Space between Ducts: 3-inches between ducts and exterior envelope wall, 2-inches between ducts for like services, and 4-inches between power and signal ducts.
  7. Elbows: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3-inches of concrete.
    - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60-inches from edge of base. Install insulated grounding bushings on terminations at equipment.
  8. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
  9. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
  10. Concrete Cover: Install a minimum of 3-inches of concrete cover at top and bottom, and a minimum of 2-inches on each side of duct bank.
  11. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
    - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18-inches into concrete on both sides of joint near corners of envelope.
  12. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Division 03 Section "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
- J. Warning Tape: Bury warning tape approximately 12-inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3-inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18-inches. Space additional tapes 12-inches apart, horizontally.
- K. Direct-Buried Duct and Duct Bank:
1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Division 31 Section "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
  2. Width: Excavate trench 12-inches wider than duct on each side.
  3. Depth: Install top of duct at least 24-inches below finished grade unless otherwise indicated.
  4. Set elevation of bottom of duct bank below frost line.
  5. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.



6. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20-feet of duct. Place spacers within 24-inches of duct ends. Stagger spacers approximately 6-inches between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
7. Install duct with a minimum of 3-inches between ducts for like services and 6-inches between power and communications duct.
8. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
9. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.
  - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3-inches of concrete.
  - b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60-inches from edge of base. Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups shall be minimum 4-inches above finished floor and minimum 3-inches from conduit side to edge of slab.
  - c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60-inches from edge of wall. Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups shall be minimum 4-inches above finished floor and no less than 3-inches from conduit side to edge of slab.
10. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4-inches over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Division 31 Section "Earth Moving" for installation of backfill materials.
  - a. Place minimum 3-inches of sand as a bed for duct. Place sand to a minimum of 6-inches above top level of duct.
  - b. Place minimum 6-inches of engineered fill above concrete encasement of duct.

### 3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

- A. Precast Concrete Handhole and Manhole Installation:
  1. Comply with ASTM C 891 unless otherwise indicated.
  2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
  3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- B. Elevations:
  1. Manhole Roof: Install with rooftop at least 15-inches below finished grade.

2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1-inch above finished grade.
  3. Install handholes with bottom below frost line, below grade.
  4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1-inch above finished grade.
  5. Where indicated, cast handhole cover frame integrally with handhole structure.
- C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- D. Manhole Access: Circular opening in manhole roof; sized to match cover size.
1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
  2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.
- E. Dampproofing: Apply dampproofing to exterior surfaces of manholes after concrete has cured at least three days. After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.
- F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
- G. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8-inches for manholes and 2-inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

### 3.7 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
  2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch-long mandrel equal to 80% fill of duct. If obstructions are indicated, remove obstructions and retest.
  3. Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

- C. Prepare test and inspection reports.

### 3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump.
  - 1. Sweep floor, removing dirt and debris.
  - 2. Remove foreign material.

**END OF SECTION 260543**

## **SECTION 260544 – SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Sleeves for raceway penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

### **PART 2 - PRODUCTS**

#### **2.1 SLEEVES**

- A. Wall Sleeves:
  - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
  - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized sheet steel.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50-inches and with no side larger than 16-inches, thickness shall be 0.052-inch.
    - b. For sleeve cross-section rectangle perimeter 50-inches or more and one or more sides larger than 16-inches, thickness shall be 0.138-inch.

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. CALPICO, Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
    - e. Proco Products, Inc.
  2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: Stainless steel.
  4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
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. Presealed Systems.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SILICONE SEALANTS

- A. 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 that are not fire rated.
  2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

### PART 3 - EXECUTION

#### 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

#### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

## **SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Identification for raceways.
  - 2. Identification of power and control cables.
  - 3. Identification for conductors.
  - 4. Underground-line warning tape.
  - 5. Warning labels and signs.
  - 6. Instruction signs.
  - 7. Equipment identification labels.
  - 8. Miscellaneous identification products.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

#### **1.3 QUALITY ASSURANCE**

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

#### **1.4 COORDINATION**

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.



- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."
- D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- E. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- (100 mm-) wide black stripes on 10-inch (250 mm) centers diagonally over orange background that extends full length of raceway or duct and is 12-inches (300 mm) wide. Stop stripes at legends.

### 2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

### 2.3 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1- to 2-inches (25 to 50 mm) wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3 mil- (0.08 mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

## 2.4 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
  - 1. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 2. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
  - 3. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with "ELECTRIC LINE, HIGH VOLTAGE", compounded for direct-burial service.
  - 4. Overall Thickness: 5 mils.
  - 5. Foil Core Thickness: 0.35 mil.
  - 6. Weight: 28 lb/1000 sq. ft.
  - 7. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.
- B. Color and Printing:
  - 1. Comply with ANSI Z535.1 through ANSI Z535.5.

## 2.5 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

## 2.6 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16-inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8-inch (3.2 mm) thick for larger sizes.
  - 1. Engraved legend with black letters on white face.
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8-inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

## 2.7 EQUIPMENT IDENTIFICATION LABELS

- A. Dry Locations: Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background. Minimum letter height shall be 3/8-inch.
- B. Wet Locations: Laser Etched, Type 316 Stainless Steel Label: Punched or drilled for screw mounting. Black letters on a white background. Minimum letter height shall be 3/8-inch.

## 2.8 CABLE TIES

- A. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
  1. Minimum Width: 3/16-inch (5 mm).
  2. Tensile Strength at 73°F (23°C), According to ASTM D 638: 7000 psi (48.2 MPa).
  3. UL 94 Flame Rating: 94V-0.
  4. Temperature Range: Minus 50°F to plus 284°F (Minus 46°C to plus 140°C).
  5. Color: Black.

## 2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in

contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15 m) maximum intervals in straight runs, and at 25-foot (7.6 m) maximum intervals in congested areas.

- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6- to 8-inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds -nches (400 mm) overall.
- J. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

### 3.2 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch- (100 mm-) wide black stripes on 10-inch (250 mm) centers over orange background that extends full length of raceway or duct and is 12-inches (300 mm) wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75 mm-) high black letters on 20-inch (500 mm) centers. Stop stripes at legends. Apply to the following finished surfaces:
  - 1. Floor surface directly above conduits running beneath and within 12-inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
  - 2. Wall surfaces directly external to raceways concealed within wall.
  - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot (10-m) maximum intervals.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
  - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
  - 2. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    - a. Colors for 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
    - b. Colors for 480/277-V Circuits:
      - 1) Phase A: Brown.
      - 2) Phase B: Violet.
      - 3) Phase C: Orange.

- c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6-inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags.
- E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  - 1. Limit use of underground-line warning tape to direct-buried cables.
  - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
  - 1. Comply with 29 CFR 1910.145.
  - 2. Identify system voltage with black letters on an orange background.
  - 3. Apply to exterior of door, cover, or other access.
  - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
  - 5. Power transfer switches.
    - a. Double-ended switchgear.
    - b. Controls with external control power connections.
- J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10 mm-) high letters for emergency instructions at equipment used for power transfer.

- L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Equipment: Unless otherwise indicated, provide a single line of text with ½-inch- (13 mm) high letters on 1½-inch- (38 mm) high label; where two lines of text are required, use labels 2-inches (50 mm) high.
    - a. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - b. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  2. Equipment to Be Labeled:
    - a. Panelboards. Also include Typewritten final directory of circuits after load balancing.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchgear.
    - e. Switchboards.
    - f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - g. Motor-control centers.
    - h. Enclosed switches.
    - i. Enclosed circuit breakers.
    - j. Enclosed controllers.
    - k. Variable-speed controllers.
    - l. Push-button stations.
    - m. Monitoring and control equipment.
    - n. UPS equipment.

**END OF SECTION 260553**

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## SECTION 260923 – LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Standalone daylight-harvesting switching controls.
  - 2. Indoor occupancy sensors.
- B. Related Requirements:
  - 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
  - 1. Interconnection diagrams showing field-installed wiring.
  - 2. Include diagrams for power, signal, and control wiring.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Available 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:
  - 1. Cooper Industries, Inc.
  - 2. Intermatic, Inc.
  - 3. NSi Industries LLC; TORK Products.
  - 4. Tyco Electronics; ALR Brand.



- B. Description: Solid state, with SPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range.
  - 3. Time Delay: Thirty-second minimum, to prevent false operation.
  - 4. Lightning Arrester: Air-gap type.
  - 5. Mounting: Twist lock complying with NEMA C136.10, with base.

## 2.2 DAYLIGHT-HARVESTING SWITCHING CONTROLS

- A. Available 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:
  - 1. Cooper Industries, Inc.
  - 2. Eaton Corporation.
  - 3. Hubbell Building Automation, Inc.
  - 4. Leviton Manufacturing Co., Inc.
  - 5. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - 6. NSi Industries LLC; TORK Products.
  - 7. Sensor Switch, Inc.
  - 8. Tyco Electronics; ALR Brand.
  - 9. Watt Stopper.
- B. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.
- C. Electrical Components, Devices, and Accessories:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Operating Ambient Conditions: Dry interior conditions, 32°F to 120°F (0°C to 49°C).
  - 3. Sensor Output: Contacts rated to operate the associated power pack, complying with UL 773A. Sensor is powered by the power pack.
  - 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  - 5. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lux), with an adjustment for turn-on and turn-off levels within that range.
  - 6. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
  - 7. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
  - 8. Test Mode: User selectable, overriding programmed time delay to allow settings check.
  - 9. Control Load Status: User selectable to confirm that load wiring is correct.
  - 10. Indicator: Two digital displays to indicate the beginning of on-off cycles.

## 2.3 DAYLIGHT-HARVESTING DIMMING CONTROLS

- A. Available 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:
1. Cooper Industries, Inc.
  2. Hubbell Building Automation, Inc.
  3. Leviton Mfg. Company Inc.
  4. Lithonia Lighting; Acuity Lighting Group, Inc.
  5. Watt Stopper.
- B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
1. Lighting control set point is based on two lighting conditions:
    - a. When no daylight is present (target level).
    - b. When significant daylight is present.
  2. System programming is done with two hand-held, remote-control tools.
    - a. Initial setup tool.
    - b. Tool for occupants to adjust the target levels by increasing the set point up to 25%, or by minimizing the electric lighting level.
- C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.
  3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
  4. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lux).

## 2.4 INDOOR OCCUPANCY SENSORS

- A. Available 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:
1. Bryant Electric.
  2. Cooper Industries, Inc.
  3. Hubbell Building Automation, Inc.
  4. Leviton Manufacturing Co., Inc.
  5. Lightolier Controls.
  6. Lithonia Lighting; Acuity Brands Lighting, Inc.
  7. Lutron Electronics Co., Inc.
  8. NSi Industries LLC; TORK Products.
  9. RAB Lighting.
  10. Sensor Switch, Inc.
  11. Square D.
  12. Watt Stopper.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
  4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  5. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a ½-inch (13 mm) knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  7. Bypass Switch: Override the "on" function in case of sensor failure.
  8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6-inch- (150 mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12-inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12-inches/s (305 mm/s).
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440 mm-) high ceiling.

## 2.5 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Available 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:
1. Bryant Electric.
  2. Cooper Industries, Inc.
  3. Hubbell Building Automation, Inc.
  4. Leviton Manufacturing Co., Inc.
  5. Lightolier Controls.
  6. Lithonia Lighting; Acuity Brands Lighting, Inc.
  7. Lutron Electronics Co., Inc.
  8. NSi Industries LLC; TORK Products.
  9. RAB Lighting.
  10. Square D.
  11. Watt Stopper.

- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Operating Ambient Conditions: Dry interior conditions, 32°F to 120°F (0°C to 49°C).
  - 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
  
- C. Wall-Switch Sensor:
  - 1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
  - 2. Sensing Technology: Dual technology - PIR and ultrasonic.
  - 3. Switch Type: Single or Double Pole as shown on drawings, field selectable automatic "on," or manual "on" automatic "off."
  - 4. Voltage: Match circuit voltage.
  - 5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
  - 6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
  - 7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
  - 8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

## 2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90% coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### 3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is ½-inch (13 mm).
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
  - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
  - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

**END OF SECTION 260923**

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## SECTION 260943 – NETWORK LIGHTING CONTROLS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes individually addressable lighting control devices communicating with data-entry and -retrieval devices using DALI protocol.
- B. Related Sections:
  - 1. Division 26 Section "Lighting Control Devices" for time clocks, photoelectric sensors, occupancy sensors, and multipole contactors.

#### 1.2 DEFINITIONS

- A. BACnet: A networking communication protocol that complies with ASHRAE 135.
- B. BAS: Building automation system.
- C. DALI: Digital addressable lighting interface.
- D. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.
- F. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- G. PC: Personal computer; sometimes plural as "PCs."
- H. Power Line Carrier: Use of radio-frequency energy to transmit information over transmission lines whose primary purpose is the transmission of power.
- I. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A.
- J. UTP: Unshielded twisted pair.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, DALI network materials, manual switches and plates, and conductors and cables.



- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
  - 3. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
  - 4. Wiring Diagrams: For power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
  - 1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
  - 2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.
- B. Field quality-control reports.
- C. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
- D. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.
- B. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Electrically Held Relays: Equal to 10% of amount installed for each size indicated, but no fewer than 5 relays.

#### 1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer.
- B. 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.
- C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
- D. Comply with protocol described in IEC 60929, Annex E, for DALI lighting control devices, wiring, and computer hardware and software.
- E. Comply with NFPA 70.

#### 1.8 COORDINATION

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
  1. Match components and interconnections for optimum performance of lighting control functions.
  2. Coordinate lighting controls with BAS. Design display graphics showing building areas controlled; include the status of lighting controls in each area.

#### 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Failure of software input/output to execute switching or dimming commands.
    - b. Failure of modular relays to operate under manual or software commands.
    - c. Damage of electronic components due to transient voltage surges.
  2. Warranty Period: Two years from date of Substantial Completion.
  3. Extended Warranty Period Failure Due to Transient Voltage Surges: Eight years.
  4. Extended Warranty Period for Electrically Held Relays: 10 years from date of Substantial Completion.

#### 1.10 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion.

Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of the software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available 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:
1. Acuity Brands Lighting, Inc.; Lithonia Lighting brand.
  2. Intelligent Lighting Controls.
  3. Leviton Mfg. Company Inc.
  4. Lighting Control & Design, Inc.
  5. Lightolier Controls; a division of Genlyte Group, LLC.
  6. Lutron Electronics Co., Inc.
  7. Musco Lighting.
  8. NexLight; part of the Northport Engineering Group.
  9. Square D; a brand of Schneider Electric.
  10. Starfield Controls, Inc.
  11. Touch-Plate Technologies.
  12. Triatek, Inc.
  13. Watt Stopper/Legrand.

### 2.2 SYSTEM REQUIREMENTS

- A. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity; to include equipment ratings, housing capacities, spare relays, terminals, number of conductors in control cables, and control software.
- B. Performance Requirements: Manual switches, an internal timing and control unit, and external sensors or other control signal sources send a signal to a PC-based network-system control module that processes the signal according to its programming and routes an open or close command to one or more relays in the power-supply circuits, or routes variable commands to one or more dimmers, for groups of lighting fixtures or other loads.
- C. BAS Interface: Provide hardware and software to enable the BAS to monitor, control, display, and record data for use in processing reports.
1. Hardwired Points:
    - a. Monitoring: On-off status, Lighting relays per schedule.
    - b. Control: On-off operation, Lighting relays per schedule.
  2. Industry-accepted, open-protocol communication interface with the BAS shall enable the BAS operator to remotely control and monitor lighting from a BAS operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the BAS.

- D. Controllable by mobile device: Provide applications software to allow programming changes to be made from an iPad, Smartphone, notebook computer or other similar mobile device.

## 2.3 CONTROL MODULE

- A. Control Module Description: Comply with UL 916 (CSA C22.2, No. 205); microprocessor-based, solid-state, 365-day timing and control unit. Output circuits shall be switched on or off by internally programmed time signals or by program-controlled analog or digital signals from external sources. Output circuits shall be pilot-duty relays compatible with power switching devices. An integral keypad shall provide local programming and control capability. A key-locked cover and a programmed security access code shall protect keypad use. An integral alphanumeric LCD or LED shall display menu-assisted programming and control.

## 2.4 DALI NETWORK MATERIALS

- A. Network Power Supply and Router: Interface device connecting TCP/IP control networks to DALI-compliant network.
  - 1. DALI-Compliant Network Power Rating: Two full-rated networks, each capable of powering up to 64 addressable devices for each network; suitable for use with NFPA 70, Class 1 and Class 2 control circuits; and 16 V dc, 250 mA.
  - 2. Primary Power: 120 or 277 V, field selectable; 12 VA.
  - 3. 10basT Ethernet port.
  - 4. LED indicator lights for Ethernet status (link, send, and receive), power-on, and DALI network failure.
- B. Lighting Control Software:
  - 1. Five-tier hierarchical architecture; high-speed, parallel query; and distributed-logic processing scalable from single rooms to full campuses.
  - 2. Automatic backup for all settings and parameters.
  - 3. TCP/IP network protocol.
  - 4. Interactive with other building management systems at TCP/IP level.
  - 5. At least three security levels.
  - 6. Support the full suite of DALI commands and device parameter settings.
  - 7. Scheduling modules to provide building-wide scene scheduling.
  - 8. Billing modules to track energy use for multiple tenants and able to produce monthly billing statements.
  - 9. Support load shedding, peak shaving, sweeps with local override, and other energy-conservation measures.
  - 10. Able to report individual device status, including inoperative lamps, ballast failure detection, and dimmer position.

## 2.5 MANUAL ANALOG SWITCHES AND PLATES

- A. Push-Button Switches: Modular, momentary-contact, low-voltage type.
  - 1. Match color specified in Division 26 Section "Wiring Devices."
  - 2. Integral green LED pilot light to indicate when circuit is on.
  - 3. Internal white LED locator light to illuminate when circuit is off.

- B. Manual, Maintained Contact, Full- or Low-Voltage Switch: Comply with Division 26 Section "Wiring Devices."
- C. Wall Plates: Single and multigang plates as specified in Division 26 Section "Wiring Devices."

## 2.6 FIELD-MOUNTED DIGITAL CONTROLS AND PLATES

- A. Connection Type: RS-485 protocol, category 5e UTP cable, using RJ45 connectors. Power shall be from the control unit.
- B. Pushbutton Switches: Modular, solid-state, programmable, digital, momentary contact, designed to connect to a microprocessor based control unit as a manual control source.
  - 1. Mounting: Standard single-gang recessed switchbox, using device plates specified in Division 26 Section "Wiring Devices."
  - 2. Multi-Gang Mounting: One to six pushbuttons per gang.

## 2.7 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cables: Stranded copper, complying with UL 83, multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Stranded copper, complying with UL 83, multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- D. Structured Network Digital and Multiplexed Signal Cables: UTP cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5e for horizontal copper cable and with Division 27 Section "Communications Horizontal Cabling."
- E. RS-485 Cables:
  - 1. Plenum-Rated Cable: NFPA 70, Type CMP.
    - a. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
    - b. Fluorinated ethylene propylene insulation.
    - c. Unshielded.
    - d. Fluorinated ethylene propylene jacket.
    - e. Flame Resistance: NFPA 262, Flame Test.

## PART 3 - EXECUTION

### 3.1 WIRING INSTALLATION

- A. Comply with NECA 1.

- B. Wiring Method: Install wiring in raceways except where installed in accessible ceilings. Minimum conduit size shall be ½-inch (13 mm).
  - 1. For power wiring comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- D. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- E. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.
- G. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

### 3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Test for circuit continuity.
  - 2. Verify that the control module features are operational.
  - 3. Check operation of local override controls.
  - 4. Test system diagnostics by simulating improper operation of several components selected by Architect.
- C. Lighting controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.3 SOFTWARE INSTALLATION

- A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.
- B. Provide application software on mobile devices furnished by owner.

### 3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls and software training for PC-based and mobile device control systems.

**END OF SECTION 260943**

## SECTION 262416 – PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

#### 1.2 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Include evidence of NRTL listing for series rating of installed devices.
  - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 7. Include wiring diagrams for power, signal, and control wiring.
  - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field Quality-Control Reports:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.



- C. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Keys: Two spares for each type of panelboard cabinet lock.

#### 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. 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.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

#### 1.9 PROJECT CONDITIONS

- A. Environmental Limitations:
  - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary

HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - a. Ambient Temperature: Not exceeding 23°F (minus 5°C) to plus 104°F (plus 40°C).
  - b. Altitude: Not exceeding 6,600 feet (2,000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6,600 feet (2,000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Construction Manager's written permission.
3. Comply with NFPA 70E.

#### 1.10 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

#### 1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and surface-mounted cabinets.
  1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  6. Finishes:
    - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
    - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
  7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- A. Incoming Mains:
1. Location: Convertible between top and bottom.
  2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
  3. Vertically mounted main circuit breaker, separate from branch bussing. Main circuit breaker shall not take up space on the branch buss.
- B. Phase, Neutral, and Ground Buses:
1. Material: Tin-plated aluminum.
  2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- C. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Tin-plated aluminum.
  2. Main and Neutral Lugs: Compression type.
  3. Ground Lugs and Bus-Configured Terminators: Compression type.
  4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- D. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Available 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:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Hinged, secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36-inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or Lugs only.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Available 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:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Available 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:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long- and short-time time adjustments.
    - d. Ground-fault pickup level, time delay, and I squared x t response.
  4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - e. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
    - f. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
    - g. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    - h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

## 2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Mount top of trim 72-inches above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- I. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- D. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- E. Panelboards will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
  - 1. Measure as directed during period of normal system loading.
  - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.

4. Tolerance: Difference exceeding 20% between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

### 3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION 262416**



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## SECTION 262726 – WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Receptacles.
  - 2. Toggle Switches
  - 3. Wall Plates.

#### 1.2 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available 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:
  - 1. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
  - 2. Hubbell Incorporated; Kellems or Bryant.
  - 3. Leviton Manufacturing Co., Inc.
  - 4. Pass & Seymour/Legrand (Pass & Seymour).

- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

## 2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Where required, simplex receptacles shall be of the same model series with equivalent properties as the duplex receptacle.
- C. Comply with NFPA 70.
- D. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  - 2. Devices shall comply with the requirements in this Section.

## 2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
- B. Standard face, 20A, 125VAC, straight blade, NEMA 5-20R, duplex grounding type.
  - 1. General Purpose – Heavy Duty, premium specification grade, with brass strap.
  - 2. Available 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. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc; 5362 Series.
    - b. Hubbell Incorporated; Wiring Device-Kellems; 5362 Series.
    - c. Leviton Manufacturing Co., Inc.; 5362 Series.
    - d. Pass & Seymour/Legrand (Pass & Seymour); 5362A Series.

## 2.4 GFCI RECEPTACLES

- A. General Description:
  - 1. Straight blade type.
  - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
  - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
  - 4. Tamper and Water Resistant, Ground Fault Circuit Interrupting Feed-Thru Type – Heavy Duty, premium specification grade, with LED “Protection Assurance” indicator on face.
  - 5. Available 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. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc; TRVGF20 Series.
    - b. Hubbell Incorporated; Wiring Device-Kellems; GFR5362TR Series.

- c. Bryant – GFTR20 Series
- d. Leviton Manufacturing Co., Inc.; T7899-HG Series.
- e. Pass & Seymour/Legrand (Pass & Seymour); 2095TRS Series.

## 2.5 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Standard Toggle Switches, 120/277 VAC, 20 A, specification grade, back and side wired: (\* Indicates 1 pole, double pole, 3-way, or 4-way, as required.)
  - 1. Available 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. Cooper; 122\* Series.
    - b. Hubbell; 122\* Series
    - c. Bryant; 490\* Series.
    - d. Leviton; 122\*-2 Series.
    - e. Pass & Seymour; 20AC\* Series.

## 2.6 FINISHES

- A. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: Gray.
  - 2. Wiring Devices Connected to UPS Panel: Red.

## 2.7 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: 0.035-inch-thick, satin-finished, Type 302 stainless steel.
  - 3. Material for Unfinished Spaces: Galvanized steel.
  - 4. Material for wet locations (process areas): Cast Aluminum.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
  - a. Cut back and pigtail, or replace all damaged conductors.
  - b. Straighten conductors that remain and remove corrosion and foreign matter.
  - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6-inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

### 3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles.

### 3.3 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.4 FIELD QUALITY CONTROL

- A. Tests for Convenience Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- B. Wiring device will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

**END OF SECTION 262726**

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## **SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Nonfusible switches.
  - 2. Enclosures.

#### **1.2 DEFINITIONS**

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Include evidence of NRTL listing for series rating of installed devices.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified testing agency.
- B. Field quality-control reports.
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- C. Manufacturer's field service report.

#### **1.5 CLOSEOUT SUBMITTALS**



- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. 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.
- E. Comply with NFPA 70.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22°F (minus 30°C) and not exceeding 104°F deg F (40°C).
  - 2. Altitude: Not exceeding 6,600 feet (2010 m).
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without Construction Manager's written permission.
  - 4. Comply with NFPA 70E.

## 1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 NONFUSIBLE SWITCHES

- A. Available 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:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
  - 4. Lugs: Compression type, suitable for number, size, and conductor material.

### 2.2 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations, or Wet or Damp Indoor Locations: NEMA 250, Type 4X, Stainless steel.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

**END OF SECTION 262816**

## SECTION 265100 – INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Interior lighting fixtures, lamps, and ballasts.
  - 2. Exit signs.
  - 3. Lighting fixture supports.

#### 1.2 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting fixture, including ballast housing if provided.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire, arranged in order of luminaire designation, include a separate product data sheet, literature, drawings, etc on each of the following:
  - 1. Luminaire – Include:
    - a. A physical description of luminaire including dimensions.
    - b. Features.
    - c. Finishes.
    - d. Lensing.
    - e. Optics.
    - f. Accessories.
    - g. Photometric performance including efficacy and optical efficiency.
  - 2. Ballast, power supply, or driver – Include:
    - a. Start method (programmed start or instant start).
    - b. Wiring method (series or parallel).
    - c. Input voltage.
    - d. Ballast factor.
    - e. Lamp compatibility and number of lamps controlled.

- f. Total input power consumption, in watts, including lamp wattage and ballast losses.
  - g. Line current data.
  - h. Total harmonic distortion data.
  - i. Minimum lamp starting temperature.
  - j. Physical dimensions.
  - k. Sound rating
3. Lamp – Include
- a. Nominal rated power.
  - b. Shape and/or style of lamp.
  - c. Rated life for 3 hour start and 12 hour start on programmed start ballast.
  - d. Initial lumens.
  - e. Design lumens.
  - f. CRI
  - g. Color temperature
  - h. Physical dimensions.
4. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
- a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 2. Ballasts: One for every 100 of each type and rating installed. Furnish at least one of each type.

## 1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. 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.
- C. Comply with NFPA 70.

## 1.8 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

## 1.9 WARRANTY

- A. Warranties in this Article shall be provided and run concurrent with other warranties require of the Contractor under the requirements of the Contract Documents. Warranty shall begin at time of Substantial Completion of project.
- B. Warranties for Fluorescent Ballasts: Written warranty, executed by manufacturer, agreeing to replace fluorescent ballasts, including labor, that fail in materials or workmanship within five years.
- C. Warranties for luminaire finishes: Written warranty, executed by manufacturer, agreeing to replace luminaires, including labor, exhibiting a failure of finish as specified below within five years
  - 1. Protection from Corrosion: Warranty against perforation or erosion of finish.
  - 2. Color Retention: Warranty against fading, staining, and chalking.
- D. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
  - 2. Warranty Period for Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Luminaire Manufacturers: Subject to compliance with requirements of this section and the design criteria specified in the Luminaire Schedule on the Drawings, provide products by the manufacturers listed on the Luminaire Schedule.
  - 1. Reference to specific luminaire manufacturers and their respective model or series numbers are included on the luminaire schedule to provide a guide to the level of quality, performance, and overall physical appearance of the specified product, which shall be met, in accordance with the Luminaire Schedule's design criteria and the requirements listed in this section.
  - 2. Listed luminaire manufacturers and their series or model numbers shall not imply unconditional approval. The listed manufacturers and their respective products have been included as acceptable manufacturers of products which shall comply with the Luminaire Schedule design criteria, luminaire descriptions, and this section. Modification to a given manufacturer's standard product may be required to make the model or series numbers listed comply with the Luminaire Schedule design criteria and this section. Product's UL listing shall not be voided or otherwise compromised in order to comply with the specified luminaire design criteria and this section.
- B. Luminaire Products and Accessory Manufacturers: Subject to compliance with requirements of this section, provide products by a listed manufacturer under the specific product section.
- C. Manufacturers of products not specifically listed in this section or the Luminaire Schedule, or submitting on the basis of "or equivalent", shall provide the following for review prior to, or along with product submission.
  - 1. Documentation showing a minimum of three years experience in the business of design and manufacture of luminaires or lighting equipment similar to the type and quality of products specified.
  - 2. Product data demonstrating conformance with the design criteria listed in the Luminaire Schedule and this section.
  - 3. Prototype and/or operating sample of the product for evaluation by the Engineer. Prototype and/or sample shall be sufficiently details and operational to allow for fair evaluation and to demonstrate compliance with the design criteria specified. Product data and shop fabrication drawings are not acceptable means of providing prototype/sample requirement.
  - 4. Engineer shall be the sole judge of compliance to the design criteria and specifications.

### 2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND ACCESSORIES

- A. Fluorescent Fixtures:
  - 1. Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
  - 2. Provide multiple ballast/lamp wiring to facilitate switching arrangements indicated on the Drawings. Unless noted otherwise, 3 and 4 lamp fluorescent luminaires shall be factory wired to multiple ballasts, to allow inboard/outboard switch of the respective lamps.
  - 3. Lampholders for linear, bi-pin fluorescent lamps, shall be knife edge style contact points, and shall be factory wired in parallel, not series, not shunted, and not jumpered.

4. Shall be provided with factory installed disconnecting means, in compliance with Article 410.130(G) of NFPA 70 – National Electric Code.
  5. Unless noted otherwise, luminaires shall be constructed of not less than 22 gauge pre-treated and pre-finished cold rolled steel, die-cut, formed, welded, and tabbed to form a rigid housing. Housing and exposed surfaces shall be painted after fabrication in the specified finish coating.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging. Unless
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp and ballast characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
    - d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
    - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    - f. CCT and CRI for all luminaires.

### 2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. Available 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:
1. Advance Transformer.
  2. GE Lighting.
  3. Lutron Electronics Co., Inc.
  4. Osram/Sylvania.
  5. Universal Lighting Technologies.
- B. General Requirements for Electronic Ballasts:
1. Comply with UL 935 and with ANSI C82.11.
  2. Designed for type and quantity of lamps served.
  3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
  4. Sound Rating: Class A.
  5. Total Harmonic Distortion Rating: Less than 10%.



6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  7. Operating Frequency: 42 kHz or higher.
  8. Lamp Current Crest Factor: 1.7 or less.
  9. BF: As specified in the Luminaire Schedule.
  10. Power Factor: 0.95 or higher.
  11. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
  12. Programmed-start ballast.
- C. Electronic Programmed-Start Ballasts for T8, T5, and T5HO Lamps: Comply with ANSI C82.11 and the following:
1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
  2. Automatic lamp starting after lamp replacement.

## 2.4 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
  2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80% of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
    - g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.5 FLUORESCENT LAMPS

- A. Products: provide one of the following:
1. T8
    - a. GE Lighting – Ecolux Starcoat XL/SPX Series.
    - b. Philips Lighting – Advantage High Lumen 800 Series.
    - c. Sylvania Lighting – Octron 800 XPS Series.
  2. T5

- a. GE Lighting – Ecolux Starcoat Series
  - b. Philips Lighting – 800 Series
  - c. Sylvania – Pentron 800 Series
- B. Unless noted otherwise, lamp correlated color temperature (CCT) shall be 3500k.
- C. Linear Fluorescent Lamps: medium bi-pin base, minimum 82 CRI, average rated life of 24,000 hours at 3 hours per start/28,000 hours at 12-hours per start.
- 1. F32T8 – 32W, T8, nominal 48-inch long, rated minimum 3100/2914 initial/mean lumens @ 25°C.
  - 2. F14T5 – 14W, T5, nominal 24-inch long, rated minimum 1350/1240 initial/mean lumens @ 25°C.

## 2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: ½-inch (13 mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, ½-inch (13 mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).
- F. Rod Hangers: 3/16-inch (5 mm) minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Lighting fixtures:
  - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  - 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48-inches (1200 mm), brace to limit swinging.

2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
  4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

**END OF SECTION 265100**

## SECTION 270526 – GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Grounding conductors.
  - 2. Grounding connectors.
  - 3. Grounding busbars.
  - 4. Grounding labeling.

#### 1.2 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. EMT: Electrical metallic tubing.
- C. TGB: Telecommunications grounding busbar.
- D. TMGB: Telecommunications main grounding busbar.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
  - 1. BCT, TMGB, TGBs, and routing of their bonding conductors.
- B. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
    - a. Result of the ground-resistance test, measured at the point of BCT connection.

- b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

## PART 2 - PRODUCTS

### 2.1 SYSTEM COMPONENTS

- A. Comply with J-STD-607-A.

### 2.2 CONDUCTORS

- A. Available 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:
  - 1. Harger Lightning and Grounding.
  - 2. Panduit Corp.
  - 3. Tyco Electronics Corp.
- B. Comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
  - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
  - 2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
- D. Cable Tray Grounding Jumper:
  - 1. Not smaller than No. 6 AWG and not longer than 12-inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- E. Bare Copper Conductors:
  - 1. Stranded Conductors: ASTM B 8.
  - 2. Tinned Conductors: ASTM B 33.
  - 3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 4. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8-inches (41 mm) wide and 1/16-inch (1.6 mm) thick.

### 2.3 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- A. Available 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:

1. Burndy; Part of Hubbell Electrical Systems.
  2. Chatsworth Products, Inc.
  3. Harger Lightning and Grounding.
  4. Panduit Corp.
  5. Tyco Electronics Corp.
- B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
1. Electroplated tinned copper, C and H shaped.
- C. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8 or 25.4 mm) centers for a two-bolt connection to the busbar.
- D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.4 GROUNDING BUSBARS

- A. Available 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:
1. Chatsworth Products, Inc.
  2. Harger Lightning and Grounding.
  3. Panduit Corp.
- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4- by 4-inches (6.3 by 100 mm) in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-A.
1. Predrilling shall be with holes for use with lugs specified in this Section.
  2. Mounting Hardware: Stand-off brackets that provide a 4-inch ((100 mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.)
  3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4- by 2-inches (6.3 by 50 mm) in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-A.
1. Predrilling shall be with holes for use with lugs specified in this Section.
  2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch ((50 mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.)
  3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-A. Predrilling shall be with holes for use with lugs specified in this Section.
1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.

2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch (483 or 584 mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical Busbar: 72- or 36-inches (1,827 or 914 mm) long, with stainless-steel or copper-plated hardware for attachment to the rack.

## 2.5 LABELING

- A. Available 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:
  1. Brother International Corporation.
  2. HellermannTyton.
  3. Panduit Corp.
- B. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8-inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with J-STD-607-A.

### 3.3 APPLICATION

- A. Conductors: Install stranded or solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
  - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
  - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Underground Grounding Conductors: Install barecopper conductor, No. 2 AWG minimum.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:
  - 1. Secure grounding and bonding conductors at intervals of not less than 36-inches (900 mm).
- E. Grounding and Bonding Conductors:
  - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90°.
  - 2. Install without splices.
  - 3. Support at not more than 36-inch (900 mm) intervals.
  - 4. Install grounding and bonding conductors in ¾-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
    - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Division 27 Section "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

### 3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 1/0 AWG.

### 3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2-inches (50 mm) minimum from wall, 12-inches (300 mm) above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.



### 3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
  - 1. Use crimping tool and the die specific to the connector.
  - 2. Pretwist the conductor.
  - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.
- J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

### 3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12-inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.

- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4-inches (100 mm) extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2-inches (50 mm) above to 6-inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

### 3.8 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
  - 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
  - 2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
  - 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

### 3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
    - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
  - 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0%.
    - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.

- C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

**END OF SECTION 270526**

## SECTION 270528 – PATHWAYS FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Metal conduits and fittings.
  - 2. Nonmetallic conduits and fittings.
  - 3. Optical-fiber-cable pathways and fittings.
  - 4. Metal wireways and auxiliary gutters.
  - 5. Nonmetallic wireways and auxiliary gutters.
  - 6. Surface pathways.
  - 7. Boxes, enclosures, and cabinets.
  - 8. Handholes and boxes for exterior underground cabling.
  
- B. Related Requirements:
  - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
  - 2. Division 26 Section "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.

#### 1.2 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of pathway groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, equipment racks and their mounting provisions, including those for internal components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
  - 4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.
- D. Source quality-control reports.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS AND FITTINGS

- A. Available 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:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit.
  - 3. Alpha Wire Company.
  - 4. Anamet Electrical, Inc.
  - 5. Electri-Flex Company.
  - 6. O-Z/Gedney.
  - 7. Picoma Industries.
  - 8. Republic Conduit.
  - 9. Robroy Industries.
  - 10. Southwire Company.
  - 11. Thomas & Betts Corporation.
  - 12. Western Tube and Conduit Corporation.
  - 13. Wheatland Tube Company.
- B. General Requirements for Metal Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569-B.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Fittings for EMT:

- a. Material: Steel or die cast.
  - b. Type: Compression.
- 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
- G. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Available 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:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit.
  - 3. Anamet Electrical, Inc.
  - 4. Arnco Corporation.
  - 5. CANTEX Inc.
  - 6. CertainTeed Corporation.
  - 7. Condux International, Inc.
  - 8. Electri-Flex Company.
  - 9. Kraloy.
  - 10. Lamson & Sessions; Carlon Electrical Products.
  - 11. Niedax-Kleinhuis USA, Inc.
  - 12. RACO; Hubbell.
  - 13. Thomas & Betts Corporation.
- B. General Requirements for Nonmetallic Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569-B.
- A. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- B. RNC: Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- C. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- D. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Available 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:
  - 1. Alpha Wire Company.
  - 2. Arnco Corporation.
  - 3. Endot Industries Inc.
  - 4. IPEX.
  - 5. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible-type pathway, approved for plenum, riser or general-use installation as appropriate unless otherwise indicated.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569-B.

## 2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Available 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:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman.
  - 3. Mono-Systems, Inc.
  - 4. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 12 unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569-B.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged or Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

## 2.5 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Available 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:
  - 1. Allied Moulded Products, Inc.
  - 2. Hoffman.
  - 3. Lamson & Sessions; Carlon Electrical Products.

4. Niedax-Kleinhuis USA, Inc.
- B. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
    1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
    2. Comply with TIA-569-B.
  - C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
  - D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
  - E. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - F. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.6 SURFACE PATHWAYS

- A. General Requirements for Surface Pathways:
  1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Comply with TIA-569-B.
- B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
  1. Available 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. Mono-Systems, Inc.
    - b. Niedax-Kleinhuis USA, Inc.
    - c. Panduit Corp.
    - d. Wiremold / Legrand.
- C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.
  1. Available 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. Lamson & Sessions; Carlon Electrical Products.
    - b. Mono-Systems, Inc.
    - c. Panduit Corp.
    - d. Quazite:Hubbell Power Systems, Inc.
    - e. Wiremold / Legrand.



- D. Tele-Power Poles:
1. Available 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. Mono-Systems, Inc.
    - b. Panduit Corp.
    - c. Wiremold / Legrand.
  2. Material: Galvanized steel with ivory baked-enamel finish.
  3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

## 2.7 BOXES, ENCLOSURES, AND CABINETS

- A. Available 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:
1. Adalet.
  2. Cooper Technologies Company; Cooper Crouse-Hinds.
  3. EGS/Appleton Electric.
  4. Erickson Electrical Equipment Company.
  5. Hoffman.
  6. Lamson & Sessions; Carlon Electrical Products.
  7. Milbank Manufacturing Co.
  8. Molex; Woodhead Brand.
  9. Mono-Systems, Inc.
  10. O-Z/Gedney.
  11. Quazite:Hubbell Power Systems, Inc.
  12. RACO; Hubbell.
  13. Robroy Industries.
  14. Spring City Electrical Manufacturing Company.
  15. Stahlin Non-Metallic Enclosures.
  16. Thomas & Betts Corporation.
  17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets:
1. Comply with TIA-569-B.
  2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Device Box Dimensions: 4-inches by 2-1/8-inches by 2-1/8-inches deep (100 mm by 60 mm by 60 mm deep).

- G. Gangable boxes are allowed.
- H. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures:
    - a. Material: Plastic.
    - b. Finished inside with radio-frequency-resistant paint.
  - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- J. Cabinets:
  - 1. NEMA 250, Type 12, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

- A. General Requirements for Handholes and Boxes:
  - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
  - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 3. Comply with TIA-569-B.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
  - 1. Available 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. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. NewBasis.
    - d. Oldcastle Precast, Inc; Christy Concrete Products.
    - e. Quazite: Hubbell Power System, Inc; Hubbell Power Systems.
    - f. Synertech Moulded Products.
  - 2. Standard: Comply with SCTE 77.
  - 3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
  - 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  - 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - 6. Cover Legend: Molded lettering, "COMMUNICATIONS."

7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12-inches wide by 24-inches long (300 mm wide by 600 mm long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.9 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
  1. Tests of materials shall be performed by an independent testing agency.
  2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
  1. Exposed Conduit: GRC.
  2. Concealed Conduit, Aboveground: GRC.
  3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased as indicated.
  4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  1. Exposed, Not Subject to Physical Damage (Office areas, Labs, Control room and similar): EMT.
  2. Exposed, Not Subject to Physical Damage (Process areas with moisture or chemical content): RNC, Type EPC-80-PVC.
  3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  4. Damp or Wet Locations: RNC, Type EPC-80-PVC.
  5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250 Type 4X in wet locations.
  6. Concealed in Ceilings and Interior Walls and Partitions: EMT or innerduct.
  7. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
  8. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, optical-fiber-cable pathway.
  9. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway.
- C. Minimum Pathway Size: ¾-inch (21 mm) trade size. Minimum size for optical-fiber cables is 1-inch (27 mm).

- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
  1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120°F (49°C).

### 3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6-inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of two 90° bends in any pathway run. Support within 12-inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12-inches (300 mm) of enclosures to which attached.
- I. Pathways Embedded in Slabs:
  1. Run conduit larger than 1-inch (27 mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3 m) intervals.
  2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
  3. Arrange pathways to keep a minimum of 2-inches (50 mm) of concrete cover in all directions.
  4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

5. Change from ENT to RNC, Type EPC-40-PVC, before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
  1. Use EMT or RMC for pathways.
  2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- M. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus  $\frac{1}{4}$  turn more.
- N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- O. Cut conduit perpendicular to the length. For conduits of 2-inch (53 mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- P. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90 kg) tensile strength. Leave at least 12-inches (300 mm) of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- Q. Surface Pathways:
  1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
  2. Install surface pathway with a minimum 2-inch (50 mm) radius control at bend points.
  3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48-inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- R. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
  1.  $\frac{3}{4}$ -inch (21 mm) Trade Size and Smaller: Install pathways in maximum lengths of 50-feet (15 m).
  2. 1-inch (27 mm) Trade Size and Larger: Install pathways in maximum lengths of 75-feet (23 m).
  3. Install with a maximum of two 90° bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- S. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a

blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.

- T. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service pathway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- U. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- V. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30°F (17°C), and that has straight-run length that exceeds 25-feet (7.6 m). Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100°F (55°C) and that has straight-run length that exceeds 100-feet (30 m).
  - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125°F (70°C) temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155°F (86°C) temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125°F (70°C) temperature change.
  - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041-inch per foot of length of straight run per °F (0.06 mm per meter of length of straight run per °C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078-inch per foot of length of straight run per °F (0.0115 mm per meter of length of straight run per °C) of temperature change for metal conduits.
  - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- Z. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

- AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

#### A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12-inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3-inches (75 mm) of concrete for a minimum of 12-inches (300 mm) on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60-inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Division 26 Section "Identification for Electrical Systems."

### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from ½-inch (12.5 mm) sieve to No. 4 (4.75 mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1-inch (25 mm) above finished grade.
- D. Install handholes with bottom below frost line.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm

lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

- F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION 270528**



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## SECTION 270536 – CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Wire-basket cable trays.
  2. Single-rail cable trays.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cable tray.
1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- C. Delegated-Design Submittal: For seismic restraints.
1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
  2. Design Calculations: Calculate requirements for selecting seismic restraints.
  3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
  2. Vertical and horizontal offsets and transitions.
  3. Clearances for access above and to side of cable trays.
  4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
- B. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Field quality-control reports.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
  - 1. Temperature Change: 120°F (67°C), ambient; 180°F (100°C), material surfaces.

### 2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
  - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
- C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
  - 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
  - 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
  - 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

### 2.3 WIRE-BASKET CABLE TRAYS

- A. Available 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:
  - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 2. Cablofil/Legrande.
  - 3. Chalfant Manufacturing Company.
  - 4. Cooper B-Line, Inc.
  - 5. Enduro Systems, Inc.
  - 6. Mono-Systems, Inc.
  - 7. MP Husky.
  - 8. Niedax-Kleinhuis USA, Inc.
  - 9. Snaketray.
  - 10. Wiremaid Products Division; Vutec Corporation.
- B. Description:

1. Configuration: Wires are formed into a standard 2-by-4-inch (50 by 100 mm) wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.
2. Materials: High-strength-steel longitudinal wires with no bends.
3. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
4. Sizes:
  - a. Straight sections shall be furnished in standard 118-inch (3,000 mm) lengths.
  - b. Wire-Basket Depth: 2-inch (50 mm) usable loading depth by 12-inches (300 mm) wide.
5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
7. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316.

## 2.4 SINGLE-RAIL CABLE TRAYS

- A. Available 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:
  1. Allied Tube & Conduit; a Tyco International Ltd. Co.
  2. Cooper B-Line, Inc.
  3. Mono-Systems, Inc.
  4. MP Husky.
- B. Description:
  1. Configuration: Center rail with extruded-aluminum rungs arranged symmetrically about the center rail.
  2. Construction: Aluminum rungs mechanically connected to aluminum center rail in at least two places, with ends finished to protect installers and cables.
  3. Rung Spacing: 9-inches (225 mm) o.c.
  4. Radius-Fitting Rung Spacing: 9-inches (225 mm) at center of tray's width.
  5. Straight Section Lengths: 10-feet (3 m) except where shorter lengths are required to facilitate tray assembly.
  6. Width: 12-inches (300 mm) unless otherwise indicated on Drawings.
  7. Support Point: Splice fittings shall be hanger support point.
  8. Support Spacing: Support each section at midpoint. Support wall-mounted sections a maximum of one-sixth of the section length from each end.
  9. Loading Depth: 3-inches (75 mm).
  10. Maximum Loads: 25 lb/ft. (37 kg/m).
  11. Unbalanced Loads: Maintain cable tray rungs within six degrees of horizontal under all loading conditions.
  12. Splicing Assemblies: Bolted type using serrated flange locknuts.
  13. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
  14. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316.
  15. Splices and Connectors: Protect cables from edges of center rail and do not intrude into cable fill area.

## 2.5 MATERIALS AND FINISHES

- A. Aluminum:
  - 1. Materials: Alloy 6063-T6 according to ANSI H 35.1/H 35.1M for extruded components and Alloy 5052-H32 according to ANSI H 35.1/H 35.1M for fabricated parts.
  - 2. Hardware: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.
- B. Stainless Steel:
  - 1. Materials: Low-carbon, passivated, stainless steel, Type 304L, ASTM F 593 and ASTM F 594.
  - 2. Hardware for Stainless-Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

## 2.6 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as for cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

## 2.7 WARNING SIGNS

- A. Lettering: 1½-inch- (40 mm-) high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."
- B. Comply with requirements for fasteners in Division 26 Section "Identification for Electrical Systems."

## 2.8 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA FG 1.

## PART 3 - EXECUTION

### 3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA FG 1.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure and install seismic restraints.
- G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb (90 kg). Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems."
- H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- J. Support bus assembly to prevent twisting from eccentric loading.
- K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- L. Locate and install supports according to NEMA FG 1. Do not install more than one cable tray splice between supports.
- M. Support wire-basket cable trays with center support hangers.
- N. Support center support hangers for wire-basket trays with ¼-inch- (6 mm-) diameter rods.
- O. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- P. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA FG 1. Space connectors and set gaps according to applicable standard.
- Q. Make changes in direction and elevation using manufacturer's recommended fittings.
- R. Make cable tray connections using manufacturer's recommended fittings.
- S. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- T. Install cable trays with enough workspace to permit access for installing cables.
- U. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
- V. Install warning signs in visible locations on or near cable trays after cable tray installation.

### 3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- D. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

### 3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18-inches (450 mm).
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72-inches (1,800 mm).
- E. Tie MI cables down every 36-inches (900 mm) where required to provide a 2-hour fire rating and every 72-inches (1,800 mm) elsewhere.
- F. In existing construction, remove inactive or dead cables from cable trays.

### 3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
  - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.

3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorqued in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

### 3.6 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

**END OF SECTION 270536**



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## SECTION 271300 – COMMUNICATIONS BACKBONE CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pathways.
  - 2. UTP cable.
  - 3. 50/125-micrometer, optical fiber cabling.
  - 4. Cable connecting hardware, patch panels, and cross-connects.
  - 5. Cabling identification products.

#### 1.2 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

#### 1.3 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration drawings and printouts.
  - 4. Wiring diagrams to show typical wiring schematics including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
  - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
    - a. Vertical and horizontal offsets and transitions.
    - b. Clearances for access above and to side of cable trays.
    - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
    - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Maintenance Data: For splices and connectors to include in maintenance manuals.

## 1.7 CLOSEOUT SUBMITTALS

- A. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
- B. Testing Agency Qualifications: An NRTL.
    1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
  - C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    1. Flame-Spread Index: 25 or less.
    2. Smoke-Developed Index: 50 or less.
  - D. 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.
  - E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
  - F. Grounding: Comply with ANSI-J-STD-607-A.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
  2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
  3. Test each pair of UTP cable for open and short circuits.

#### 1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### 1.11 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

#### 1.12 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
  - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

## PART 2 - PRODUCTS

### 2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 2. Lacing bars, spools, J-hooks, and D-rings.
  - 3. Straps and other devices.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceways and Boxes for Electrical Systems."
  - 1. Outlet boxes shall be no smaller than 2-inches (50 mm) wide, 3-inches (75 mm) high, and 2½-inches (64 mm) deep.

### 2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, ¾- by 48- by 96-inches (19 by 1,220 by 2440 mm). Comply with requirements in Division 06 Section "Miscellaneous Rough Carpentry" for plywood backing panels.

### 2.3 OPTICAL FIBER CABLE

- A. Available 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:
  - 1. Berk-Tek; a Nexans company.
  - 2. CommScope, Inc.
  - 3. Corning Cable Systems.
  - 4. General Cable Technologies Corporation.
  - 5. Mohawk; a division of Belden CDT.
  - 6. Nordex/CDT; a subsidiary of Cable Design Technologies.
  - 7. Optical Connectivity Solutions Division; Emerson Network Power.
  - 8. Superior Essex Inc.
  - 9. SYSTIMAX Solutions; a CommScope Inc. brand.
  - 10. 3M.
  - 11. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

- B. Description: Multimode, 50/125-micrometer, 24-fiber, tight buffer, optical fiber cable.
  - 1. Comply with ICEA S-83-596 for mechanical properties.
  - 2. Comply with TIA/EIA-568-B.3 for performance specifications.
  - 3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - a. General Purpose, Nonconductive: Type OFN or OFNG.
    - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
  - 5. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
  - 6. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- C. Jacket:
  - 1. Jacket Color: Aqua for 50/125-micrometer cable.
  - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
  - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40-inches (1000 mm).

## 2.4 OPTICAL FIBER CABLE HARDWARE

- A. Available 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:
  - 1. ADC.
  - 2. American Technology Systems Industries, Inc.
  - 3. Berk-Tek; a Nexans company.
  - 4. Corning Cable Systems.
  - 5. Dynacom Corporation.
  - 6. Hubbell Premise Wiring.
  - 7. Molex Premise Networks; a division of Molex, Inc.
  - 8. Nordex/CDT; a subsidiary of Cable Design Technologies.
  - 9. Optical Connectivity Solutions Division; Emerson Network Power.
  - 10. Siemon Co. (The).
- B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
  - 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900 mm) lengths.
- D. Cable Connecting Hardware:
  - 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
  - 2. Quick-connect, simplex and duplex, Connector Type as directed by the Owner. Insertion loss not more than 0.75 dB.

## 2.5 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

## 2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## 2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

### 3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceways and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.3 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.
- B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 26 Section "Raceways and Boxes for Electrical Systems" for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation in Communications Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits 3-inches (76 mm) above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch (2,440 mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

### 3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30-inches (760 mm) and not more than 6-inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
  - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.



8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  9. In the communications equipment room, install a 10-foot- (3 m-) long service loop on each end of cable.
  10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
  2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- D. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  2. Suspend UTP cable not in a wireway or pathway, a minimum of 8-inches (200 mm) above ceilings by cable supports not more than 60-inches (1,524 mm) apart.
  3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
  2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5-inches (127 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12-inches (300 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24-inches (610 mm).
  3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2½-inches (64 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6-inches (150 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12-inches (300 mm).
  4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3-inches (76 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6-inches (150 mm).
  5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48-inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5-inches (127 mm).

### 3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50 mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  1. Administration Class: 1.
  2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
- C. Comply with requirements in Division 27 Section "Communications Horizontal Cabling" for cable and asset management software.
- D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- F. Cable and Wire Identification:
  1. Label each cable within 4-inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15-feet (4.5 m).
  4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
1. Cables use flexible vinyl or polyester that flexes as cables are bent.

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
  2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  4. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:
      - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
      - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

**END OF SECTION 271300**

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## SECTION 271500 – COMMUNICATIONS HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. UTP cabling.
  - 2. Multiuser telecommunications outlet assemblies.
  - 3. Cable connecting hardware, patch panels, and cross-connects.
  - 4. Telecommunications outlet/connectors.
  - 5. Cabling system identification products.
  - 6. Cable management system.
- B. Related Requirements:
  - 1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

#### 1.2 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. LAN: Local area network.
- G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. RCDD: Registered Communications Distribution Designer.
- J. UTP: Unshielded twisted pair.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration drawings and printouts.
  - 4. Wiring diagrams to show typical wiring schematics, including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
  3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
1. Test each pair of UTP cable for open and short circuits.

## PART 2 - PRODUCTS

### 2.1 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
  2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
  3. Bridged taps and splices shall not be installed in the horizontal cabling.
  4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295-feet (90 m). This maximum allowable length does not include an allowance for the length of 16-feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
  2. Smoke-Developed Index: 50 or less.



- C. 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.
- D. Grounding: Comply with J-STD-607-A.

## 2.3 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4- by 48- by 96-inches (19 by 1,220 by 2,440 mm). Comply with requirements in Division 06 Section "Miscellaneous Rough Carpentry" for plywood backing panels.

## 2.4 UTP CABLE

- A. Available 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:
  1. ADC.
  2. Belden Inc.
  3. Berk-Tek; a Nexans company.
  4. CommScope, Inc.
  5. Draka Cableteq USA.
  6. Genesis Cable Products; Honeywell International, Inc.
  7. Mohawk; a division of Belden Networking, Inc.
  8. Superior Essex Inc.
  9. SYSTIMAX Solutions; a CommScope, Inc. brand.
  10. 3M Communication Markets Division.
  11. Tyco Electronics Corporation; AMP Products.
- B. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
  1. Comply with ICEA S-90-661 for mechanical properties.
  2. Comply with TIA/EIA-568-B.1 for performance specifications.
  3. Comply with TIA/EIA-568-B.2, Category 6 of Category 6A as indicated.
  4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications, General Purpose: Type CM or CMG.
    - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
    - c. Communications, Riser Rated: Type CMR, complying with UL 1666.
    - d. Multipurpose: Type MP or MPG.
    - e. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
    - f. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

## 2.5 UTP CABLE HARDWARE

- A. Available 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:
  1. ADC.

2. American Technology Systems Industries, Inc.
  3. Belden Inc.
  4. Dynacom Inc.
  5. Hubbell Premise Wiring.
  6. Leviton Commercial Networks Division.
  7. Molex Premise Networks; a division of Molex, Inc.
  8. Panduit Corp.
  9. Siemon Co. (The).
  10. Tyco Electronics Corporation; AMP Products.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for both Category 6 and Category 6A. Provide blocks for the number of cables terminated on the block, plus 25% spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- G. Patch Cords: Factory-made, four-pair cables in 48-inch (1,200 mm) lengths; terminated with eight-position modular plug at each end.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
  2. Patch cords shall have color-coded boots for circuit identification.

## 2.6 CONSOLIDATION POINTS

- A. Available 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:
1. American Technology Systems Industries, Inc.
  2. Belden Inc.
  3. Chatsworth Products, Inc.
  4. Dynacom Inc.
  5. Hubbell Premise Wiring.
  6. Molex Premise Networks; a division of Molex, Inc.
  7. Ortronics, Inc.; a subsidiary of Legrand Group.
  8. Panduit Corp.
  9. Siemon Co. (The).

## 2.7 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate.
  - 1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
  - 2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
    - a. Flush mounting jacks, positioning the cord at a 45° angle.
  - 3. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

## 2.8 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with J-STD-607-A.

## 2.9 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

## 2.10 CABLE MANAGEMENT SYSTEM

- A. Available 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:
  - 1. iTRACS Corporation, Inc.
  - 2. TelSoft Solutions.
- B. Description: Computer-based cable management system, with integrated database capabilities.
- C. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.
- D. Information shall be presented in database view, schematic plans, or technical drawings.
  - 1. Microsoft Visio Professional or AutoCAD drawing software shall be used as drawing and schematic plans software.
- E. System shall interface with the following testing and recording devices:
  - 1. Direct upload tests from circuit testing instrument into the personal computer.
  - 2. Direct download circuit labeling into labeling printer.

## 2.11 SOURCE QUALITY CONTROL

- A. Factory test UTP cables according to TIA/EIA-568-B.2.
- B. Cable will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

### 3.2 WIRING METHODS

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements in Division 27 Section "Pathways for Communications Systems."
  - 3. Comply with requirements in Division 27 Section "Cable Trays for Communications Systems."
- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:
  - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
  - 2. Install lacing bars and distribution spools.
  - 3. Install conductors parallel with or at right angles to sides and back of enclosure.

### 3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. MUTOA shall not be used as a cross-connect point.
  - 5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
    - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.

- b. Locate consolidation points for UTP at least 49-feet (15 m) from communications equipment room.
  6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30-inches (760 mm) and not more than 6-inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  12. In the communications equipment room, install a 10-foot- (3 m-) long service loop on each end of cable.
  13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
  2. Do not untwist UTP cables more than ½-inch (12 mm) from the point of termination to maintain cable geometry.
- D. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  2. Suspend UTP cable not in a wireway or pathway a minimum of 8-inches (200 mm) above ceilings by cable supports not more than 60-inches (1,524 mm) apart.
  3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
  2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5-inches (127 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12-inches (300 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24-inches (610 mm).
  3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

- a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2½-inches (64 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6-inches (150 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12-inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3-inches (76 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6-inches (150 mm).
  5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48-inches (1200 mm).
  6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5-inches (127 mm).

### 3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50 mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  1. Administration Class: 1.
  2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
- D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- F. Cable and Wire Identification:
  - 1. Label each cable within 4-inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15-feet (4.5 m).
  - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
  - 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
  - 1. Cables use flexible vinyl or polyester that flex as cables are bent.

### 3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
  - 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.

3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
  - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
5. UTP Performance Tests:
  - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
    - 1) Wire map.
    - 2) Length (physical vs. electrical, and length requirements).
    - 3) Insertion loss.
    - 4) Near-end crosstalk (NEXT) loss.
    - 5) Power sum near-end crosstalk (PSNEXT) loss.
    - 6) Equal-level far-end crosstalk (ELFEXT).
    - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
    - 8) Return loss.
    - 9) Propagation delay.
    - 10) Delay skew.
  - B. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
  - C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
  - D. Prepare test and inspection reports.

### 3.7 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
  1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

### 3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different



workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

**END OF SECTION 271500**

## **SECTION 282300 – VIDEO SURVEILLANCE**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes a video surveillance system consisting of cameras, digital video recorder, data transmission wiring, and a control station with its associated equipment.

#### **1.2 DEFINITIONS**

- A. AGC: Automatic gain control.
- B. BNC: Bayonet Neill-Concelman - type of connector.
- C. B/W: Black and white.
- D. CCD: Charge-coupled device.
- E. FTP: File transfer protocol.
- F. IP: Internet protocol.
- G. LAN: Local area network.
- H. MPEG: Moving picture experts group.
- I. NTSC: National Television System Committee.
- J. PC: Personal computer.
- K. PTZ: Pan-tilt-zoom.
- L. RAID: Redundant array of independent disks.
- M. TCP: Transmission control protocol - connects hosts on the Internet.
- N. UPS: Uninterruptible power supply.
- O. WAN: Wide area network.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

- B. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
  - 3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
  - 4. UPS: Sizing calculations.
  - 5. Wiring Diagrams: For power, signal, and control wiring.
- C. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

#### 1.6 QUALITY ASSURANCE

- A. 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.
- B. Comply with NECA 1.
- C. Comply with NFPA 70.
- D. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC.

## 1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
  - 1. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30°F to plus 122°F (minus 34°C to plus 50°C) dry bulb and 20% to 90% relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h). Use NEMA 250, Type 3R enclosures.
- B. Components shall function as an integrate part of the Mitec Access Control System.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Three years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SYSTEM REQUIREMENTS

- A. Video-signal format shall comply with NTSC standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.
  - 1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements as recommended and provided by manufacturer for type of line being protected.
  - 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements as recommended and provided by manufacturer for type of line being protected.
- C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

### 2.2 STANDARD CAMERAS

- A. Available 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:
  - 1. AXCESS International Inc.

2. Bosch Security Systems, Inc.
3. EverFocus Electronics Corporation.
4. Hitachi, Ltd.
5. Honeywell International Inc.; Honeywell Video Systems.
6. JVC Americas Corp.; JVC Professional products.
7. Panasonic Corporation of North America; Panasonic Security Systems.
8. Pelco.
9. Pixera Corporation.
10. Safety Vision.
11. Samsung Opto-Electronics.
12. SANYO North America Corporation.
13. Toshiba Corporation; Surveillance products.
14. Trinus Systems Inc.
15. Tyco International Limited; Sensormatic products.

B. Automatic Color Dome Camera: Assembled and tested as a manufactured unit, containing dome assembly, color camera, motorized pan and tilt, zoom lens, and receiver/driver.

1. Comply with UL 639.
2. Pickup Device: CCD interline transfer, 380,000 768(H) by 494(V) pixels.
3. Horizontal Resolution: 480 lines.
4. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.
5. With AGC, manually selectable on or off.
6. Sensitivity: Camera shall provide usable images in low-light conditions, delivering an image at the locations shown on the drawings. Camera shall provide true day/night functionality and infrared illumination for capturing images in various lighting scenarios.
7. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.
8. Manually selectable modes for backlight compensation or normal lighting.
9. Pan and Tilt: Direct-drive motor, 360° rotation angle, and 180° tilt angle. Pan-and-tilt speed shall be controlled by operator. Movement from preset positions shall be not less than 300 degrees per second.
10. Preset Positioning: Eight user-definable scenes, each allowing 16-character titles. Controls shall include the following:
  - a. In "sequence mode," camera shall continuously sequence through preset positions, with dwell time and sequencing under operator control.
  - b. Motion detection shall be available at each camera position.
  - c. Up to four preset positions may be selected to be activated by an alarm. Each of the alarm positions may be programmed to output a response signal.
11. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
12. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
13. Motion Detector: Built-in digital.
14. Dome shall support multiplexed control communications using coaxial cable recommended by manufacturer.

## 2.3 LENSES

- A. Available 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:
1. Bosch Security Systems, Inc.
  2. CBC (AMERICA) Corp.
  3. COP-USA.
  4. Crest Electronics, Inc.
  5. Elbex Ltd.; Elbex America Inc.
  6. GENWAC; a brand of Watec Cameras.
  7. GE Security, Inc.
  8. Hitachi, Ltd.
  9. Honeywell International Inc.; Honeywell Video Systems.
  10. Hunt Electronics USA, Inc.
  11. International Space Optics; Rainbow CCTV products.
  12. Panasonic Corporation of North America; Panasonic Security Systems.
  13. Pelco.
  14. Samsung Opto-Electronics.
  15. SANYO North America Corporation.
  16. Tamron USA, Inc.; Industrial Optics Division.
  17. Telpix Electronics, Inc.
  18. Tyco International Limited; Sensormatic products.
  19. VELTEK.
  20. Vicon Industries, Inc.
  21. Videology Imaging Solutions, Inc.
  22. Watec America Corporation.
- B. Description: Optical-quality coated lens, designed specifically for video-surveillance applications and matched to specified camera. Provide color-corrected lenses with color cameras.
1. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.
  2. Zoom Lens: Motorized, remote-controlled unit, rated as "quiet operating." Features include the following:
    - a. Electrical Leads: Filtered to minimize video signal interference.
    - b. Motor Speed: Variable.
    - c. Lens shall be available with preset positioning capability to recall the position of specific scenes.

## 2.4 POWER SUPPLIES

- A. Low-voltage power supplies matched for voltage and current requirements of cameras and accessories, and of type as recommended by manufacturer of camera and lens.
1. Enclosure: NEMA 250, Type 4X.

## 2.5 CAMERA-SUPPORTING EQUIPMENT

- A. Available 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:
1. Bosch Security Systems, Inc.
  2. CBC (AMERICA) Corp.
  3. COP-USA.
  4. Crest Electronics, Inc.
  5. Elbex Ltd.; Elbex America Inc.
  6. ELMO.
  7. EverFocus Electronics Corporation.
  8. GENWAC; a brand of Watec Cameras.
  9. GE Security, Inc.
  10. Honeywell International Inc.; Honeywell Video Systems.
  11. Ikegami Electronics (USA) Inc.
  12. Merit Li-Lin (USA) Corp.
  13. Panasonic Corporation of North America; Panasonic Security Systems.
  14. Pelco.
  15. Samsung Opto-Electronics.
  16. SANYO North America Corporation.
  17. Telpix Electronics, Inc.
  18. Tyco International Limited; Sensormatic products.
  19. VELTEK.
  20. Vicon Industries, Inc.
  21. Videolarm.
  22. Video Mount Products.
  23. Visiontech.
  24. Wren Associates Limited.
- B. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.
- C. Pan-and-Tilt Units: Motorized units arranged to provide remote-controlled aiming of cameras with smooth and silent operation, and equipped with matching mounting brackets.
1. Panning Rotation: 0° to 355° degrees, with adjustable stops.
  2. Tilt Movement: 90° degrees, plus or minus 5°, with adjustable stops.
  3. Speed: 12° per second in both horizontal and vertical planes.
  4. Wiring: Factory prewired for camera and zoom lens functions and pan-and-tilt power and control.
  5. Built-in encoders or potentiometers for position feedback.
  6. Pan-and-tilt unit shall be available with preset positioning capability to recall the position of a specific scene.
- D. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment.
- E. Protective Housings for Fixed and Movable Cameras: Steel or 6061 T6 aluminum enclosures with internal camera mounting and connecting provisions that are matched to camera/lens combination and mounting and installing arrangement of camera to be housed.
1. Camera Viewing Window: Lexan window, aligned with camera lens.

2. Duplex Receptacle: Internally mounted.
3. Alignment Provisions: Camera mounting shall provide for field aiming of camera and permit removal and reinstallation of camera lens without disturbing camera alignment.
4. Built-in, thermostat-activated heater and blower units. Units shall be automatically controlled so the environmental limits of the camera equipment are not exceeded.
5. Sun shield shall not interfere with normal airflow around the housing.
6. Mounting bracket and hardware for wall or ceiling mounting of the housing. Bracket shall be of same material as the housing; mounting hardware shall be stainless steel.
7. Finish: Housing and mounting bracket shall be factory finished using manufacturer's standard finishing process suitable for the environment.
8. Enclosure Rating: NEMA 3R.

## 2.6 IP VIDEO SYSTEMS

- A. Available 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:

1. AXCESS International Inc.
2. Bosch Security Systems, Inc.
3. CBC (AMERICA) Corp.
4. COP-USA.
5. Crest Electronics, Inc.
6. Dedicated Microcomputers Limited; Dedicated Micros USA.
7. Elbex Ltd.; Elbex America Inc.
8. EverFocus Electronics Corporation.
9. GE Security, Inc.
10. Hitachi, Ltd.
11. Honeywell International Inc.; Honeywell Video Systems.
12. Ikegami Electronics (USA) Inc.
13. JVC Americas Corp.; JVC Professional products.
14. Panasonic Corporation of North America; Panasonic Security Systems.
15. Pelco.
16. Samsung Opto-Electronics.
17. SANYO North America Corporation.
18. Tyco International Limited; Sensormatic products.
19. VELTEK.
20. Vicon Industries, Inc.

- B. Description:

1. System shall provide high-quality delivery and processing of IP-based video, audio, and control data using standard Ethernet-based networks.
2. System shall have seamless integration of all video surveillance and control functions.
3. Graphical user interface software shall manage all IP-based video matrix switching and camera control functions, two-way audio communication, alarm monitoring and control, and recording and archive/retrieval management. IP system shall also be capable of integrating into larger system environments.
4. System design shall include all necessary compression software for high-performance, dual-stream, MPEG-2/MPEG-4 video. Unit shall provide connections for all video cameras, camera PTZ control data, bidirectional audio, discreet sensor inputs, and control system outputs.



5. All camera signals shall be compressed, encoded, and delivered onto the network for processing and control by the IP video-management software.
6. Camera system units shall be ruggedly built and designed for extreme adverse environments, complying with NEMA Type environmental standards.
7. Encoder/decoder combinations shall place video, audio, and data network stream that can be managed from multiple workstations on the user's LAN or WAN.
8. All system interconnect cables, workstation PCs, PTZ joysticks, and network intermediate devices shall be provided for full performance of specified system.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN, WAN, and IP network before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 WIRING

- A. Comply with requirements in Division 26 Section "Raceways and Boxes for Electrical Systems."
- B. Wiring Method: Install cables in raceways unless otherwise indicated.
  1. Except raceways are not required in accessible indoor ceiling spaces and attics.
  2. Except raceways are not required in hollow gypsum board partitions.
  3. Conceal raceways and wiring except in unfinished spaces.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- E. For LAN connection and fiber-optic and copper communication wiring, comply with Division 27 Sections "Communications Backbone Cabling" and "Communications Horizontal Cabling."
- F. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

### 3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Install cameras and infrared illuminators level and plumb.
- B. Install cameras with 84-inch- (2,134 mm-) minimum clear space below cameras and their mountings. Minimum height above floor shall be 12'-0". Change type of mounting to achieve required clearance.
- C. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.
- D. Install power supplies and other auxiliary components at control stations unless otherwise indicated.
- E. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system-component enclosures and mounted in self-protected, inconspicuous positions.
- F. Avoid ground loops by making ground connections only at the control station.
  - 1. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.
- G. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
  - 2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
    - a. Prepare equipment list described in "Informational Submittals" Article.
    - b. Verify operation of auto-iris lenses.
    - c. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
    - d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet

(17 to 23 m) away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.

- e. Set and name all preset positions; consult Owner's personnel.
  - f. Set sensitivity of motion detection.
  - g. Connect and verify responses to alarms.
  - h. Verify operation of control-station equipment.
- 3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
  - 4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
- D. Video surveillance system will be considered defective if it does not pass tests and inspections.
  - E. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:
  - 1. Check cable connections.
  - 2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
  - 3. Adjust all preset positions; consult Owner's personnel.
  - 4. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
  - 5. Provide a written report of adjustments and recommendations.

### 3.6 CLEANING

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

**END OF SECTION 282300**

## SECTION 311000 – SITE CLEARING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Protecting existing vegetation to remain.
  - 2. Removing existing vegetation.
  - 3. Clearing and grubbing.
  - 4. Stripping and stockpiling topsoil.
  - 5. Removing above- and below-grade site improvements.

#### 1.2 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.
- F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

#### 1.3 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

#### 1.4 SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
  - 1. Use sufficiently detailed photographs or videotape.

2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

## 1.5 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks and other adjacent occupied or used facilities during site-clearing operations.
1. Do not close or obstruct streets, walks or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Owner anticipates no work associated with this contract outside of Owner's property. Should Contractor wish to obtain any rights for work (e.g., storage, parking, etc.) on property not owned by Owner, obtaining such rights will be Contractor's responsibility.
- C. Utility Locator Service: Notify NC One Call (811 or 1-800-632-4949) for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.
- E. Do not direct vehicle or equipment exhaust towards protection zones.
- F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
- G. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earth Moving."
1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees to remain.
- C. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

### 3.2 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site.
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Engineer.

### 3.3 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
  - 1. Arrange with utility companies to shut off indicated utilities.
- B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Owner not less than five days in advance of proposed utility interruptions.
- C. Excavate for and remove underground utilities indicated to be removed.

### 3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
  - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  - 2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18-inches (450 mm) below exposed subgrade.
  - 3. Use only hand methods for grubbing within protection zones.
  - 4. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
  - 1. Place fill material in horizontal layers not exceeding a loose depth of 8-inches (200 mm), and compact each layer to a density equal to adjacent original ground.

### 3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth of 6-inches (150 mm) in a manner to prevent intermingling with underlying subsoil or other waste materials.
  - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2-inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
  - 1. Limit height of topsoil stockpiles to 72-inches (1800 mm).
  - 2. Do not stockpile topsoil within protection zones.
  - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
  - 4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

### 3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
  - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut a line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

### 3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

**END OF SECTION 311000**

## SECTION 312000 – EARTH MOVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Earth and rock excavation
  2. Cutting and filling of subgrade
  3. Preparing subgrades, including excavation and backfill, for structures, foundations and slabs-on-grade
  4. Preparing subgrades, including excavation and backfill, for walks, pavements and grasses
  5. Excavating and backfilling trenches for utilities
  6. Excavating and backfilling for buildings and structures
  7. Excavation and removal of unsuitable soils
  8. Soil and backfill material compaction requirements
  9. Subbase course for concrete slabs-on-grade
  10. Subbase course for concrete walks and pavement
  11. Subbase course and base course for asphalt paving
  12. Subsurface drainage course for foundation/footing trenches and concrete slabs-on-grade
  13. Furnishing and placing earth and granular materials
  14. Removing from site excess and/or unsuitable fill
- B. **All Earthwork shall be unclassified. There shall be no additional payment to the Contractor for any rock excavation required for the successful installation of the project.**

#### 1.2 REFERENCES

- A. National Fire Protection Association:
1. NFPA 495 - Explosive Materials Code.

#### 1.3 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.



- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
  2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation. Fill of unauthorized excavations shall be as follows:
    - a. Under footings or foundation bases, fill of unauthorized excavations under footing or foundation bases shall be accomplished by replacing with crushed stone to bring elevations to proper position, when acceptable to Engineer.
    - b. In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by the Owner's Designated Representative.
- G. Fill: Soil materials used to raise existing grades.
- H. Non-Granular Fill: Soil fill material used to raise existing grades in areas that do not require granular or structural fill.
- I. Rock: All boulder, solid ledges, bedded deposits, unstratified masses, and conglomerations of material so firmly cemented as to possess the characteristics of solid rock, which cannot be dislodged and excavated with modern, track mounted, heavy-duty excavating equipment without drilling, blasting, or ripping.
1. For open excavations, material which cannot be effectively excavated during general grading with a D-8 or equivalent dozer drawing a new single-tooth ripper. Effective open excavation is defined as the ability to remove 10 cubic yards or more of material after one hour of continuous ripping. Typical of materials classified as Rock in open excavation are boulders larger than 1½ cubic yards or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.
  2. For trenches and pits, materials and obstructions encountered that cannot be practically excavated with a track-mounted power excavator, equivalent to a Caterpillar Model No. 325 or equivalent equipped with new rock teeth. Practical excavation is defined as the ability to remove at least 30 cubic yards during one hour of continuous digging. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavation.
  3. When included as a pay item, unit pay for Rock Excavation will include removal and disposal on-site of above-defined Rock materials encountered, on a per cubic yard basis. Estimation of the number of cubic yards will be by the RPR, who will advise the Contractor within one week in advance of the anticipated start of Rock Excavation, of the estimating method(s) to be used, including how void factors will be estimated. RPR will also advise the Contractor of running estimates during the course of Rock Excavation work.
    - a. At the Contractor's option and sole expense, pre- and post-excavation survey(s) by a licensed Surveyor may be conducted to precisely measure the quantities of Rock Excavation and if conducted, the results of the survey(s) will be used to calculate Rock Excavation quantities.

- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

#### 1.4 SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
  - 1. Classification according to ASTM D 2487.
- C. Approved blasting plan in the event rock is encountered.
- D. Seismic survey report from seismic survey agency.
- E. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

#### 1.5 QUALITY ASSURANCE

- A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:
  - 1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
  - 2. Seismographic monitoring during blasting operations.
- B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
  - 1. Obtain seismic survey prior to rock excavation to determine maximum charges that can be used at different locations in area of excavation without damaging adjacent properties or other work.
  - 2. Conduct survey and document conditions of buildings near locations of rock removal, prior to blasting.

3. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
  4. Seismographic monitoring during blasting operations.
  5. Advise owners of adjacent buildings or structures in writing, prior to executing seismographic survey. Explain planned blasting and seismic operations.
- C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

## 1.6 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
  3. Contractor must assure that each property owner has adequate access to their property at all times.
- B. Utility Locator Service: Notify "NC One Call" for area where Project is located before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 31 Section "Erosion Control" are in place.
- D. Locate, protect, and maintain benchmarks, monuments, control points, and project engineering reference points. Reestablish disturbed or destroyed items at Contractor's expense.
- E. The control of dust, noise, erosion, and sediment originating from construction operations is considered a critical responsibility of the Contractor. The Engineer will be the final judge of the adequacy of the Contractor's dust, noise, erosion, and sedimentation control. Work may be suspended by the Engineer until adequate dust, noise, erosion, and sedimentation control is attained.
- F. Protect structures, utilities, sidewalks, pavements, buildings, and other services or facilities on site and adjacent to the site from damage caused by earth moving operations or other work in support of Contractor operations. Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Cost of repair and restoration of damaged items shall be at Contractor's expense.
- G. The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material.
  2. Parking vehicles or equipment.
  3. Foot traffic.
  4. Erection of sheds or structures.
  5. Impoundment of water.
  6. Excavation or other digging unless otherwise indicated.

7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
  8. Do not direct vehicle or equipment exhaust towards protection zones.
  9. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
- H. The existing ground elevations as shown on the Drawings are believed to be reasonably correct. The Contractor shall satisfy himself, however, by actual examination of the sites of the work, as to the existing elevations and the amount of work required under this section. No claim shall be made by the Contractor for additional compensation for conditions other than that shown.
- I. If, during the course of earth moving operations, contaminated soil or groundwater is encountered, cease activities in the immediate area and contact Owner for further direction. Contaminated soil or groundwater may be recognized by the appearance of unusual color, differing consistency or texture, unusual odor, oozing liquids, sheen or other discoloration on ponded water, or other signs of sudden or unexpected change in the nature of the excavated soils.
- J. Utilities shown on the Contract Drawings are for the convenience of the Contractor, exact locations are not guaranteed. The Contractor shall verify existing utilities with the proper authorities.

## PART 2 - PRODUCTS

- A. Soil Materials:
1. General: Provide imported soil materials when sufficient satisfactory soil materials are not available from onsite excavations.
  2. Topsoil: Refer to Division 32 Section "Turf and Grasses".
- B. Hazardous Materials:
1. Provide fill materials that are not contaminated with petroleum product, hazardous waste or industrial waste.
  2. Contamination above federal, state or local requirements is not acceptable. Materials with a visible sheen or petroleum odor shall be rejected.
- C. Unsuitable Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
1. Unsuitable soils also include satisfactory soils not maintained within 2% of optimum moisture content at time of compaction.
- D. Non-Granular Fill: Material is to comply with NCDOT requirements for Borrow Material (Section 1018) with modifications shown below. This material is not allowed in areas where granular soils are required, including within the building footprint, below pavement areas, below pipe or below a synthetic turf athletic field.
1. On-Site Non-Granular Fill
    - a. Submittal must be provided demonstrating that on-site soil material meets the criteria outlined in this Section for use as fill material.
    - b. Obtain approval of Engineer before proceeding with use of on-site material.

- c. Material is to have no particles greater than 4-inches in maximum dimension, no more than 70% by weight passing the #40 sieve and no more than 20% passing the #200 sieve.
    - d. Testing submitted is to demonstrate that proper compaction can be achieved as required in Part 3, Execution.
  - 2. Imported Non-Granular Fill
    - a. Where quantity of approved non-granular fill materials required exceeds that available from on-site stock-piles, provide suitable material from off-site sources.
    - b. Obtain approval of Engineer before proceeding with use of imported fill material.
    - c. Material is to have no particles greater than 4-inches in maximum dimension, no more than 70% passing by weight the #40 sieve and no more than 15% passing the #200 sieve.
    - d. Testing submitted is to demonstrate that proper compaction can be achieved as required in Part 3, Execution.
- E. Rock: All boulder, solid ledges, bedded deposits, unstratified masses, and conglomerations of material so firmly cemented as to possess the characteristics of solid rock, which cannot be dislodged and excavated with modern, track mounted, heavy-duty excavating equipment without drilling, blasting, or ripping.
  - 1. For open excavations, material which cannot be effectively excavated during general grading with a D-8 or equivalent dozer drawing a new single-tooth ripper. Effective open excavation is defined as the ability to remove 10 cubic yards or more of material after one hour of continuous ripping. Typical of materials classified as Rock in open excavation are boulders larger than 1½ cubic yards or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.
  - 2. For trenches and pits, materials and obstructions encountered that cannot be practically excavated with a track-mounted power excavator, equivalent to a Caterpillar Model No. 325 or equivalent equipped with new rock teeth. Practical excavation is defined as the ability to remove at least 30 cubic yards during one hour of continuous digging. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavation.
  - 3. When included as a pay item, unit pay for Rock Excavation will include removal and disposal on-site of above-defined Rock materials encountered, on a per cubic yard basis. Estimation of the number of cubic yards will be by the RPR, who will advise the Contractor within one week in advance of the anticipated start of Rock Excavation, of the estimating method(s) to be used, including how void factors will be estimated. RPR will also advise the Contractor of running estimates during the course of Rock Excavation work.
    - a. At the Contractor's option and sole expense, pre- and post-excavation survey(s) by a licensed Surveyor may be conducted to precisely measure the quantities of Rock Excavation and if conducted, the results of the survey(s) will be used to calculate Rock Excavation quantities.
- F. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; provide granular No. 57 stone as indicated in granular fill below.
- G. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; provide ABC fill as indicated in structural fill below.

- H. Structural Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand.
1. ABC Fill (NCDOT Standard Specification, Section 1016, Class IV/Granular Fill) gradation requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
1½-inch	100
1-inch	75 to 97
½-inch	55 to 80
#4	35 to 55
#10	25 to 45
#40	14 to 30
#200	4 to 12

- I. Granular Fill: Import all granular fill types from off-site sources. Granular fill consists of stone, sand, and gravel, or blends of these materials, free of slag, complying with North Carolina Department of Transportation (NCDOT) Standard Specification, Section 1016, as modified below:
1. No. 57 Stone (NCDOT Class 57/Washed Stone, Crushed Ledge Rock or Naturally occurring) Gradation Requirements.

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
1½-inch	100
1-inch	95 to 100
½-inch	25 to 60
#4	0 to 10
#8	0 to 5
#200	0 to 0.6

- J. Pipe Bedding Course: Refer to Construction Drawings for pipe bedding requirements.
- K. Drainage Fill: Coarse aggregate complying with the following requirements:
1. ASTM D448, Size 57 Requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
1½ inch	100
1-inch	95 to 100
½-inch	25 to 60
#4	0 to 10
#8	0 to 5

- L. Sand: ASTM C 33; fine aggregate.
- M. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

## 2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50%; complying with AASHTO M 288 and the following, measured per test methods referenced:
  - 1. Survivability: Class 2; AASHTO M 288.
    - a. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
    - b. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
    - c. Tear Strength: 56 lbf (250 N); ASTM D 4533.
    - d. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
  - 2. Apparent Opening Size: No. 40 (0.425 mm) sieve, maximum; ASTM D 4751.
  - 3. Permittivity: 0.5 per second, minimum; ASTM D 4491.
  - 4. UV Stability: 50% after 500 hours' exposure; ASTM D 4355.

## 2.3 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6-inches (150 mm) wide and 4-mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30-inches (750 mm) deep; colored as follows:
  - 1. Red: Electric.
  - 2. Yellow: Gas, oil, steam, and dangerous materials.
  - 3. Orange: Telephone and other communications.
  - 4. Blue: Water systems.
  - 5. Green: Sewer systems.

## 2.4 BLASTING MATERIALS

- A. Explosives: Type recommended by explosive firm following seismic survey.
- B. Delay Device: Type recommended by explosives firm.
- C. Blast Mat Materials: Type recommended by explosives firm.

## 2.5 COMPACTION

- A. Utilize the proper compaction methods and equipment to suit the soils and conditions encountered. Mechanical, vibratory, pneumatic tampers or other method as approved by the Engineer shall be required.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
- D. Prior to start of work, the Contractor's surveyor shall verify that all boundaries of temporary and permanent easements and property lines are clearly marked in the field so that the work will not violate these boundaries.
- E. The Contractor shall be responsible for providing all necessary fill materials.

### 3.2 EARTH MOVING, GENERAL

- A. The work shall be performed by methods acceptable to the Engineer.
- B. Excavation shall include the satisfactory removal and disposal of all materials encountered, regardless of the nature of the materials, or the manner in which they were excavated, except materials classified as rock excavation.
- C. Excavate to subgrade elevations.
- D. All pipe lines or existing structures encountered during the excavation operation and designated to remain shall be properly supported/protected to prevent damage.
- E. Erosion and sedimentation control measures meeting the requirements of Division 31 Section "Erosion Control" shall be used around all earthen material stockpiles.
- F. Provide and maintain suitable temporary crossings over open trenches where necessary to maintain access for other Contractors, the Engineer, or general public (if applicable).
- G. The Contractor shall have available a supply of steel plates with minimum dimensions of 4-feet x 8-feet x 1-inch, or thicker, as required by jurisdictional authorities and to maintain emergency access and egress to the project area. The plates shall be used to bridge open trenches crossing roadways, or driveways as directed by the Engineer. When used, they shall be secured against the possibility of shifting or dropping into the excavation.
- H. When excavating in or adjacent to the traveled portion of highways, driveways, or parking areas take whatever measures are necessary to protect the road/drive/parking surfaces from becoming undermined.
- I. All traffic maintenance shall be done in a manner satisfactory to the Engineer.



### 3.3 MANNER OF EXECUTION

- A. Materials for reuse on the project shall be stockpiled in an approved designated area adjacent to the work site. Suitable excavated material to be used for trench backfill or fill shall be properly segregated by the Contractor to avoid mixture with topsoil or other unsuitable materials. Contamination of the excavated material as a direct result of the Contractor's work shall result in rejection of the contaminated material by the Engineer.
- B. The excavated material to be used for trench backfill or fill shall be stored so that it will cause a minimum of inconvenience to public travel, active facility, adjacent owners or tenants and other contractors or subcontractors.
- C. Conduct operations in a manner, which will keep the work free of standing and flowing water and dispose the water so as not to damage or create a nuisance to the work, the public, surface, groundwater, and adjacent properties.
- D. Keep graded surfaces well drained, but avoid erosion. Do not place earth or granular fill on wet grade, in water, or over frost, ice or snow. Excavations shall be maintained free of water.
- E. Bottom of excavations shall be finish graded by hand methods to receive bedding. The stone bedding shall be placed, compacted, and trimmed by hand to ensure the grade as necessary or as detailed.
- F. The Contractor shall make up any settlement of trenches or embankments with suitable material and stabilize at no additional cost to the Owner. This work shall be performed promptly and as directed by the Engineer

### 3.4 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
  - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

### 3.5 EXPLOSIVES

- A. Explosives: Obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.
  - 1. Perform blasting without damaging adjacent structures, property, or site improvements.
  - 2. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.
  - 3. Provide seismographic monitoring during progress of blasting operations.

4. Disintegrate rock and remove from excavation.
  5. Video the inside of existing structures prior to any blasting operations.
  6. Follow all items in Part 1.4.C and D and Part 1.5.A and B of this Specification Section.
- B. All blasting operations shall be conducted in strict accordance with existing laws, rules and regulations relative to the storage and use of explosives. Blasting shall be done only by experienced men working according to accepted practice, and extreme care shall be exercised by the Contractor to prevent injury to any existing pipes, water lines, gas mains, poles, wires, cables, drains, buildings or other structures or utilities either below or above the surface of the ground. Any injury which may be caused shall be the responsibility of the Contractor. Where there is any possibility of damage being caused by blasting it may be necessary to resort to drilling and wedging to remove the rock.
- C. The Contractor will be held strictly responsible for any and all injuries to public and private property or persons.
- D. Preblasting Conference: Conduct conference at Project site.

### 3.6 EXCAVATION, GENERAL

- A. All excavation shall be made to the dimension and depth indicated with proper allowance for space in which to install the necessary work, including such bracing and supporting of the trench banks as may be necessary.
- B. All excavations shall be kept dry at all times. Should water enter the trenches or excavations all work within such areas shall cease until after the water has been disposed of, unless otherwise directed by the Engineer. Contractor shall, at his expense, provide the necessary means for maintaining dry trenches and excavations, including pumps, well-points, or other mechanical equipment suitable for the actual field conditions encountered. No masonry shall be laid in water and water shall not be allowed to rise over masonry until the mortar has set at least 36 hours. All water pumped or drained from the work shall be disposed of in a suitable manner without damage to adjacent property or to other work under construction.
- C. Excavation, trenching, backfill, and pipe work within the rights-of-way of public and/or private utility companies or public carriers shall be done in accordance with these Specifications and the requirements of the particular company involved. The Contractor shall make all arrangements and pay all cost charged by the utility company for protection of and/or the relocation of the existing improvement required by the work performed under this Contract. This includes any cost that the public and/or private utility company or public carriers may charge to have their own representative on site during construction by the Contractor that is adjacent to their utility.
- D. Where sheeting is installed to maintain the trench banks, no part of the sheeting below the top of the pipe shall be removed. Whenever sheeting is installed to maintain trench banks in water-bearing soil, the sheeting shall not be removed from a level 4-feet above the top of the pipe, or 1-foot below finish grade, whichever is the lower.
- E. Unclassified Excavation: Unless the Bid Form provides for payment for one or more Excavation Types, excavation is unclassified. Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials

may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

- F. Classified Excavation: Excavate to subgrade elevations. Unit Price payment will be made for any Excavation Types separately itemized in the Bid Form. All other excavation types will be unclassified.
- G. Excavation Types:
1. Satisfactory soil excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
    - a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
  2. Remove unsatisfactory soil to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions (if excavated materials intended for fill and backfill include unsatisfactory soil materials, replace with satisfactory soil materials):
    - a. 24-inches (600 mm) outside of concrete forms other than at footings.
    - b. 12-inches (300 mm) outside of concrete forms at footings.
    - c. 6-inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
    - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    - e. 6-inches (150 mm) beneath bottom of concrete slabs-on-grade.
    - f. 6-inches (150 mm) beneath pipe in trenches, and the greater of 24-inches (600 mm) wider than pipe or 42-inches (1065 mm) wide.
  3. Rock excavation includes removal and proper disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
    - a. 24-inches (600 mm) outside of concrete forms other than at footings.
    - b. 15-feet outside of concrete forms at footings.
    - c. 6-inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
    - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    - e. 6-inches (150 mm) beneath bottom of concrete slabs-on-grade.
    - f. 6-inches (150 mm) beneath pipe in trenches, and the greater of 24-inches (600 mm) wider than pipe or 42-inches (1065 mm) wide.
      - 1) If pipe with bells is used, excavation at these points shall be carried 6-inches below the bells and of sufficient length to enable the Contractor to make up the pipe joint. This extra depth of excavation shall then be backfilled with satisfactory soil materials and thoroughly tamped to pipe grade.
- H. Excess excavation or material not suitable for backfill shall be removed by the Contractor. Rock shall be removed from the property and streets. Disposal of excess material and rock shall be the responsibility of the Contractor. No additional payment will be made for disposal.

### 3.7 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Flowable fill may be used when approved by Engineer.
  - 1. Fill unauthorized excavations under other construction, pipe or conduit as directed by Engineer.

### 3.8 EXCAVATIONS BELOW SUBGRADE

- A. In case earth materials encountered at subgrades are unsuitable, the Contractor shall immediately notify the Engineer and shall excavate from the limiting subgrades shown or specified, to such new lines and grades, as will be ordered. Excavation below subgrade shall be done only upon express orders of the Engineer.
- B. At subgrade in pavement areas any loose, soft, wet, frozen, organic, or otherwise unsuitable material shall be removed.
- C. Whenever excavations are carried beyond or below the lines and grade shown on the Construction Drawings, or as given or directed by the Engineer, all such over-excavation shall be backfilled with backfill as directed by the Owner's Designated Representative or Engineer.
  - 1. Fill over-excavations under foundations or footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Whether over-excavation was directed by the Engineer or unauthorized, backfill shall be crushed stone.
  - 2. Fill authorized or unauthorized over-excavations below other construction, pipe, or conduit with crushed stone.
  - 3. In pavement areas fill over-excavations with crushed stone.
- D. Special backfill materials ordered by the Engineer as a result of unauthorized over-excavation by the Contractor without prior approval shall be provided by the Contractor at no additional cost to the Owner.
- E. Payment for authorized over-excavation and subsequent backfill materials shall be on a unit price basis agreed between the Owner and the Contractor prior to the required work.
- F. All material which slides, fails, or caves into the established limits of excavations due to any cause whatsoever, shall be removed and disposed of at the Contractor's own expense and no extra compensation shall be paid the Contractor for any materials ordered for backfilling the void areas left by the slide, fall, or cave-in. It is the Contractor's responsibility to make all excavations safe for ongoing construction.

### 3.9 EXCAVATION FOR STRUCTURES

- A. Excavations for structures and facilities shall be of sufficient size to give suitable room for proper construction procedures and no larger, or as shown on the Contract Drawings.

- B. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1-inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
  - 2. Excavations at Edges of Tree- and Plant-Protection Zones: Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
- C. Ensure that movement of equipment in excavation does not cause working or pumping of underlying soil, which is not to be excavated. Should equipment cause the soil to work or pump, use other methods of excavation to maintain the design bearing capacity of the soil.

### 3.10 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### 3.11 EXCAVATION FOR UTILITY TRENCHES

- A. General
  - 1. Before any trenching operation starts, the line of work shall be cleared and all existing underground pipe lines and structures located. Test pits shall be opened where necessary to properly establish the location.
  - 2. When trenches crossing other pipe lines occur, machine excavation shall stop at least 2-feet away from the location of any pipe. The pipe line shall then be uncovered by manual excavation before proceeding with machine work.
  - 3. Trenches shall be kept free of water by pumping or providing well points.
  - 4. Trench sheeting and bracing shall be placed as required to meet local, state and federal safety regulations.
  - 5. All pipe lines encountered during the trenching operation shall be properly supported to prevent damage.
- B. Excavate trenches to indicated gradients, lines, depths, and elevations.
- C. Excavate trenches to uniform widths to provide the 12-inches of clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12-inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.
- D. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
  - 1. The trench bottoms shall be prepared to receive the pipe in accordance with details shown on the project drawings.

- E. Top of Trench: Width of the trench at the top of the pipe shall not be wider than:
  - 1. The outside diameter of the pipe plus 24-inches for pipe sizes less than and equal to 36-inches,
  - 2. The outside diameter of the pipe plus 36-inches for pipe sizes equal to and greater than 42-inches,
  - 3. Except in instances where additional width is required to accommodate a trench box or sloping and benching of soil per OSHA requirements. Limits of trench widths at top of pipe shall be strictly adhered to, and where width of trench at the top of the pipe exceeds the width specified, the Contractor, at his expense, shall provide additional pipe bedding and backfill as directed by the Engineer including concrete cradle or concrete casing as required.
  
- F. Trenches in Tree- and Plant-Protection Zones
  - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
  - 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

### 3.12 EXCAVATION AND BACKFILL IN NCDOT RIGHT-OF-WAY

- A. Excavation, backfill, and pipe work under highways or streets maintained by the North Carolina Department of Transportation (NCDOT) shall be done in accordance with these specifications and the specifications and requirements of NCDOT.
  
- B. Where pipe is to be constructed across an existing roadway, the Contractor shall have the road restored with aggregate base and open to two-way traffic at the end of each workday. The surface shall be restored with a bituminous surface within 3 days of the complete installation of utilities for each section.

### 3.13 CUTTING AND REPLACEMENT OF PAVING

- A. All pavement cuts shall be 12-inches wider on each side of the trench than the earth cut at the top of the trench, to provide extra bearing for the replaced pavement. Pavement replaced in State highways or County roads shall be of the same material and done in accordance with these specifications and the specifications and requirements of NCDOT.

### 3.14 SUBGRADE INSPECTION

- A. Notify Engineer when excavations have reached required subgrade.
  
- B. If Engineer determines that unsuitable soil is present, continue excavation and replace with compacted backfill or fill material as directed.
  
- C. Proof-roll subgrade below structure slabs, building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
  2. Excavate soft spots, unsuitable soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

### 3.15 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust. All stockpiled materials shall be stored in locations so as not to endanger the work, and so that easy access may be had at all times to all parts of the excavation. Stored materials shall be kept neatly piled and trimmed, so as to cause as little inconvenience as possible to other Contractors on site, to adjoining property owners and to the active facility.
1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.16 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
  2. Surveying locations of underground utilities for Record Documents.
  3. Testing and inspecting underground utilities.
  4. Removing concrete formwork.
  5. Removing trash and debris.
  6. Removing temporary shoring and bracing, and sheeting.
  7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. All excavations shall be backfilled to the original grade, except at locations where original grade would result in less than a minimum of 2-feet of cover over the top of the bell of the pipe, as specified herein or as directed by the Engineer. Where original grade would result in less than a minimum of 2-feet of cover over the top of the bell of the pipe, additional backfill shall be accomplished to the typical outline shown on the drawings.
- C. Excavated space for manholes, wet wells and similar structures shall be free of all debris prior to placing backfill. Remove all concrete forms. Place backfill in 6-inch thick layers and thoroughly compact each layer with mechanical tampers as necessary to prevent subsequent settlement. Extend backfill to indicated finish grade.
- D. Place backfill on subgrades free of mud, frost, snow, or ice.

### 3.17 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints and fittings.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18-inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete for footings is specified in Division 03 Section "Cast-in-Place Concrete."
- D. Trenches under Roadways: Provide 4-inch thick, concrete-base slab support for piping or conduit less than 30-inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4-inches of concrete before backfilling or placing roadway subbase course.
- E. Backfill voids with satisfactory soil while removing shoring and bracing.
- F. Place and compact initial backfill of satisfactory soil, free of particles larger than 1-inch (25 mm) in any dimension, to a height of 12-inches (300 mm) over the pipe or conduit.
  - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- G. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- H. Install warning tape directly above utilities, 12-inches (300 mm) below finished grade, except 6-inches (150 mm) below subgrade under pavements and slabs.
- I. All pipes shall be protected from lateral displacement and possible damage resulting from backfill operations through impact or unbalanced loading by maintaining the pipe adequately embedded as detailed on the Contract Drawings. All pipe embedment shall be placed so as to insure adequate lateral and vertical stability of the installed pipe during pipe jointing and backfill operations. A sufficient amount of the specified pipe backfill material to hold the pipe in rigid alignment shall be uniformly deposited and thoroughly compacted below, on each side, as well as above each pipe laid in accordance with the limits as shown on the Contract Drawings.
- J. Pipe initial backfill shall be granular material or as indicated on the Contract Drawings. Pipe initial backfill materials placed any point below an elevation of 12-inches above the top of the pipe barrel shall be placed and compacted in layers not to exceed 6-inch lifts and shall be done simultaneously and uniformly on both sides of the pipe to the limits as shown on the Contract Drawings. All such materials shall be graded in the trench with hand tools in such a manner that they will be placed uniformly alongside the pipe. Each layer shall be thoroughly compacted to prevent settlement.
- K. Trench final backfill under structures shall be as indicated on the Contract Drawings and shall extend from the top of pipe initial backfill material to the bottom of the subbase. These materials shall be compacted in layers not to exceed 6-inch lifts. Each layer shall be thoroughly compacted to prevent settlement.



- L. Trench final backfill outside of pavements, utilities, buildings, and other structures shall be as shown on the Contract Drawings and shall extend from the top of pipe initial backfill material to the bottom of the topsoil. These backfill materials shall be compacted in layers not to exceed 12-inch lifts after compaction. Each layer shall be thoroughly compacted to prevent settlement.
- M. Where trenches are constructed in, near, or across roadway ditches or other watercourses, the backfill shall be protected from surface erosion.
- N. Trucks or other heavy equipment shall not be operated over pipelines until a minimum of 24 inches of backfill above the crown of the pipe has been placed and properly compacted.
- O. Where pedestrian, bicycle or vehicle traffic is impacted; all trenches within paved areas shall be immediately restored to existing grade with temporary subbase material to allow traffic flow to continue until final restoration is complete.

### 3.18 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal (1:4) so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
  1. Under grass and planted areas, use satisfactory non-granular fill material.
  2. Under walks, pavements and exterior slabs, use Structural Fill below subbase layer and granular fill for subbase layer.
  3. Under steps and ramps, use structural fill below subbase layer and granular fill for subbase layer.
  4. Under building slabs, use structural fill below subbase layer. For subbase, use granular fill for subbase layer.
  5. Under footings and foundations, use structural fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

### 3.19 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2% of optimum moisture content.
  1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2% and is too wet to compact to specified dry unit weight.

### 3.20 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 6-inches (150 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4-inches (100 mm) in loose depth for material compacted by hand-operated tampers.

- B. Equipment for compaction backfill in trenches and excavations shall be especially selected for the type of material used in the backfill. Generally, vibrating type equipment shall be utilized for non-cohesive soils and impact type equipment shall be used for cohesive soils.
- C. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- D. Backfill shall be placed in uniform layers not exceeding 6-inches in thickness with each layer thoroughly compacted by mechanical tamping. Special care shall be exercised in tamping backfill under pipe to secure solid bearing for the pipe, being careful, however, not to disturb the alignment or grade of the pipe or the pipe joints. Backfill from 2-feet above the top of the pipe to the top of the trench or finished grade shall be made in layers not over 6-inches in thickness. Rock not exceeding 6-inches maximum diameter in volume may be included in this part of the backfill provided that sufficient earth is included to make a compact mass. Each 6-inch layer shall be compacted by mechanical tampers. Heavy rollers, vehicles, or other equipment shall not be used for compacting backfill nor be allowed to cross over completed work except at crossing points prepared by the Contractor and approved by the Engineer. The top of the backfill shall be carried above the surrounding grade so that upon subsequent settlement, the backfill will be at the proper elevation. Backfill flooding will not be acceptable in lieu of compaction as specified but may be required in addition to the specified compaction. The Contractor shall maintain the backfill of all parts of the work until completion of the guarantee period of the Contract. Should settlement of backfill occur during this period, the Contractor shall add sufficient backfill to bring it up to finished grade.
- E. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
  - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12-inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 98%.
  - 2. Under walkways, scarify and recompact top 6-inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95%.
  - 3. Under turf or unpaved areas, scarify and recompact top 6-inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85%.
  - 4. For utility trenches, material backfilled in trenches shall be placed in uniform layers not exceeding 6-inches in thickness with each layer thoroughly compacted by mechanical tamping to 95% of Standard Proctor AASHTO-T99 density. Backfill under structures shall be compacted to 98% of Standard Proctor Density. The top 6-inches of trenches shall be compacted to 95% Standard Proctor Density. Backfill in the roadways shall be tamped to North Carolina Department of Transportation (NCDOT) requirements.

### 3.21 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  - 1. Provide a smooth transition between adjacent existing grades and new grades.
  - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
  - 3. Subgrade surfaces shall drain, be compacted, and well graded.

- B. The Contractor shall be responsible to subtract from finished grades shown on the plans the depths indicated on the Contract Drawings to ensure that the proper subgrade elevations are established. Any questions regarding subgrade elevations shall be answered by the Engineer. The Engineer's decision shall mandate.
- C. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  1. Turf or Unpaved Areas: Plus or minus 1-inch (25 mm).
  2. Walks: Plus or minus ½-inch (13 mm).
  3. Pavements: Plus or minus ½-inch (13 mm).
  4. Slabs and Foundations: Plus zero inches to minus ½-inch.
- D. Grading under, within 10-feet, and inside Building Lines: Finish subgrade to a tolerance of ½-inch (13 mm) when tested with a 10-foot (3 m) straightedge.
- E. Slopes: All areas shall have positive drainage.
- F. Following stripping, the subgrade shall be compacted sufficiently to develop required compaction to a depth of at least 12-inches. Within slab, foundation, or pavement limits, no fill shall be placed until the subgrade has been proof rolled and approved by the Engineer. If subgrade ruts, waves or quakes during proof rolling, recompact or replace the unacceptable areas and proof roll again. Repeat process until satisfactory results are obtained as approved by the Engineer.

### 3.22 SUBSURFACE DRAINAGE

- A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch (150 mm) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12-inches (300 mm) of filter material, placed in compacted layers 6-inches (150 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6-inches (150 mm).
  1. Compact each filter material layer to 92% of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
- B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12-inches (300 mm) of final subgrade, in compacted layers 6-inches (150 mm) thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6-inches (150 mm).
  1. Compact each filter material layer to 92% of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
  2. Place and compact impervious fill over drainage backfill in 6-inch (150 mm) thick compacted layers to final subgrade.

### 3.23 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
  1. Place base course material over subbase course under hot-mix asphalt pavement.

2. Shape subbase course and base course to required crown elevations and cross-slope grades.
  3. Place subbase course and base course 6-inches (150 mm) or less in compacted thickness in a single layer.
  4. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98% of maximum dry unit weight according to ASTM D 698.
- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12-inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 98% of maximum dry unit weight according to ASTM D 698.

### 3.24 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
  1. Place sub base 6-inches or less in compacted thickness in a single layer.
  2. Place drainage course that exceeds 6-inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6-inches (150 mm) thick or less than 3-inches (75 mm) thick.
  3. Compact each layer of sub base to required cross sections and thicknesses to not less than 95% of maximum dry density according to ASTM D 698.

### 3.25 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
  2. Determine that fill material and maximum lift thickness comply with requirements.
  3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- B. Contractor shall provide free access to Work and shall provide assistance and cooperation with appointed testing firm during testing. Coordinate operations to allow ample time for the required sampling and testing.
- C. Testing Agency: Contractor will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- D. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- E. Testing agency will test compaction of soils in place according to ASTM D 698. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2,000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.
  2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 foot (30 m) or less of wall length, but no fewer than two tests.
  3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 foot (46 m) or less of trench length, but no fewer than two tests.
- F. Laboratory testing for on-site fills:
1. ASTM D 698, Proctor compaction curve including sieve analysis.
- G. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.
- H. Compacted soils not meeting compaction densities shall be re-excavated, re-compacted, and re-tested until all requirements are met. All costs of re-testing shall be borne by the Contractor.
- I. Materials not meeting gradation requirements shall be removed from the project site and replaced with appropriate materials. All costs of re-testing shall be borne by the Contractor.
- J. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Engineer.

### 3.26 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- D. Any backfill or fill materials that settle and/or erode during the general project warranty period shall be repaired by the Contractor upon receipt of written notice from the Engineer, at no expense to the Owner.
1. Remove finished surface (pavement, lawn, or other finish areas), add backfill material, compact, and replace/reconstruct surface treatment.
  2. Restore appearance, quality, and condition of finished surface to match adjacent work, and eliminate evidence of restoration to greatest extent possible, at the Contractor's expense.

3.27 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove waste materials, including, trash, and debris, and legally dispose of them off Owner's property.
- B. Remove excess excavated material and other materials not specified to be stored, or reused. Dispose off-site at a disposal site approved for the materials.
- C. Replace or repair any pipe, structure, or other work, which has been displaced or damaged during construction and general project warranty period at no expense to Owner.
- D. Repair to proper grade any settlement of slab, pavement, utility structure, lawn, etc. adversely affected by settlement within general project warranty period at no expense to Owner.

**END OF SECTION 312000**

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## SECTION 312100 - EROSION CONTROL

### PART 1 - GENERAL

#### 1.1 EROSION AND SEDIMENTATION CONTROL

- A. Soil erosion and sedimentation control shall be provided by Contractor through phasing of project and construction of control devices such that siltation onto adjacent properties does not occur. The control measures shall begin prior to land disturbing activity, shall continue during construction with necessary maintenance until the disturbed land is stabilized. All areas of the site which are disturbed shall be protected. Temporary erosion control measures shall be removed at the conclusion of the project.
- B. Construction sequence shall generally be as follows:
1. Obtain all required construction grading permits.
  2. Install stabilized construction entrances as required.
  3. Install all erosion control measures as shown on the construction drawings.
  4. Develop Site/Install Utility.
  5. Provide inlet protection on all new inlets immediately after installation.
  6. Maintain erosion control measures until permanent ground cover is established. Clean and repair as needed.
  7. Seed and mulch disturbed areas or exposed slopes within required timeframe.
  8. Fine grade site and landscape.
  9. Complete grassing/paving operations.
  10. Remove temporary protective measures and accumulated sediment and stabilize all remaining areas.
- C. Contractor shall provide ground cover according to the following table after completion of construction within areas not otherwise used for storage of materials or construction of project.

STABILIZATION TIMEFRAMES		
Site Area Description	Stabilization	Timeframe Exceptions
Perimeter Dikes, Swales, Ditches and Slopes	7 days	None
High Quality Water (HQW) Zones	7 days	None
Slopes steeper than 3:1	7 days	If slopes are 10' or less in length and are not steeper than 2:1, 14 days are allowed.
Slopes 3:1 or flatter	14 days	7 days for slopes greater than 50' in length.
All other areas with slopes flatter than 4:1	14 days	None, except for perimeters and HQW Zones.

#### 1.2 EROSION CONTROL MEASURES

- A. A letter of approval and certificate of plan approval from the North Carolina Department of Environmental Quality's Division of Energy, Mineral and Land Resources (NCDEMLR) for



erosion and sedimentation control was required for the construction of this project. All provisions of the plan approval must be followed. The Contractor is obligated to become familiar with the terms of the referenced plan prior to bidding and to assess any implications with respect to construction cost, pricing, and bidding. Contractor's failure to become familiar with the plan provisions will not constitute justification for added compensation for any requirements thereof which may not have been included in the Contractor's bid.

- B. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control drawings and requirements of NCDEMLR or other authorities having jurisdiction.
- C. Erosion control measures shall be provided as indicated on drawings and specified herein. Contractor shall inspect, maintain, and repair/replace erosion control measures throughout duration of project until permanent vegetation has been established as required due to accumulation of sediment or deterioration of control devices.
- D. Other methods of protecting structures and facilities may be used at the option of the Contractor and subject to the approval of the Engineer.
- E. Additional measures may become necessary upon field inspection by the NCDEMLR or other authorities having jurisdiction over the project.
- F. Contractor shall minimize vehicle tracking of sediment or soil off site at locations where vehicles exit the construction site onto paved surfaces. Sediment or soil which is tracked onto the paved surfaces and which does not drain back onto the construction site must be cleaned off the paved surface within 24 hours by the Contractor at his own expense.
- G. Reasonable care shall be taken during construction to avoid damage to vegetation. Ornamental shrubbery and tree branches shall be temporarily tied back where appropriate to minimize damage. Trees which receive damage to branches shall be trimmed of these branches to improve the appearance of the tree. Tree trunks receiving damage from equipment shall be treated with a tree dressing.
- H. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- I. The Contractor shall acquire and maintain at the job site throughout the construction period a copy of Erosion and Sedimentation Control Planning and Design Manual published by the N.C. Sedimentation Control Commission and the NCDEMLR. Contractor shall be familiar with the Sedimentation Pollution Control Act and shall avoid violations of the act. Actions by the Contractor resulting in a Notice of Violation of the Act will result in payment to the Contractor being withheld equal to the amount of potential fines and penalties.
- J. Any changes required to accommodate subsequent conditions that may develop or become evident will be compensated for by a duly processed change order.
- K. Protection of existing structures and facilities from sedimentation shall be the responsibility of the Contractor. Items to be protected shall include catch basins, natural waterways, drainage ditches, sidewalks, drives, roads and lawns. Contractor shall not block storm drains and shall

provide adequate drainage in the event that heavy rains occur. Large quantities of water shall not be impounded by temporary erosion control measures.

- L. Stone berms may be used as a temporary measure to filter sedimentation entering catch basins, drainage ditches, walks, etc. Stone shall be removed after the site is stabilized and all trapped sediment redistributed on the site in a manner such that the sediment will not erode into the surrounding drainageways. Grates of catch basins shall be kept free of debris and stone at all times.
- M. Riprap shall be field stone or rough unhewn quarry stone. Stone shall be sound, dense and resistant to the action of air and water and shall vary in weight from 5 to 200 pounds. 30% of the total weight of riprap shall be in individual pieces weighing a minimum of 60 pounds. Install where indicated on drawings.
- N. All construction traffic shall be routed to access points which shall be graveled to prevent tracking of mud onto adjacent paved surfaces.
  - 1. The access points shall be maintained in a condition which will prevent tracking or flowing of sediment onto public streets or existing pavement. This may require periodic top dressing with additional stone as conditions demand. All sediment spilled, dropped, washed or tracked onto public streets must be removed immediately. When necessary, wheels must be cleaned to remove sediment prior to entering a public street. When washing is required, it shall be done on an area stabilized with crushed stone which drains into an approved sediment basin.
- O. Excavation and backfill material shall be placed on the uphill side of the excavations during earthwork operations whenever possible, and shall be protected from eroding into adjacent properties and/or waterways.
- P. Silt check fences shall be as indicated on the drawings.
- Q. Sediment traps and silt basins shall be as indicated on the drawings.
- R. Diversion ditches shall be as indicated on the drawings.
- S. Jute matting shall be installed on all slopes greater than 2½ to 1, along ditches subject to erosion.
- T. Grass shall be provided on all disturbed areas not otherwise occupied by buildings, roads or other structures.
- U. Mulching may be either a small grain straw or tame hay, and shall be free of obnoxious weed seeds or other undesirable matter. The material shall be spread over areas at a rate of 120 bales per acre. Mulch shall be spread according to the following table following disturbance of the original grades occurs. In the event the soil is not suitable for seeding, mulch shall be spread over the site until grassing operations are favorable.
- V. The use of hay bales for erosion and sediment control shall not be acceptable.
- W. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### 1.3 JUTE MATTING

- A. Jute matting shall be a uniform open plain weave of single jute yarn of loosely twisted construction. Yarn thickness shall not vary by more than one half its normal diameter. The width shall be approximately 48-inches with 78 warp ends per width of cloth and 41 weft ends per yard of cloth. Weight of cloth shall average 1.22 pounds per linear yard. Staples shall be 6-inches minimum length, 11 gauge steel wire, “U” shaped.
- B. Install matting down grade and run each strip parallel to the previous strip with a 4-inch overlap. Bury the top end of the jute strip in a trench 4-inches deep. Staple the matting at 2-foot to 3-foot on center and 12-inches to 18-inches on center at edges and at overlaps.

### 1.4 NYLON EROSION CONTROL MAT

- A. Description
  - 1. This work shall consist of furnishing and installing a nylon erosion control mat for concentrated water flow areas (ditches and swales) and non-concentrated water flow areas (slope surfaces) in accordance with the provisions of this specification and within reasonably close conformity with the lines, dimensions, and grades shown on the plans.

- B. Materials
  - 1. Nylon Erosion Control Mat: The nylon erosion control mat shall consist of nylon 6 with a minimum content of 0.5% by weight carbon black and shall consist of a bulky structure of entangled nylon monofilaments fused at their intersections, forming a stable mat of suitable weight and configuration. The mat shall be resilient, permeable, and highly resistant to environmental deterioration and ultraviolet degradation. In addition the mat shall comply with the following minimal physical properties:

<b><u>Properties</u></b>	<b><u>Type A</u></b>	<b><u>Type B</u></b>
Filament diameter	0.0157 in.	0.0138 in.
Weight	0.077 psf	0.05 psf
Mat thickness	0.7 in.	0.35 in.
Mat width	36 in.	36 in.
Roll length	318 ft.	482 ft.
*Tensile strength		
Length	7.84 lb/in.	4.48 lb/in.
Width	4.48 lb/in.	2.24 lb/in.
Elongation	50%	50%
**Resiliency	80%	80%

- a. \*ASTM 1682 strip test procedure modified to obtain filament bond strength.
- b. \*\*Percent recovery after 30 minutes at compressive load cycling of 100 psi for three cycles.

- C. Ground Fasteners
  - 1. Wooden Stakes: Wooden stakes shall be sound, rough sawed hardwood, measuring 1-inch x 3-inch sawed to a point in a triangular shape and shall be 12-inches long for dense, well compacted soils, and 18-inches long for loose or soft soils. Stakes are to be driven to within 2-inches to 3-inches of being flush with ground.

D. Site Preparation

1. All surfaces to be protected with nylon erosion control mat shall be graded, shaped, and finished so that the surfaces are stable, firm, and free of rocks or obstructions which would prevent the mat from lying in direct contact with the soil surface.
2. Seeding, fertilizing, and liming shall be in accordance with Division 31 Section "Grassing for Erosion Control". Areas may be planted before or after mat installation; however, seeding prior to mat installation will require trenches and slots to be seeded after backfilling.

E. Construction

1. Installation of Mat in Concentrated Water Flow Areas (Ditches and Swales): A transverse trench, 6-inches wide by 12-inches deep, is to be cut at the entry and terminal ends of the concentrated water flow area to be protected. In addition, there shall be transverse check slots, 6-inches wide by 12-inches deep, installed at 25-foot intervals. The mat shall be secured in the trenches and slots with ground fasteners at intervals of 3-foot or less, prior to backfilling and compacting of soil in the trenches and slots. Adjoining mats in the longitudinal direction shall be overlapped with a minimum of 3-inches and fasteners provided at 3-foot intervals. The ends of mats shall be overlapped 36-inches with the upslope mat on top. The outer edges of the mat shall be buried in a longitudinal 6-inches wide slot and fastened at 3-foot intervals and then backfilled to prevent water from undercutting the edges.
2. Installation of Mat on Non-Concentrated Water Flow Areas (Slope Surfaces): Installation of mat on non-concentrated water flow areas shall be the same as for concentrated water flow areas except as follows: No transverse check slots or longitudinal slots are required. All longitudinal fasteners shall be placed at 5-foot intervals. The ends of mats are to be overlapped 18-inches with the upslope mat on top.

1.5 GRASSING

- A. See Division 31 Section "Grassing for Erosion Control" for grassing specifications.

**END OF SECTION 312100**

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**SECTION 312110 - GRASSING FOR EROSION CONTROL**

**PART 1 - GENERAL**

1.1 Grassing consists of the establishment of a healthy and vigorous turf over all areas of the site disturbed by the Contractor and not otherwise occupied by permanent construction. Embankments and drainage channels shall be seeded with materials and installed as specified herein.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

**A. Grass Seed**

<u>Type / Name</u>	<u>Proportion By Weight</u>	<u>Minimum Percent Of Purity</u>	<u>Minimum Percent Of Germination</u>
<i>Type I:</i>			
Kentucky 31 Fescue	100%	98	90
<i>Type II:</i>			
Kentucky 31 Fescue	75%	98	90
Annual Ryegrain	25%	98	90

- B. All seed shall be fresh, clean, from new crop seed, and delivered in unopened original packages, which carry a guaranteed analysis by a recognized authority.
- C. Lime: Ground limestone (dolomite) containing not less than 85% of total carbonates.
- D. Commercial Fertilizer: 10-10-10 formula conforming to the applicable state of North Carolina Board of Agriculture fertilizer laws.
  - 1. It shall be uniform in composition, dry and free flowing and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer’s guaranteed analysis.
  - 2. Any fertilizer which becomes caked or otherwise damaged will not be accepted.
- E. Superphosphate: Phosphate rock, finely ground, as commonly used for agricultural purposes, containing not less than 18% available phosphoric acid.
- F. Wood cellulose fiber mulch, for use with hydraulic application of grass seed and fertilizer: Wood cellulose fiber, Conwed Hydro Mulch as manufactured by the Conwed Corp. or equal.
- G. Adhesive Additive: Adhesive shall be added to the hydroseeding operations to secure the wood fiber mulch in place. Adhesive shall be as manufactured by Hydro-Turf, Inc. or equal.
- H. Water: Contractor shall make, at his expense, arrangements to ensure an adequate supply of water to meet the needs of this contract. Furnish all necessary hose, equipment, attachments and accessories.

- I. Jute Matting: A uniform open plain weave of single jute yarn, 18-inches in width plus or minus 1-inch. The yarn shall be of a loosely twisted construction and shall not vary in thickness by more than one-half its normal diameter. There shall be 78 warp ends, plus or minus 2, per width of the matting, 41 weft ends, plus or minus 1, per linear yard, and the weight shall average 1.22 pounds per linear yard of the matting with a tolerance of plus or minus 5%.
- J. Mulch: Small grain straw or tame hay, undamaged, air dry threshed and free of undesirable weed seed.

PART 3 - EXECUTION

3.1 SEED BED PREPARATION

- A. Preparation of Subgrade: Subsoil shall be graded and uniformly compacted so that it will be parallel to proposed finished grade. Subgrade material shall be loosened and mixed to a depth of 3-inches and all stones over 2-inches in size, sticks, and rubbish shall be removed. No heavy objects except lawn rollers shall be moved over prepared subgrade unless the subgrade soil is again graded and loosened as specified above before topsoil is spread.
- B. Finished Grading: After the subgrade soil has been prepared, topsoil shall be spread evenly thereon and lightly compacted. No topsoil shall be spread in a frozen or muddy condition. Final grades shall be as shown on drawings. Where final grades are not indicated, finished grades shall be sloping between points for which elevations are given or between such points and existing grades in conformity with the molding of the surface indicated by the finish grade contours. Spot elevations take precedence over the grades which might be interpolated between contours. Surfaces shall be rounded where there is an appreciable or noticeable change in slope. Good surface drainage must be provided and minor modifications in the specified grades as may be necessary for that purpose are authorized subject to approval of the Engineer. Areas which must drain onto walks or pavements shall be filled so that after settlement they will be ½-inch higher than the adjacent walks or pavement. Areas toward which walks are sloped to drain shall be filled so that after settlement they will be ½-inch to 1-inch lower than the adjacent walk.
  - 1. Areas to be seeded shall be brought to finished grade and smoothed.
  - 2. Allowance for settlement shall be made.
  - 3. Areas where the topsoil has not been removed shall be scarified and smoothed. Remove sticks, stones and rubbish.
- C. Soil Improvements
  - 1. Application rates for soil additives and mulch.
 

a. Fertilizer 10-10-10	@ 20 lb. per 1000 sq. ft.
b. Lime	@ 100 lb. per 1000 sq. ft. (Apply October-March)
c. Superphosphate	@ 15 lb. per 1000 sq. ft.
d. Wood cellulose fiber mulch	As recommended by manufacturer.
e. Adhesive additive	As recommended by manufacturer.
f. Asphalt emulsion	7 gallons per 1000 sq. ft.
g. Mulch all areas	1½ to 2 bales per 1000 sq. ft.

3.2 SEEDING

- A. Seed may be sown immediately after application of soil additives, provided the bed has remained in a good, friable condition and has not become muddy or hard. If it has become hard, it shall be tilled to a friable condition again.
- B. Seed must be sown according to the following table after grading is completed, and whenever the weather and soil conditions are favorable.

STABILIZATION TIMEFRAMES		
Site Area Description	Stabilization	Timeframe Exceptions
Perimeter Dikes, Swales, Ditches and Slopes	7 days	None
High Quality Water (HQW) Zones	7 days	None
Slopes steeper than 3:1	7 days	If slopes are 10' or less in length and are not steeper than 2:1, 14 days are allowed.
Slopes 3:1 or flatter	14 days	7 days for slopes greater than 50' in length.
All other areas with slopes flatter than 4:1	14 days	None, except for perimeters and HQW Zones.

- C. Seeding shall be accomplished by any accepted method such as, but not limited to, hand broadcast, cultipacker, drill type, or the hydraulic method. The hydraulic method may be required on embankments with slopes greater than 3 to 1.
- D. Sowing of Seed: Immediately before any seed is to be sown, the ground shall be scarified and raked until the surface is smooth, friable and of uniform medium-fine texture. The method of sowing the seed may be varied at the discretion of the Contractor on his responsibility to establish a smooth, uniform turf composed of the grasses specified. Sowing of seed shall be at the rates as shown below.

<u>Name/Type</u>	<u>Dates For Seeding</u>	<u>Rate Pounds Per Acre</u>
<b><i>Type I:</i></b>		
Kentucky 31 Fescue	Feb. 15 - Oct. 15	200
<b><i>Type II:</i></b>		
Kentucky 31 Fescue	Oct. 15 - Feb. 15	150
Annual Ryegrain	Oct. 15 - Feb. 15	50

- E. Wood Cellulose Fiber Mulch Spreader: Hydraulic equipment used for the application of seed and slurry of prepared wood pulp and adhesive additive shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry containing up to 40 pounds of fiber for each 100 gallons of water. The discharge line shall be equipped with a set of hydraulic spray nozzles that will provide even distribution of the slurry on the various slopes to be mulched. The slurry tank shall have a minimum capacity of 1000 gallons and shall be mounted on a traveling unit which may be either self-propelled or drawn by a separate unit that will place the slurry tank and spray nozzles near the areas to be mulched so as to provide uniform distribution without waste. Smaller tank capacity may be used provided that the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat over the surface of the area to be mulched. A hose unit may, at the Contractor's option, be attached to the hydroseeding equipment for a more accurate and uniform coverage.



- F. Installation of Jute Matting: Unroll jute matting downgrade and run each strip parallel to the previous strip with a 2-inch overlap. Bury the top end of the jute strip in a trench 4-inches deep. Staple the matting 10-inches on center at intervals 4-feet apart. Staples should be No. 8 gauge wire 8-inches to 10-inches in length. Jute matting shall be used on all slopes with a gradient steeper than a 2½ to 1 slope. Ditches which are subject to erosion shall receive jute matting.
- G. Mulch: Spread straw mulch and tack with asphalt emulsion using application rates specified above.
- H. Clean-Up: Any soil, manure, or similar material which has been brought onto paved areas by hauling operations, shall be promptly removed. Upon completion of the planting, all excess soil, stones and debris shall be removed from the site.

3.3 MAINTENANCE AND PROTECTION

- A. Maintenance of grass areas shall consist of watering, weeding, mowing and reseeding as necessary to control soil erosion. It shall continue until acceptance of the project.
- B. Maintenance shall also include all temporary protection fences, barriers and signs, where deemed necessary, and all other work incidental to proper maintenance.

PART 4 - TEMPORARY SEEDING

- 4.1 In accordance with the North Carolina State “Erosion and Sediment Control Planning and Design Manual”, measures shall be taken to provide temporary seeding to temporarily stabilize denuded areas that will not be brought to final grade according to the table shown in Part 3.2.B of this specification.
- 4.2 Temporary seeding is the planting of rapid-growing annual grasses, small grains, or legumes to provide initial, temporary cover for erosion control on disturbed areas.
- 4.3 Temporary seeding mixtures shall be included along with the fescue or annual ryegrain materials specified within this Section.
- 4.4 Recommendations for temporary seeding shall be as shown within Tables 6.10a, 6.10b, and 6.10c included in the “Practice Standards and Specifications” section of the North Carolina State “Sediment Control Planning and Design Manual”. Seeding mixture species and application rates are as follows:

<u>Season</u>	<u>Species</u>	<u>Rate (Lb/Acre)</u>
Late Winter and Early Spring	Rye (Grain)	120
	Annual Lespedeza	50
Summer	German Millet	40
Fall	Rye (Grain)	120

**END OF SECTION 312110**

## SECTION 316000 – RAMMED AGGREGATE PIERS FOR GROUND IMPROVEMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This work includes the following:
1. Furnishing all necessary design, supervision, labor, materials and equipment to perform all work necessary to install subsurface ground improvements by constructing Rammed Aggregate Piers (RAP) in accordance with these specifications and in close conformity with the lines, grades, design, and dimensions shown on the plans or as directed by the Architect.
  2. Soil reinforcement shall be performed by constructing RAPs to provide foundation support within the proposed building envelope, using special high energy impact densification equipment. RAPs will be installed at finished subgrade elevation within the foundation areas and are intended to limit settlement of building foundations and slabs, and reduce risk associated with the existing fill and alluvial soils. Where existing fill or alluvial soils contain 5% or more organics, Cement Treated Aggregate (CTA) shall be used within the organic zone to prevent long-term bulging.
  3. Mandrel-installed RAP pier locations must be predrilled.
- B. Related Sections include the following:
1. Division 03 Section “Cast-in-Place Concrete:.
  2. Division 31 Section “Earthwork”.

#### 1.2 APPROVED INSTALLERS

- A. The RAP Installer shall be experienced in this type of geotechnical construction work and shall furnish to the Architect for review and acceptance certification that he has a minimum of 5 years of experience with the installation of aggregate piers in the area of the site and has successfully installed RAPs on at least 20 projects of similar size and nature. The RAP Installer's certification shall include the date, location, owner's name and contact information, and quantity of all these required previous installations.
- B. The Installer must be approved two weeks prior to bid opening. Installers currently approved for these works are:
1. Hayward Baker, Philip Byrd, P.E., pbyrd@haywardbaker.com  
208 Little Santee Road Colfax, NC 27235, 336-339-1319 (phone)
  2. Peterson Contractors, Alma Dizdarevic alma@petersoncontractors.com  
104 Blackhawk Street Reinbeck, Iowa 50669, 319-345-2713 (phone)
  3. GeoConstructors, Inc, Zach Scarboro, P.E., zscarboro@geostructures.com  
413 Browning Ct. Purcellville, Virginia 20132, 704-519-7735 (phone)

### 1.3 RELATED WORK

- A. The RAP Installer shall furnish all supervision, labor, equipment, materials and engineering services necessary to perform all RAP ground improvement work.
- B. The stationing, limits, and pattern spacing for the RAP work shall be determined by RAP Installer and shall be reviewed and approved by the project design team. In addition, the RAP Installer shall prepare site specific construction drawings showing specific RAP locations and identification numbers and provide these to the General Contractor prior to construction.
- C. Spoils Removal – Drilling spoils generated by RAP installation shall be removed from the RAP work area in a timely manner and consolidated into a common area for removal by General Contractor.
- D. Footing Preparation – Reference Division 31 Section “Earthwork” for measures employed by General Contractor for preparation for placement of footings.
- E. RAP Protection – Reference Division 31 Section “Earthwork” for measures employed by the General Contractor for protection of RAPs.
- F. RAP Layout – The General Contractor shall be responsible for the layout of individual RAPs. These piers shall be marked in the field using survey stakes or similar means at locations shown on the drawings.
- G. The General Contractor shall be provided copies of all records of site compaction work to verify the suitability of the fill material as structural fill by the Third Party Inspection Agency a minimum of 1 week before the initiation of RAP or mandrel-installed RAP installation.

### 1.4 SUBMITTALS

- A. RAP Design Report - A complete report describing the size and location of RAPs and Mandrel-Installed RAPs shall be submitted to the Engineer, Third Party Inspection Agency, and the project Structural and Geotechnical Engineer at least 21 days prior to the scheduled start of Aggregate Pier production. The report shall include the following:
  - 1. Engineering Calculations - The design by the RAP Installer shall consider the bearing capacity and settlement of all footings and/or slabs supported by RAPs, and shall be in accordance with acceptable engineering practice and these specifications. Detailed calculations shall be prepared by the RAP Installer’s Professional Engineer, licensed in the state of NC , shall be signed and sealed by the Installer’s Engineer and shall include anticipated loads, design assumptions, and relevant subsurface information. The design life of the structure shall be 50 years. The RAP design shall meet the following criteria: Contractor's superintendent.
    - a. Maximum Allowable Bearing Pressure under DL+LL shall be 5,000 psf for RAP supported footings.
    - b. Total settlement shall be 1-inch, and the differential settlement shall be ½-inch.
    - c. RAP elements shall penetrate the existing fill and up to the RAP designer determine if the alluvial soils at the site shall be penetrated.
    - d. Minimum RAP to spread footing area ratio shall be 0.1.
    - e. Maximum RAP to spread footing area ratio shall be 0.4.
    - f. Minimum RAP modulus shall be 250 pci.

- g. RAP design analysis shall consider adjacent footing stress.
  - h. RAP design analysis shall consider any stresses imposed by new fill placed on and/or adjacent to the site.
2. RAP Installation and Location Drawing – Drawings shall be signed and sealed by the Installer’s Professional Engineer and shall include the following information:
    - a. Aggregate pier numbering.
    - b. Dimensioned aggregate pier locations relative to building column grid as defined in contract drawings. Include layout of piers beneath footings.
    - c. Length of aggregate piers.
    - d. Aggregate pier diameter.
    - e. Aggregate pier design load (compression and tension).
    - f. Identification of uplift aggregate piers.
  3. Modulus Test Requirements - One modulus test for compression piers is required. A modulus test schedule shall be prepared for each modulus test, based on the project requirements. The proposed modulus test location shall be shown on the shop drawings
  4. Modulus Test Report - When a modulus test is authorized, a report of modulus test results shall be submitted no later than 5 working days after completion of the modulus test.
  5. Provide Work Plan including schedule, safety plan, and construction quality control plan required to complete the work according to the project schedule.
- B. Daily RAP Progress Reports - The Third Party Inspection Agency shall furnish a complete and accurate record of RAP installation to the RAP Installer and Architect within 2 days of pier installation. The record shall include the pier location, equipment used, elevation of top and bottom of aggregate pier, approximate aggregate tonnage, average diameter and lift thickness for each pier, results of dynamic cone penetrometer tests, flow test (if applicable) and bottom-stabilization tests performed and any pertinent remarks such as elevation of ground water table, and modifications to procedures. A tabular record of the compaction energy (densification time) for each aggregate lift shall be kept for all piers. The date and pier identification shall be kept on each record. Any unusual conditions shall be documented and reported to the Architect immediately.
- C. Any alternate or optional methods of construction proposed with the RAP design and installation shall be subject to review and acceptance by the Architect and the Owner’s Geotechnical Engineer.
- D. Upon completion of the project, submit record drawings showing the locations, depths, and details of construction of the RAPs and/or Mandrel-installed RAPs. The Installer shall provide a summary report of the installation. This report shall be sealed by a professional engineer, registered in the State of North Carolina, and shall certify that the installation has been successful and the ground improvements will meet the required design capacities.
- E. Qualification data as specified in Section 1.3.

## 1.5 QUALITY ASSURANCE

- A. The RAP Installer shall have a full-time Quality Control representative to verify and report all QC installation procedures.
- B. The General Contractor shall employ a Third Party Inspection Agency, who shall monitor the RAP installation and modulus test and provide Quality Assurance services. The Third Party

Inspection Agency shall monitor the installation of all test RAPs to document procedures and criteria used for constructing the test pier(s). The Third Party Inspection Agency shall monitor the installation of RAPs and submit copies of all field reports on within two days of field activity to the Architect for review. The Installer shall adhere to all methods, standards, and codes described herein, unless authorized in writing by the Architect. The Third Party Inspection Agency shall immediately notify the Architect of any changes made in the field.

- C. The Geotechnical Engineer of Record, or an approved representative of, shall be notified 24 hours prior to the start of the modulus and uplift tests.

## 1.6 PROJECT CONDITIONS

- A. Test boring logs, laboratory data and load test results obtained from the site is not guaranteed to represent all conditions which may be encountered. The RAP Installer shall make his own interpretations of the subsurface conditions which may affect the methods or cost of construction of the work required under this contract.
- B. The Contractor shall use every precaution to prevent damage to areas that are adjoining or included in the site area, and shall repair or replace at his own expense any material or work damaged or destroyed by his forces, while performing the work of this Section.
- C. Protection of Existing Structures: Protect structures, underground utilities, and other construction from damage caused by RAP installation operations.
- D. The limits of the working area and acceptable laydown areas will be established to the General Contractor upon request.

## 1.7 THIRD PARTY INSPECTION AGENCY QUALIFICATIONS

- A. An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548. Agency shall meet "Recommended Requirements for Independent Laboratory Qualification", published by American Council of Independent Laboratories". Testing and inspections shall be performed under the direction of a Licensed Professional Geotechnical Engineer, registered in the State of NC.
- B. Inspector Qualifications: (This should be determined by the Owner and design team)
  - 1. Current Level II certification in geotechnical engineering technology/construction from the National Institute for Certification in Engineering Technologies (NICET).
  - 2. Engineer-in-Training (EIT) with relevant experience.

## PART 2 - PRODUCTS

### 2.1 AGGREGATE

- A. Aggregate used for RAPs constructed above the water table shall be Type I Grade B in accordance with ASTM D-1241-68, or shall be other graded aggregate selected by the RAP Installer approved by the project Geotechnical Engineer of Record and successfully used in the modulus test. It shall be compacted to a densification and strength which provides resistance to

the dynamic penetration test (ASTM STP 399) of a minimum average of 15 blows per 1.75-inch vertical movement.

- B. Aggregate used for RAPs constructed below the water table shall be Type II, which is the same as Type I Gradation B, except that there will be no particles passing the No. 40 sieve. Alternately, No. 57 stone or other stone selected by the RAP Installer and approved by the project Geotechnical Engineer of Record and used successfully in the modulus test may be used. Dynamic penetration resistance is inappropriate for this material.
- C. Aggregate used for the installation of mandrel-installed RAPs shall be No. 57 stone or shall be other graded aggregate selected by the RAP Installer, successfully used in the modulus test and approved by the project Geotechnical Engineer of Record.
- D. Cement used in Rigid Inclusion Piers shall meet the requirements for Type I or Type II Portland cement per ASTM C150. Potable water or other suitable source shall be used to increase aggregate moisture content where required.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Rammed aggregate pier (RAP) ground improvement shall be performed following rough grading of the building pad.
- B. Mandrel installed RAP's may be pre-drilled if necessary for installation.
- C. Where existing geotechnical information does not define vertical limits of existing fill soils, the project geotechnical engineer shall confirm RAPs have penetrated existing fill and alluvial soils through onsite observations.
- D. If cave-ins occur during excavation such that the sidewalls of the shaft are deemed to be unstable, a temporary steel casing may be used to stabilize the excavation.
- E. If cave-ins occur on top of a lift of aggregate such that the volume of the caved soils is greater than 25 percent of the volume of the aggregate in the lift, then the aggregate shall be considered contaminated and shall be removed and replaced with uncontaminated aggregate.
- F. If organic content of the existing fill soils exceeds 10% by weight, as determined or estimated by the project geotechnical engineer, Cement Treated Aggregate (CTA) shall be used within the organic layer and extending at least 1-foot below and 1-foot above the layer. RAP Installer shall provide a unit price per linear foot cement treatment of aggregate piers.

#### 3.2 RAMMING AND DENSIFICATION OF AGGREGATE

- A. Special high-energy impact ramming apparatus shall be employed to install the RAP elements for support of foundations and slabs. The ramming assembly shall include a 3,500 lb. class hydraulic hammer that imparts vertical ramming energy. The apparatus shall apply direct downward impact ramming energy to each lift of aggregate.

- B. Ramming and densification shall be performed using a patented beveled rammer foot. The beveled rammer foot is required to improve the matrix soil and to adequately increase the lateral earth pressure in the matrix soil during installation.
- C. A minimum hydraulic hammer CIMA energy level of 3,000 foot-pounds impact energy shall be applied by the energy source. Downward pressure shall be applied to the rammer apparatus during ramming of aggregate with a minimum 22 ton hydraulic excavator.
- D. After drilling of the shaft, the rammer energy shall be applied on the first lift of Type 2 aggregate to form the bottom bulb. After construction of the bottom bulb, Type 1 or Type 2 aggregate shall be rammed in thin lifts in the shaft to the planned top elevation as shown in the drawings.
- E. Well-graded Type 1 aggregate shall be rammed to a density that provides resistance to the dynamic penetration test (ASTM STP 399) of a minimum average of 15 blows per 1.75-inches vertical movement.
- F. Each lift of aggregate shall be rammed for a minimum of 5 to 10 seconds depending on soil conditions and BST results.
- G. Aggregate lift thickness shall not exceed 24-inches in loose thickness.
- H. Type 1 aggregate above the water table shall be placed at or below optimum moisture content as determined by ASTM D1557.

### 3.3 MANDREL-INSTALLED RAP INSTALLATION

- A. A device will be used at the end of the mandrel to keep the mandrel from filling with soil while being pushed in to the ground.
- B. The mandrel (and end cap) shall be driven or pushed to the design depth using crowd force and impact energy.
- C. Aggregate shall be placed in the cavity. If the sidewalls of the cavity remain stable when the mandrel is lifted, the aggregate may be placed by pouring into the cavity from the ground surface. If the sidewalls of the cavity cave during mandrel extraction, then the first lift of aggregate (to the design installation depth) shall be placed through an opening at the bottom of the mandrel.
- D. The pier shall be constructed by placing aggregate in lifts that, after placement of the initial lift, average one foot in compacted thickness. A larger lift may be placed at the bottom of the piers in caving soils provided that this construction technique is verified by the results of the full scale modulus load test.
- E. Each lift shall be compacted by driving the blunt bottom edge of the mandrel downward using static crowd force and vertical dynamic impact energy.
- F. Special high-energy impact densification apparatus shall be employed to densify the Displacement Rammed Aggregate Pier elements during installation. The apparatus shall apply direct vertical impact energy to each constructed lift of aggregate.

- G. Densification shall be performed using a blunt-ended and beveled (tapered) tamper. The beveled tamper foot is required to adequately increase the lateral earth pressure in the matrix soil during installation.
- H. Downward crowd pressure shall be constantly applied to the tamper shaft during tamping.
- I. If the mandrel is used to place the aggregate, the mandrel shall be lifted at a rate no faster than determined from the flow test.
- J. Subsequent lifts shall be constructed following the same procedure described above until the pier is constructed to the top of pier elevation.
- K. Alternate lift heights and lowering depth, may be used as appropriate for the project site upon approval by the Installer's Engineer.
- L. The volume of flow shall be periodically checked throughout installation to verify volume of aggregate is consistent with the demonstration pier volume.
- M. At the completion of the pier installation, the hammer shall be turned off and the mandrel pushed downward applying crowd pressure on the top of the pier to provide preloading.

#### 3.4 DEMONSTRATION PIERS AND FLOW TEST FOR MANDREL-INSTALLED RAPs

- A. If mandrel-installed RAPs are planned to be utilized, the Installer shall install an initial "demonstration pier" as part of the modulus testing to provide project-specific construction procedures prior to installing production mandrel-installed RAPs. The demonstration pier installation shall be used to determine driving depths, the thickness of the initial bottom lift, and procedures used to place the aggregate. The results of the demonstration program shall be used to establish the site-specific installation criteria for the installation of production piers.
- B. A Flow Test shall be performed to establish mandrel extraction times. The Flow Test shall be performed as follows:
  1. The mandrel shall be installed to the design depth.
  2. The mandrel shall be filled with aggregate.
  3. The mandrel shall be lifted out of the ground quickly and moved so that the aggregate may form a cone-shaped pile on the ground as the aggregate exits the mandrel bottom.
  4. The flow of aggregate through bottom of the tamper head shall be observed and timed. Aggregate flow rates shall be made by measuring the amount of aggregate displaced from the hopper over a particular time period to determine the volume per time (i.e. ft<sup>3</sup>/second) of aggregate displaced from the hopper.
  5. The aggregate flow rate observed during the Flow Rate test shall be used by the installer to determine the appropriate mandrel lifting rate during initial aggregate placement.
  6. Hammer impact operations and flow enhancers (compressed air or water) within the mandrel may be used during the flow test, if necessary, to provide a constant, uniform flow of aggregate. If used, the rate of water flow or compressed air pressure shall be noted for implementation during production pier installation. The production piers shall be installed using methods that are consistent with the demonstration pier procedures.
  7. The installation of the Demonstration Pier shall be observed and the details recorded by the Installer's Quality Control Technician. The flow rate shall be recorded by the Installer's Quality Control Technician.



### 3.5 MODULUS TEST

- A. Prior to the start of aggregate pier installation, one (1) test RAPs shall be installed within the building pad at a location identified on the shop drawings for the purpose of establishing quality control procedures. The RAP Installer shall furnish a description of installation equipment, installation records, complete test data and analysis of the test data including design parameter values for each test pier. The report shall be prepared under the supervision of a registered NC Professional Engineer experienced in this type of geotechnical design and installation. Test piers may not be part of the finished work.
- B. A minimum of one modulus test shall be performed by the RAP Installer, as identified on the plans, to verify the parameter values selected for design. If mandrel-installed RAPs are utilized, perform one modulus test on a RAP and the other on a mandrel-installed RAP. Testing shall be performed to a stress level of 150% of the design top of pier stress identified on the RAP submittal. A telltale shall be installed at the bottom of all test piers so that bottom-of-pier deflections may be determined. Acceptable performance is indicated when the bottom of the pier deflection is no more than 20% of the top of pier deflection at the design stress level. The modulus test schedule shall be as follows:

Increment Seat	Approximate Load % Design	Minimum Duration (min)	Maximum Duration
	<5	0	n/a
1	17	15	60
2	33	15	60
3	50	15	60
4	67	15	60
5	83	15	60
6	100	15	60
7	117	60	120
8	133	15	60
9	150	15	60
10	100	n/a	n/a
11	66	n/a	n/a
12	33	n/a	n/a
13	0	n/a	n/a

- C. Each load increment shall be held for the minimum duration shown. For each load increment the deflection of the top plate and the bottom plate shall be measured. The top plate shall be located on top of the Aggregate Pier or on top of concrete cast on top of the Aggregate Pier. The bottom plate shall be located within 1 foot of the bottom design depth of the pier. With the exception of the load increment representing approximately 117% of the design maximum top of aggregate pier stress, if the rate of the Aggregate Pier deflection exceeds 0.01-inches per hour, the load shall be held in 15 minute increments until the rate of the Aggregate Pier deflection is less than 0.01-inches per hour (0.0025-inches per 15 minutes), or the maximum duration is reached. The load increment that represents approximately 117% of the design maximum stress on the aggregate pier shall be held for a minimum of 15 minutes, a maximum of 4 hours and until the rate of deflection reduces to 0.01-inch per hour.

- D. Test RAP deflections of each plate shall be measured using a minimum of two dial gauges graduated to 0.001-inches. Dial gauges shall be anchored to the loading jack base, with gauge plungers set on reference beams anchored at least two diameters from the RAP.
- E. A seating load equal to 5% of the total load shall be applied to the loaded steel plate prior to application of load increments and prior to measurement of deflections to compensate for surficial disturbance. If actual parameters measured do not meet design criteria then piers shall be added and/or lengthened to meet the design criteria at the RAP Installer's expense. All RAPs shall have the minimum modulus specified on the design submittal with less than 1-inch of settlement under the design stress as identified on the plans.

### 3.6 PRODUCTION PIER ACCEPTANCE TESTING

- A. Bottom stabilization tests shall be performed by the RAP Installer, in the presence of the Third Party Inspection Agency, on the test piers and subsequently during construction (at least twice per day) or as required by the Architect, to verify adequate pier stabilization and that production piers are comparable in quality to modulus test pier. The Third Party Inspection Agency shall conduct a minimum of two independent stabilization tests per day. The bottom stabilization test consists of applying tamper energy to the bottom lift of aggregate for the same duration as in the modulus test, turning off the energy source, placing a reference bar over the hole, marking a reference point on tamper shaft, restarting the energy for 15 seconds, turning off the energy source, marking the tamper shaft again at the reference bar and measuring the downward displacement. If the displacement is less than 1.5 times the displacement measured in the approved modulus test for that area, the bottom stabilization test is acceptable. If the displacement exceeds 1.5 times the value measured in the approved modulus test, additional bottom stabilization tests shall be performed until acceptable values are achieved.
- B. Dynamic cone penetrometer testing of piers shall be performed by the RAP installer, in the presence of the Third Party Inspection Agency, on the test piers and subsequently during construction (at least twice per day) or as required by the Engineer, to verify sufficient energy is being imparted to the aggregate. The Third Party Inspection Agency shall conduct a minimum of two independent dynamic cone penetrometer tests per day. The dynamic cone penetrometer test consists of a 15 pound mass falling a distance of 20-inches to strike an anvil above a 1.5-inch diameter cone with a 45° vertex angle. The "N" value is defined as the number of blows required to produce 1.75-inches of penetration after an initial seating interval of 2-inches. Standard "E" rods should be used, if necessary, to extend the depth of testing. Alternatively, cone penetrometers may be permitted, with approval of the Engineer, provided that they are calibrated on the modulus test pier. Dynamic cone penetrometer testing is not appropriate for No. 57 aggregate.

### 3.7 ALLOWABLE CONSTRUCTION TOLERANCES

- A. The center of each pier shall be within six inches of the locations indicated on the plans.
- B. RAP elements and mandrel-installed RAP elements improperly located or installed beyond the maximum allowable tolerances shall be abandoned or reinstalled with new piers, as required by the Architect on a case-by-case basis. RAP Installer shall submit proposed remedial measures to the Architect for review and approval. RAP Installer shall not proceed with remedial measures without Architect's approval. All material and labor required to replace rejected piers

shall be provided at no additional cost to the Owner, unless the cause of the rejection is due to an obstruction.

**END OF SECTION 316000**

## SECTION 321216 – ASPHALT PAVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Hot-mix asphalt patching.
  - 2. Hot-mix asphalt paving.
- B. Related Sections:
  - 1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
  - 1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
  - 2. Job-Mix Designs: For each job mix proposed for the Work.
- B. Material Certificates: For each paving material, from manufacturer.
- C. Material Test Reports: For each paving material.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by representatives of the North Carolina Department of Transportation (NCDOT).
- B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the "Standard Specifications for Roads and Structures" of NCDOT for asphalt paving work.
  - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

#### 1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
  - 1. Tack Coat: Minimum surface temperature of 60°F (15.6°C).
  - 2. Asphalt Base Course: Minimum surface temperature of 40°F (4.4°C) and rising at time of placement.

3. Asphalt Surface Course: Minimum surface temperature of 60°F (15.6°C) at time of placement.

## PART 2 - PRODUCTS

### 2.1 AGGREGATES

- A. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- B. Fine Aggregate: AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
- C. Mineral Filler: AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

### 2.2 ASPHALT MATERIALS

- A. Tack Coat: Comply with NCDOT, Section 605. Asphalt grade shall be RS-1H. Asphalt for tack coat shall be at not less than 90°F. nor more than 145°F. during application.

### 2.3 MIXES

- A. Hot-Mix Asphalt: Comply with applicable requirements of the North Carolina Department of Transportation's (NCDOT) "Standard Specifications for Roads and Structures", unless otherwise specified.
  1. Binder Course: Comply with NCDOT, Section 610, Type I 19.0B.
  2. Surface Course: Comply with NCDOT, Section 610, Type S 9.5B.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

### 3.2 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12-inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically.

Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances and surroundings. Remove spillages and clean affected surfaces.
- C. Patching: Partially fill excavated pavements with hot-mix asphalt binder mix and, while still hot, compact. Cover asphalt binder course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

### 3.3 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances and surroundings. Remove spillages and clean affected surfaces.

### 3.4 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section and thickness when compacted.
  - 1. Place hot-mix asphalt binder course in number of lifts and thicknesses indicated.
  - 2. Place hot-mix asphalt surface course in single lift.
  - 3. Spread mix at minimum temperature of 250°F (121°C).
  - 4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10-feet (3 m) wide unless infill edge strips of a lesser width are required.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.5 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
  - 1. Clean contact surfaces and apply tack coat to joints.

2. Offset longitudinal joints, in successive courses, a minimum of 6-inches (150 mm).
3. Offset transverse joints, in successive courses, a minimum of 24-inches (600 mm).
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2% of specified course density.

### 3.6 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
  1. Complete compaction before mix temperature cools to 185°F (85°C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
  1. Average Density: 92% of reference maximum theoretical density according to ASTM D 2041, but not less than 90% nor greater than 96%.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.7 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  1. Binder Course: Plus or minus ¼-inch (6 mm).
  2. Surface Course: Plus ¼-inch (6 mm), no minus.

- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
  - 1. Binder Course: ¼-inch (6 mm).
  - 2. Surface Course: 1/8-inch (3 mm).
  - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is ¼- inch (6 mm).

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. Replace and compact hot-mix asphalt where core tests were taken.
- E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

### 3.9 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

**END OF SECTION 321216**



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## SECTION 321313 – CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Driveways.
  - 2. Curb and gutters.
  - 3. Sidewalks.
- B. Related Sections:
  - 1. Division 03 Section “Cast-in-Place Concrete” for general building applications of concrete.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Action Submittals:
  - 1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Material Test Reports: For the following:
  - 1. Aggregates.

#### 1.3 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
  - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- C. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

### PART 2 - PRODUCTS

#### 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

## 2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
  - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

## 2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420); deformed.
- C. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars; assembled with clips.
- D. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.
- E. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) plain-steel bars. Cut bars true to length with ends square and free of burrs.
- F. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- G. Hook Bolts: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- H. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
  - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

## 2.4 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers (containing no reprocessed olefin materials) engineered and designed for use as secondary reinforcing in concrete, complying with ASTM C 1116/C 1116M, Type III, 1¼- to 2¼-inches (25 to 57 mm) long, varying fiber thickness, and no water absorption.
  - 1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. 3M; Scotchcast Polyolefin Fibers 2”.

- b. BASF Construction Chemicals, "MasterFiber MAC" Series
- c. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
- d. FORTA Corporation; FORTA FERRO.
- e. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
- f. Nycon, Inc.; XL.
- g. Propex Concrete Systems Corp.; Fibermesh 650.
- h. Sika Corporation; Sika Fiber MS10.

## 2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
  - 1. Portland Cement: ASTM C 150, portland cement Type I/II. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class F.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, standard size No. 57, 67, or 78M, uniformly graded. Provide aggregates from a single source.
  - 1. Maximum Coarse-Aggregate Size: 1-inch (25 mm) nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1% water-soluble chloride ions by mass of cementitious material.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

## 2.6 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete with the following properties:
  - 1. Driveways, Sidewalks, and Curb and Gutter
    - a. Minimum Compressive Strength (28 Days): 4,500 psi (31.0 MPa).
    - b. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45
    - c. Slump Limit: 4 inches, (100 mm) plus or minus 1-inch (25 mm); or 8-inches (200 mm) for concrete with verified slump of 2- to 4-inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1-inch (25 mm).
    - d. Air Content: 5.5% plus or minus 1.5% at point of delivery for 1½-inch (38 mm) nominal maximum aggregate size.
- B. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture, at concrete batch facility, at manufacturer's recommended rate, but not less than 3.0 lb/cu. yd. (2.4 kg/cu. m).

- C. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing admixture in concrete as required for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

## 2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.
  - 1. When air temperature is between 85 and 90°F (30 and 32°C), reduce mixing and delivery time from 1½ hours to 75 minutes; when air temperature is above 90°F (32°C), reduce mixing and delivery time to 60 minutes.

## 2.8 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ChemMasters; Spray-Film.
    - b. Dayton Superior Corporation; Sure Film (J-74).
    - c. Kaufman Products, Inc.; VaporAid.
    - d. Lambert Corporation; LAMBCO Skin.
    - e. Meadows, W. R., Inc.; EVAPRE.
    - f. SpecChem, LLC; Spec Film.
- E. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

## 2.9 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1752, cork or self-expanding cork in preformed strips.

## PART 3 - EXECUTION

### 3.1 EXAMINATION AND PREPARATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Remove loose material from compacted subbase surface immediately before placing concrete.
- C. Proof-roll prepared subbase surface below concrete curb and gutter and walks to identify soft pockets and areas of excess yielding.
  - 1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph (5 km/h).
  - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
  - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of ½-inch (13 mm) according to requirements in Division 31 Section "Earth Moving."
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### 3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap of adjacent mats.

### 3.4 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
  - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
  - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
  - 2. Provide tie bars at sides of paving strips where indicated.
  - 3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1½-inches (38 mm) into concrete.
  - 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
  - 1. Locate expansion joints at intervals of 50 feet (15.25 m) unless otherwise indicated.
  - 2. Extend joint fillers full width and depth of joint.
  - 3. Terminate joint filler not less than ½-inch (13 mm) or more than 1-inch (25 mm) below finished surface if joint sealant is indicated.
  - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
  - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a ¼-inch (6 mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

### 3.5 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, placing, and consolidating concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Screed paving surface with a straightedge and strike off.
- H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- I. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- J. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
  - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- K. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
  - 1. When air temperature has fallen to or is expected to fall below 40°F (4.4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C) and not more than 80°F (27°C) at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- L. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:
  - 1. Cool ingredients before mixing to maintain concrete temperature below 90°F (32°C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  - 3. Fog-spray forms, steel reinforcement and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.



### 3.6 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
  - 1. Burlap Finish: For curb and gutter, drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
  - 2. Medium-to-Fine-Textured Broom Finish: For sidewalks, draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
  - 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16- to 1/8-inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

### 3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture-retaining-cover curing, curing compound, or a combination of these.
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12-inches (300 mm) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

### 3.8 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
  - 1. Elevation:  $\frac{3}{4}$ -inch (19 mm).
  - 2. Thickness: Plus  $\frac{3}{8}$ -inch (10 mm), minus  $\frac{1}{4}$ -inch (6 mm).
  - 3. Surface: Gap below 10-foot- (3 m-) long, unlevelled straightedge not to exceed  $\frac{1}{2}$ -inch (13 mm).
  - 4. Joint Spacing: 3-inches (75 mm).
  - 5. Contraction Joint Depth: Plus  $\frac{1}{4}$ -inch (6 mm), no minus.
  - 6. Joint Width: Plus  $\frac{1}{8}$ -inch (3 mm), no minus.

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  - 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  - 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40°F (4.4°C) and below and when it is 80°F (27°C) and above, and one test for each composite sample.
  - 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
  - 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
    - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
- D. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

- E. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.
- F. Concrete paving will be considered defective if it does not pass tests and inspections.
- G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- H. Prepare test and inspection reports.

### 3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete curb and gutters and walks that are broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Engineer.
- B. Protect concrete curb and gutters and walks from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain concrete as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

**END OF SECTION 321313**

## SECTION 329200 – TURF AND GRASSES

### PART 1 - GENERAL

#### 1.1 DESCRIPTION OF WORK

- A. The work consists of the re-establishment of a healthy and vigorous turf over all areas of the site disturbed by the Contractor that were occupied by permanent lawns prior to construction.
- B. Specific notations on the Drawings supersede the requirements of this Section where there is conflict.

#### 1.2 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

#### 1.3 FIELD CONDITIONS

- A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

<u>Type/Name</u>	<u>Prop by Weight</u>	<u>Minimum Percent Purity</u>	<u>Minimum Percent Germ.</u>	<u>Maximum Percent Weed Seed</u>
<i>Type I:</i>				
Kentucky 31 Fescue	100%	98	90	1
<i>Type II:</i>				
Kentucky 31 Fescue	75%	98	90	1
Annual Ryegrain	25%	98	90	1

- A. Grass Seed
  - 1. All seed shall be fresh, clean, from new crop seed, and delivered in unopened original packages, which carry a guaranteed analysis by a recognized authority.
- B. Lime: Ground limestone (dolomite) containing not less than 85% of total carbonates.

- C. Commercial Fertilizer: 10-10-10 formula conforming to the applicable State of North Carolina Board of Agriculture Fertilizer Laws. It shall be uniform in composition, dry and free flowing and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis.
- D. Superphosphate: Phosphate rock, finely ground, containing not less than 18% available phosphoric acid.
- E. Water: Contractor shall make, at his expense, arrangements to ensure an adequate supply of water to meet the needs of this Contract. Furnish all necessary hose, equipment and attachments, for the adequate irrigation of lawns as may be required to complete the work.
- F. Jute Matting: A uniform open plain weave of single jute yarn, 18-inches wide. Weight shall average 1.22 pounds per linear yard of matting.
- G. Mulch: Small grain straw or tame hay, air dry threshed and free of undesirable weed seed.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
  1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.

#### 3.2 SEEDBED PREPARATION

- A. Preparation of Subgrade: Subsoil shall be graded and uniformly compacted so that it will be parallel to proposed finished grade. Subgrade material shall be loosened and mixed to a depth of 3-inches and all stones over 2-inches in size, sticks, and rubbish shall be removed. No heavy objects except lawn rollers shall be moved over prepared subgrade unless the subgrade soil is again graded and loosened as specified above before topsoil is spread.
- B. Finished Grading: After the subgrade soil has been prepared, topsoil shall be spread evenly thereon and lightly compacted. No topsoil shall be spread in a frozen or muddy condition. Finished grades shall be the same as final grades shown on drawings. Where final grades are not

indicated, finished grades shall be level or sloping between points for which elevations are given or between such points and existing grades in conformity with the molding of the surface indicated by the finish grade contours. Spot elevations take precedence over the grades which might be interpolated between contours. Surfaces shall be rounded where there is an appreciable or noticeable change in slope. Good surface drainage must be provided and minor modifications in the specified grades as may be necessary for that purpose are authorized subject to approval of the Engineer. Areas which must drain onto walks or pavement shall be filled so that after settlement they will be ½-inch higher than the adjacent walks or pavement. Areas toward which walks are sloped to drain shall be filled so that after settlement they will be ½-inch to 1-inch lower than the adjacent walk.

1. Areas to be seeded shall be brought to finished grade.
2. Allowance for settlement shall be made.
3. Areas where the topsoil has not been removed shall be scarified and smoothed. Remove sticks, stones and rubbish.

### 3.3 SOIL IMPROVEMENTS

#### A. Application rates for soil additives and mulch:

1. Fertilizer 10-10-10 @ 20 lb. per 1000 sq. ft.
2. Lime @ 100 lb. per 1000 sq. ft. (Apply October-March)
3. Superphosphate @ 15 lb. per 1000 sq. ft.
4. Asphalt emulsion 7 gallons per 1,000 sq. ft.
5. Mulch all areas 1½ to 2 bales per 1,000 sq. ft.

### 3.4 SEEDING

- A. Seed may be sown immediately after application of soil additives, provided the bed has remained in a good, friable condition and has not become muddy or hard. If it has become hard, it shall be tilled to a friable condition again.
- B. Seed must be sown according to the following table after grading is completed, and whenever the weather and soil conditions are favorable or as otherwise authorized by the Owner or his representative and with the consent of the Contractor.

STABILIZATION TIMEFRAMES		
Site Area Description	Stabilization	Timeframe Exceptions
Perimeter Dikes, Swales, Ditches and Slopes	7 days	None
High Quality Water (HQW) Zones	7 days	None
Slopes steeper than 3:1	7 days	If slopes are 10' or less in length and are not steeper than 2:1, 14 days are allowed.
Slopes 3:1 or flatter	14 days	7 days for slopes greater than 50' in length.
All other areas with slopes flatter than 4:1	14 days	None, except for perimeters and HQW Zones.

- C. Seeding shall be accomplished by any accepted method such as, but not limited to, hand broadcast, cultipacker, drill type, or the hydraulic method. The hydraulic method may be required on embankments with slopes greater than 3 to 1.
- D. Sowing of Seed: Immediately before any seed is to be sown, the ground shall be scarified as necessary and shall be raked until the surface is smooth, friable and of uniform medium-fine texture. The method of sowing the seed may be varied at the discretion of the Contractor on his responsibility to establish a smooth, uniform turf composed of the grasses specified. If area is to be seeded between October 15 and February 15, sow with Type II seed. After February sow Type I seed over the areas seeded with Type II. Sowing of seed shall be at the rates as shown below:

<u>Name</u>	<u>Dates for Seeding</u>	<u>Rate - lbs. per Acre</u>
Type I	Feb. 15 - Oct. 15	200
Type II (Temporary)	Oct. 15 - Feb. 15	200

- E. Protect seeded areas with slopes exceeding 1:4 or where indicated on the drawings with erosion-control blankets installed according to manufacturer's written instructions.
- F. Installation of Jute Matting: Unroll jute matting downgrade and run each strip parallel to the previous strip with a 2-inch overlay. Bury the top end of the jute strip in a trench 4-inches deep. Staple the matting 10-inches on center at intervals 4-feet apart. Staples should be No. 8 gauge wire 8-inches to 10-inches in length. Jute matting shall be used on all slopes with a gradient steeper than a 2½ to 1 slope. Ditches which are subject to erosion shall receive jute matting.
- G. Mulch: Spread straw mulch and tack with asphalt emulsion using the application rates specified above.
- H. Clean-Up: Any soil, manure, or similar material which has been brought onto paved areas by hauling operations, shall be removed. Upon completion of the planting, all excess soil, stones and debris shall be removed from the site or disposed of as directed by the Engineer. All lawns and planting areas shall be prepared for final inspection.
- I. Erosion Control: Areas of erosion damage shall be repaired and maintained until acceptance of the project.

### 3.5 MAINTENANCE AND PROTECTION

- A. Acceptance Before Maintenance Begins: There shall be an acceptance of grading and lawn installation before maintenance begins.
- B. Contractor shall make, at his expense, arrangements to ensure an adequate supply of water to meet the needs of this contract. Contractor shall maintain grass areas by watering, weeding, mowing and reseeding as necessary to control erosion. It shall continue until the turf is established even though the remainder of the project may have been accepted by the Owner.
- C. Maintenance shall also include all temporary protection fences, barriers and signs, where deemed necessary, and all other work incidental to proper maintenance.

### 3.6 RESPONSIBILITY FOR LAWNS

- A. Until the project is finally accepted, the Contractor shall repair or replace any seeding or mulching that is defective or becomes damaged. When, in the judgment of the Engineer, such defects or damages are the result of poor workmanship or failure to meet the requirements of the specifications, the cost of the necessary repairs or replacements shall be borne by the Contractor.

### 3.7 INSPECTION AND ACCEPTANCE

- A. At the conclusion of the project the Engineer shall inspect the seeded areas upon written request by the Contractor. The request shall be received at least 10 days before the anticipated date of inspection.
- B. Inspection and acceptance of seeded areas may be requested and granted in part, provided the area for which acceptance is requested is relatively substantial in size with clearly definable boundaries.

**END OF SECTION 329200**



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## SECTION 331100 – WATER DISTRIBUTION PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Pipe and fittings.
  2. Tapping sleeves and valves.
  3. Valves and boxes.
  4. Pipe support systems.

#### 1.2 REFERENCE STANDARDS

- A. ASTM International:
1. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
  2. ASTM D2464 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
  3. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
  4. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- B. American Water Works Association:
1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
  2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.
  3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  4. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
  5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
  6. AWWA C153 - Ductile-Iron Compact Fittings.
  7. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
  8. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.
  9. AWWA C606 - Grooved and Shouldered Joints.
  10. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-inch through 12-inch (100 mm through 300 mm), for Water Transmission and Distribution.

#### 1.3 SUBMITTALS

- A. Product Data: Submit manufacturer information regarding pipe materials, pipe fittings, valves, tapping sleeves, hydrants, and backflow preventers.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

## 1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
  - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. NSF Compliance: Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
  - 1. Ensure that valves are dry and internally protected against rust and corrosion.
  - 2. Protect valves against damage to threaded ends and flange faces.
  - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
  - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
  - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- A. Storage:
  - 1. Protect stored piping, flanges, fittings, and specialties from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
  - 2. Store materials according to manufacturer instructions.
  - 3. Block individual and stockpiled pipe lengths to prevent moving.
  - 4. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
  - 5. Store PVC materials out of sunlight.
- B. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Provide additional protection according to manufacturer instructions.
3. Provide temporary covers for backflow preventer assemblies to prevent entry of foreign materials.
4. Protect openings in sections of completed piping systems.
5. Protect openings in piping systems when Work is not in progress.

## 1.6 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
  1. Notify the Owner no fewer than three days in advance of proposed interruption of service.

## 1.7 COORDINATION

- A. Coordinate connection to water main with utility company.

## PART 2 - PRODUCTS

### 2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Available 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:
  1. American Cast Iron Pipe Co. (ACIPCO)
  2. Griffin Pipe
  3. Tyler Pipe/Union Foundry
  4. U.S. Pipe
- B. All ductile iron pipe shall be minimum pressure class 250.
- C. Mechanical-Joint Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  1. Mechanical-Joint Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- D. Push-on-Joint Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  1. Push-on-Joint Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  2. Gaskets: AWWA C111, rubber.
- E. Push-on-Restrained-Joint Pipe: AWWA C151, with grooved or flanged ends.

1. Push-on-Restrained-Joint Fittings: AWWA C600, Flex-Ring or Lok-Ring joint as manufactured by American Cast Iron Pipe Company, TR Flex Joint as manufactured by US Pipe, or equal. Restrained joints shall be capable of being deflected after full assembly.
2. Couplings: AWWA C606, restrained groove-end with flush seal type gasket designed for ductile iron pipe. Unless otherwise specified, grooved end couplings shall be rigid joint for exposed service and flexible joint for buried service.
3. Bolts and Nuts: ANSI/AWWA C111/A21.11, corrosion-resistant, high-strength, low alloy steel.

## 2.2 PVC PIPE AND FITTINGS

- A. PVC, Schedule 80 Pipe:
  1. Comply with ASTM D1785.
  2. End Connections: Bell and spigot style, with solvent-sealed ends.
  3. Fittings:
    - a. Material: PVC.
    - b. Comply with ASTM D2464.
  4. Joints:
    - a. Solvent welded with solvent cement conforming to ASTM D2564.
    - b. Comply with ASTM D2855.
- B. PVC, AWWA Pipe: AWWA C900, Class 150, with bell end with gasket, and with spigot end.
  1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Gaskets: AWWA C111, rubber.
  2. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

## 2.3 SPECIAL PIPE FITTINGS

- A. Ductile-Iron Flexible Expansion Joints:
  1. Available 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. EBAA Iron, Inc.
    - b. Hays Fluid Controls; a division of ROMAC Industries Inc.
    - c. Star Pipe Products.
  2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
    - a. Pressure Rating: 250 psig (1725 kPa) minimum.

- B. Ductile-Iron Deflection Fittings:
  - 1. Available 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. EBAA Iron, Inc.
  - 2. Description: Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
    - a. Pressure Rating: 250 psig (1725 kPa) minimum.
- C. Mechanical Joint Restraints
  - 1. Restraint devices for nominal pipe sizes 3-inch through 54-inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.
  - 2. The devices shall have a working pressure rating of 350 psi for 3-to-16-inch, 250 psi for 18-to-48-inch and 200 psi for the 54-inch size. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.
  - 3. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.

## 2.4 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Cast Iron Pipe Co.; American Flow Control Div., Series 500 or 2500
    - b. East Jordan Iron Works, Inc.
    - c. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa), Series F-6100
    - d. Mueller Co.; Water Products Div., Series 2360
    - e. U.S. Pipe and Foundry Company
  - 2. Nonrising-Stem, Resilient-Seated Gate Valves
    - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      - 1) Standard: AWWA C509.
      - 2) Minimum Working Pressure Rating: 200 psig.
      - 3) Hydrostatic Test Pressure Rating: 300 psig.
      - 4) 2-inch operating nut.
      - 5) Interior and Exterior Coating: Epoxy coating complying with AWWA C550.
      - 6) End Connections: Mechanical Joint, with slotted holes allowed only at the 11 o'clock and 1 o'clock positions.
      - 7) Shoulder bolts (not tee bolts) shall be used in the slotted holes.
      - 8) Open Direction: Left

## 2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary, Series 500 or 2500
    - b. East Jordan Iron Works, Inc.
    - c. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa), F-5211
    - d. Mueller Co.; Water Products Div.
    - e. U.S. Pipe and Foundry Company.
  2. Description: Sleeve and valve compatible with drilling machine.
    - a. Standard: MSS SP-60.
    - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
    - c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated, gate valve with one raised face flange mating tapping-sleeve flange.
    - d. No slots on flange side.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable (slip type only) extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5-inches in diameter.
1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

## 2.6 CHECK VALVES

### A. AWWA Check Valves

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. American Cast Iron Pipe Co.; American Flow Control Div.
  - b. APCO Willamette; Valve and Primer Corporation.
  - c. Crane Co.; Crane Valve Group; Crane Valves.
  - d. McWane, Inc.; M & H Valve Company Div.
  - e. Mueller Co.; Water Products Div.
2. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
  - a. Standard: AWWA C508.
  - b. Pressure Rating: 175 psig (1207 kPa).

## 2.7 TRACE WIRE

### A. Materials

1. All trace wire shall have HDPE insulation intended for direct bury, color coated blue.
2. For open trench installation, trace wire shall be 12 gage Copper Clad Steel, High Strength with minimum 450 lb. break load and minimum 30 mil HDPE insulation thickness.
3. For directional drilling/boring, trace wire shall be 12 gage Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load and minimum 30 mil HDPE insulation thickness.

B. General

1. For long runs in excess of 500 linear feet without service laterals or hydrants, trace wire access must be provided utilizing an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway. The grade level/in-ground trace wire access box shall be delineated using a minimum 48-inch polyethylene marker post, color coded blue.
2. For service laterals, trace wire must terminate at an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway.
3. For hydrants, trace wire must terminate at an approved above-ground trace wire access box, properly affixed to the hydrant grade flange.

C. Connectors

1. All mainline trace wires must be interconnected at intersections, mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.
2. Direct bury wire connectors shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.
3. Non locking friction fit, twist on or taped connectors are prohibited.

D. Termination/Access

1. All trace wire termination points must utilize a grade level/in-ground trace wire access box, specifically manufactured for this purpose.
2. All grade level/in-ground access boxes shall be appropriately identified with "water" cast into the cap and be color coded.
3. A minimum of 2-feet of excess/slack wire is required in all trace wire access boxes after meeting final elevation.
4. All trace wire access boxes must include a manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for the grounding anode wire connection.
5. Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.

E. Grounding

1. Trace wire must be properly grounded at all dead ends/stubs.
2. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20 feet of 14 gage red HDPE insulated copper clad steel wire connected to anode (minimum of 0.5 lb.) specifically manufactured for this purpose, and buried at the same elevation as the utility.
3. When grounding the trace wire at dead ends/stubs, the grounding anode shall be installed in a direction 180° opposite of the trace wire, at the maximum possible distance.
4. When grounding the trace wire in areas where the trace wire is continuous and neither the mainline trace wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the trace wire. Do not coil excess wire from grounding anode. In this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to trace wire with a mainline to lateral lug connector.



5. Where the anode wire will be connected to a trace wire access box, a minimum of 2-feet of excess/slack wire is required after meeting final elevation.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving".

### 3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- A. Thoroughly clean end connections before installation.
- B. Do not use flanges or unions for underground piping.
- C. Underground water-service piping shall be any of the following:
  1. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints.
  2. PVC, AWWA C900, Class 235, DR18; PVC fabricated or molded fittings of same class as pipe; and gasketed joints.
  3. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
  4. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
  5. Ductile-iron, push-on restrained joint pipe; ductile-iron, push-on restrained joint fittings; and gasketed joints.

### 3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use corporation valves with ends compatible with piping, for NPS 2 and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, bronze-seated gate valves with valve box on existing water lines, and resilient-seated gate valves with valve box on new water lines.

### 3.4 PIPING INSTALLATION

- A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

- B. Make connections larger than NPS 2 with tapping machine according to the following:
  - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
  - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
  - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
  - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
  
- C. Make connections NPS 2 and smaller with drilling machine according to the following:
  - 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
  - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
  - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
  - 4. Install corporation valves into service-saddle assemblies.
  
- D. Install ductile-iron piping and fittings according to AWWA C600.
  
- E. Install PVC piping and fittings according to ASTM D2774.
  
- F. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
  
- G. Bury piping with depth of cover over top at least 36-inches (910 mm), with top at least 12-inches (300 mm) below level of maximum frost penetration, and according to the following:
  - 1. Under Driveways: With at least 36-inches (910 mm) cover over top.
  - 2. In Loose Gravelly Soil and Rock: With at least 12-inches (300 mm) additional cover.
  
- H. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
  
- I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, or other supports.
  
- J. Installation of Watermain in relation to Sanitary Sewer:
  - 1. Horizontal Separation
    - a. Watermains shall be laid at least 10-feet horizontally from any existing or proposed sanitary sewer. The distance shall be measured edge to edge.
  - 2. Vertical Separation/Crossings
    - a. Watermain crossing sanitary sewer shall be installed to provide a minimum vertical separation of 18-inches between the outside of the watermain and the outside of the sanitary sewer. Watermain shall be laid above the sanitary sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.
  - 3. When proper horizontal and/or vertical separation cannot be achieved on of the of the following methods must be specified:
    - a. If the local conditions prevent an 18-inch vertical separation, then the water main shall be constructed of ductile iron pipe with mechanical type joints for a lateral distance measured at right angles to the sewer, of at least 10-feet on each side of the sewer. One full length of water main shall be centered over the sewer.

- b. Both the watermain and sanitary sewer must be constructed of ferrous pipe and pressure tested to 150 psi.
- c. Either the watermain or the sanitary sewer line may be encased in a watertight carrier pipe which extends 10-feet on both sides of the crossing as measured perpendicular to the watermain.

### 3.5 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
  - 1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
  - 2. PVC Piping Gasketed Joints: Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.

### 3.6 ANCHORAGE INSTALLATION

- A. Install anchorages for tees, plugs and caps, bends, crosses and valves.
- B. Concrete blocking on the end of waterlines or hydrants is not permitted. A thrust collar and mega lugs shall be used to restrain hydrant legs, end caps and plugs, multiple bend configurations. Threaded rods (stainless steel or coal tar epoxy steel) may be required in addition to mega lugs by the Engineer or Owner's Representative if field conditions dictate.
- C. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
  - 1. Concrete thrust blocks.
  - 2. Locking mechanical joints.
  - 3. Bolted flanged joints.
  - 4. Pipe clamps and tie rods.
- D. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
  - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
  - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.

### 3.7 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
  - 1. Center and plumb valve box over valve.
  - 2. Set box cover flush with finished grade.
- B. Check Valves: Install according to AWWA C508.
- C. Corporation Valves: Install each underground corporation valve with head pointed up.

### 3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve or service clamp and corporation valve depending on the size of the existing water main.

### 3.9 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Use only potable water.
- B. Hydrostatic Tests for Water Lines
  1. The water line shall be tested for leakage. The water leakage test is a two part test; Part A (pressure loss) and Part B allowable leakage. Part A & Part B must pass for the test to be considered successful.
  2. Water line leakage tests shall be conducted on a schedule agreed upon by the Engineer/Owner representative. A representative of the Engineer/Owner is required during the tests with a minimum 48 hour notice (2 business days).
  3. Water services (tap, service line, and meter setter) shall be installed prior to water line leakage test. The pipe shall be filled with potable water for a period of 24 hours before testing begins. It shall be ensured that the pipe is full of water and all air has been removed before testing. Contractor shall pretest the water line prior to scheduling a test with Engineer/Owner.
  4. The water line shall be tested at 1.25 times the highest working pressure along the section, or 200 psig, whichever is greater. The test shall be of at least 2 hours duration and the pressure may not drop more than 5 psig during the test.
  5. All exposed pipe, fittings, valves and hydrants shall be visually examined during the test. Leakage shall be no greater than the amount determined by the formula:

$$L = \frac{SD(P)^{1/2}}{133,200}$$

Where L = allowable leakage (gallons/hour)  
S = length of pipe in test (feet)  
D = nominal pipe diameter (inches)  
P = average test pressure (psig)

6. Pipe having more than allowed leakage shall be repaired. All visible leaks shall be repaired regardless of the amount of leakage.
- C. Prepare reports of testing activities.

### 3.10 IDENTIFICATION

- A. Install continuous underground warning tape during backfilling of trench for DIP underground water-distribution piping. Underground detectable warning tape shall be used for any piping that is not DIP. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

### 3.11 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
  - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
  - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
    - a. Fill system or part of system with water/chlorine solution containing at least 100 ppm of chlorine; isolate and allow to stand for 24 hours. City inspector will test the chlorinated water to verify a minimum of 100 ppm and again in 24 hours to verify that the chlorine residual is still above 24 ppm.
    - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    - d. City inspector will take water samples for biological testing. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

### 3.12 DISINFECTION

- A. Sampling Taps
  - 1. Sampling taps shall be provided every 1,000 feet and at the end of each branch.
  - 2. Taps shall be located and constructed so samples may be easily collected without danger to personnel or likelihood of sample contamination.
  - 3. Sampling taps may be used as blow-offs.
- B. Sterilization
  - 1. Hydrants may not be used for bacteriological sampling.
  - 2. All parts of a potable water system (including service lines) shall be sterilized in accordance with AWWA C601 and these specifications.
  - 3. Preventive and corrective measures during construction (AWWA C601) should be adhered to during construction to ensure success of the sterilization process.
  - 4. Lines shall be initially chlorinated to 100 mg/l.
  - 5. Lines must have a minimum free chlorine residual of 24 mg/l after 24 hours.
  - 6. The City laboratory must be used for this test, the contractor may not utilize a private outside laboratory.
  - 7. When the Contractor has determined that the line has been chlorinated to the proper level, he shall contact the Engineer/Owner representative to schedule the City laboratory to conduct the sampling and analysis for confirmation of the free chlorine level. A 48 hour advance notice shall be given to the Engineer/Owner prior to conducting the test.
  - 8. After the required contact time (24 hours), the Contractor shall have the chlorine residual tested and if the chlorine levels are at least 24 mg/l then the contractor can flush the line and all appurtenances with Thomasville distribution water until completely purged.
  - 9. No bacteriological samples will be collected at points where the free chlorine residual exceeds the ambient distribution system free residual by more than 0.5 mg/l.

10. Care must be taken to discharge the chlorinated water in a manner which will not endanger plant or animal life or be unsafe. Chlorinated water must be discharged in an environmentally safe manner and in accordance with all federal, state, and/or local laws and regulations. Chlorinated sterilization water shall not be discharged into the City's sewer or storm drain systems. Contractor must treat the chlorinated water to meet North Carolina Quality Discharge Standards.
11. Bacteriological testing/sampling shall be requested on the same day the line is flushed. Bacteriological testing will be performed by the City laboratory Monday through Thursday prior to 12:00 p.m. at least 48 hour notice shall be given the Engineer/Owner prior to sampling. The City's Utilities Inspector will collect and deliver the samples to the lab (testing fee applies). Each sample shall be marked legibly, identifying with letters or numbers each sampling point.

**END OF SECTION 331100**

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## SECTION 334100 – STORM UTILITY DRAINAGE PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes gravity-flow, nonpressure storm drainage with the following components:
  - 1. Pipe and fittings.
  - 2. Manholes.
  - 3. Cleanouts.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water (30 kPa). Pipe joints shall be at least silt-tight, unless otherwise indicated.

#### 1.3 SUBMITTALS

- A. Product Data: For the following:
  - 1. Pipe Material including joint material.
- B. Shop Drawings:
  - 1. Manholes: Include plans, elevations, sections, details, frames, and covers.
- C. Field quality-control test reports.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic pipe and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

#### 1.5 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Owner no fewer than three days in advance of proposed interruption of service.



## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

### 2.2 PVC PIPE AND FITTINGS

- A. Large Diameter PVC Gravity Sewer Piping ( $\geq$  18-inch)
  - 1. Pipe and Fittings: ASTM F 679, T-1 wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.
- B. Small Diameter PVC Gravity Sewer Piping ( $\leq$  15-inch)
  - 1. Pipe: ASTM D 3034, SDR 35, PVC gravity sewer pipe with bell-and-spigot ends for gasketed joints.
  - 2. Fittings: ASTM D 3034, PVC with bell ends.
  - 3. Gaskets: ASTM F 477, elastomeric seals.

### 2.3 MANHOLES

- A. Standard Precast Concrete Manholes:
  - 1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
  - 2. Diameter: 48-inches (1200 mm) minimum unless otherwise indicated.
  - 3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
  - 4. Base Section: 6-inch (150 mm) minimum thickness for floor slab and 4-inch (102 mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
  - 5. Riser Sections: 4-inch (102 mm) minimum thickness, and lengths to provide depth indicated.
  - 6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
  - 7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
  - 8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
  - 9. Steps: ASTM A 615/A 615M, deformed, ½-inch (13 mm) steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300 to 400 mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 30 inches (750 mm).
  - 10. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.

11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150 to 225 mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175 to 225 mm) riser with 4-inch- (102 mm-) minimum width flange and 26-inch- (660 mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

## 2.4 CLEANOUTS

A. Plastic Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

## 2.5 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type I/II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4,000 psi (20.7 MPa) minimum, with 0.45 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (420 MPa), deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4,000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
  - a. Invert Slope: 0.2-foot drop through manhole unless otherwise noted.
2. Benches: Concrete, sloped to drain into channel.
  - a. Slope: 4 percent.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

### 3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install gravity-flow, nonpressure drainage piping according to the following:
  - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
  - 2. Install piping with 36-inch (915 mm) minimum cover.
  - 3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

### 3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping according to the following:
  - 1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.

### 3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.
  - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
  - 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
  - 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
  - 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18-by-18-by-12-inches (450 by 450 by 300 mm) deep. Set with tops 1-inch (25 mm) above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

### 3.5 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.

- C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3-inches (76 mm) above finished surface elsewhere unless otherwise indicated.

### 3.6 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

### 3.7 CONNECTIONS

- A. Make connections to existing piping and underground manholes.
  - 1. Make branch connections to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3-inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of manhole or structure wall, encase entering connection in 6-inches (150 mm) of concrete for minimum length of 12-inches (300 mm) to provide additional support of collar from connection to undisturbed ground.
    - a. Use concrete that will attain a minimum 28-day compressive strength of 4,000 psi (27.6 MPa) unless otherwise indicated.
    - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
  - 2. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

### 3.8 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
  - 1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

### 3.9 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24-inches (610 mm) of backfill is in place, and again at completion of Project.
  - 1. Submit separate reports for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Crushed, broken, cracked, or otherwise damaged piping.

- d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  1. Do not enclose, cover, or put into service before inspection and approval.
  2. Test completed piping systems according to authorities having jurisdiction.
  3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
  4. Submit separate report for each test.
  5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
    - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
    - b. Option: Test plastic piping according to ASTM F 1417.
    - c. Option: Test concrete piping according to ASTM C 924 (ASTM C 924M).
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

### 3.10 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

**END OF SECTION 334100**

## SECTION 334600 - SUBDRAINAGE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Drainage conduits.
  - 2. Geotextile filter fabrics.

#### 1.2 SUBMITTALS

- A. Product Data:
  - 1. Drainage conduits, including rated capacities.
  - 2. Geotextile filter fabrics.

### PART 2 - PRODUCTS

#### 2.1 DRAINAGE CONDUITS

- A. Single-Pipe Drainage Conduits: Prefabricated geocomposite with perforated corrugated core molded from HDPE complying with ASTM D 3350 and wrapped in geotextile filter fabric.
  - 1. Nominal Size: 12-inches (305 mm) high by approximately 1-inch (25 mm) thick.
    - a. Minimum In-Plane Flow: 30 gpm (114 L/min.) at hydraulic gradient of 1.0 when tested according to ASTM D 4716.
  - 2. Nominal Size: 18-inches (457 mm) high by approximately 1-inch (25 mm) thick.
    - a. Minimum In-Plane Flow: 45 gpm (170 L/min.) at hydraulic gradient of 1.0 when tested according to ASTM D 4716.
  - 3. Fittings: HDPE with combination NPS 4 and NPS 6 (DN 100 and DN 150) outlet connection.
  - 4. Couplings: Corrugated HDPE band.
  - 5. Filter Fabric: PP geotextile.

#### 2.2 SOIL MATERIALS

- A. Soil materials are specified in Division 31 Section "Earth Moving."

#### 2.3 GEOTEXTILE FILTER FABRICS

- A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4480 to 13 440 L/min. per sq. m) when tested according to ASTM D 4491.
- B. Structure Type: Nonwoven, needle-punched continuous filament.

1. Survivability: AASHTO M 288 Class 2.
2. Styles: Flat and sock.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

### 3.3 FOUNDATION DRAINAGE INSTALLATION

- A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6-inches (150 mm) deep and 12-inches (300 mm) wide.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4-inches (100 mm).
- D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.
- E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.
- F. Add drainage course to width of at least 6-inches (150 mm) on side away from wall and to top of pipe to perform tests.
- G. After satisfactory testing, cover drainage piping to width of at least 6-inches (150 mm) on side away from footing and above top of pipe to within 12-inches (300 mm) of finish grade.
- H. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
- I. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4-inches (100 mm).
- J. Place backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6-inches (150 mm). Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

### 3.4 UNDERSLAB DRAINAGE INSTALLATION

- A. Excavate for underslab drainage system after subgrade material has been compacted but before drainage course has been placed. Include horizontal distance of at least 6-inches (150 mm) between drainage pipe and trench walls. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4-inches (100 mm).
- D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.
- E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for underslab subdrainage.
- F. Add drainage course to width of at least 6-inches (150 mm) on side away from wall and to top of pipe to perform tests.
- G. After satisfactory testing, cover drainage piping with drainage course to elevation of bottom of slab, and compact and wrap top of drainage course with flat-style geotextile filter fabric.

### 3.5 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.
  - 1. Foundation Subdrainage: Install piping level and with a minimum cover of 24-inches (610 mm) unless otherwise indicated.
  - 2. Underslab Subdrainage: Install piping level.
  - 3. Lay perforated pipe with perforations down.
  - 4. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

### 3.6 PIPE JOINT CONSTRUCTION

- A. Join perforated PVC sewer pipe and fittings according to ASTM D 3212 with loose bell-and-spigot, push-on joints.
- B. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.



### 3.7 CLEANOUT INSTALLATION

- A. Comply with requirements for cleanouts specified in Division 33 Section "Storm Utility Drainage Piping."
- B. Cleanouts for Foundation and Retaining Wall Subdrainage:
  - 1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
  - 2. In vehicular-traffic areas, use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18-by-18-by-12-inches (450-by-450-by-300 mm) deep. Set top of cleanout flush with grade.
  - 3. In nonvehicular-traffic areas, use NPS 4 (DN 100) PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12-by-12-by-4-inches (300-by-300-by-100 mm) deep. Set top of cleanout 1-inch (25 mm) above grade.
- C. Cleanouts for Underslab Subdrainage:
  - 1. Install cleanouts and riser extensions from piping to top of slab. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
  - 2. Use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout flush with top of slab.

### 3.8 CONNECTIONS

- A. Comply with requirements for piping specified in Division 33 Section "Storm Utility Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

### 3.9 IDENTIFICATION

- A. Arrange for installation of green warning tapes directly over piping. Comply with requirements for underground warning tapes specified in specified in Division 31 Section "Earth Moving."
  - 1. Install detectable warning tape over nonferrous piping and over edges of underground structures.

### 3.10 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.
  - 2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.
- B. Drain piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.11 CLEANING

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

**END OF SECTION 334600**

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## SECTION 400507 – HANGERS AND SUPPORTS FOR PROCESS PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pipe hangers and supports.
  - 2. Hanger rods.
  - 3. Structural attachments.
  - 4. Pipe guides.
  - 5. Formed steel channel.
  
- B. Related Requirements:
  - 1. Division 03 Section “Cast-in-Place Concrete”.
  - 2. Division 09 Section “High-Performance Coating.
  - 3. Division 33 Section “Water Distribution Piping”.
  - 4. Division 40 Section “Stainless Steel Process Piping”.

#### 1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers:
  - 1. ASME B31.1 – Power Piping.
  - 2. ASME B31.9 – Building Services Piping.
  
- B. ASTM International:
  - 1. ASTM A36 – Standard Specification for Carbon Structural Steel.
  - 2. ASTM A36M – Standard Specification for Carbon Structural Steel.
  - 3. ASTM A47 – Standard Specification for Ferritic Malleable Iron Castings.
  - 4. ASTM A47M – Standard Specification for Ferritic Malleable Iron Castings.
  - 5. ASTM A576 – Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
  - 6. ASTM A181 – Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
  - 7. ASTM A181M – Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
  - 8. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General.
  - 9. ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes.
  - 10. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
  
- C. American Welding Society:
  - 1. AWS D1.1 – Structural Welding Code Steel - Reference Manual.
  
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
  - 1. MSS SP-58 – Pipe Hangers and Supports – Materials, Design, Manufacturer, Selection, Application, and Installation.

### 1.3 COORDINATION

- A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's catalog data including load capacity.
- B. Shop Drawings: Indicate system layout with location – including critical dimensions, sizes, and pipe hanger and support locations – and detail of trapeze hangers, anchors, and guides.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Welders' Certificate: Submit welders' certification of compliance with AWS D1.1, verifying qualification within previous 12 months.
- E. Delegated Design Submittals:
  - 1. Submit signed and sealed Shop Drawings with design calculations and assumptions for load carrying capacity of trapeze, multiple pipe, and riser support hangers.
  - 2. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
  - 3. Submit calculations sealed by a registered professional engineer.
- F. Manufacturers' Instructions: Submit special procedures and assembly of components.
- G. Qualifications Statements:
  - 1. Submit qualifications for manufacturer, fabricator, installer, and licensed professional.
  - 2. Submit manufacturer's approval of installer.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts:
  - 1. Furnish one set of manufacturer's recommended spare parts.
- B. Tools: Furnish special wrenches and other devices required for Owner to maintain.

### 1.6 QUALITY ASSURANCE

- A. Perform Work according to AWS D1.1 for welding hanger and support attachments to building structure.

### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years' experience.

- B. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' experience.
- C. Installer: Company specializing in performing Work of this Section with minimum three years' experience.
- D. Licensed Professional: Professional Engineer experienced in design of specified Work and licensed at Project location.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on-Site in original factory packaging, labeled with manufacturer's identification.
- B. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

#### 1.9 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

#### 1.10 WARRANTY

- A. Furnish five-year manufacturer's warranty for pipe hangers and supports.

### PART 2 - PRODUCTS

#### 2.1 PIPE HANGERS AND SUPPORTS

- A. Available 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:
  1. Piping Technology and Products, Inc..
  2. Anvil International.
  3. Empire Industries, Inc.
- B. Description:
  1. Conform to MSS SP58.
  2. Provide means of vertical adjustment after erection.
  3. Pipe Sizes ½- to 1½-inch (13 to 38 mm): ASTM A240 (A240M), Type 316L, Stainless Steel, adjustable swivel, split ring.
  4. Pipe Sizes 2-inch (50 mm) and Larger: ASTM A240 (A240M), Type 316L, Stainless Steel, adjustable, clevis.
  5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  6. Wall Support for Pipe Sizes 3-inch (76 mm) and Smaller: J-hook.
  7. Wall Support for Pipe Sizes 4-inch (100 mm) and Larger: Welded bracket.

8. Vertical Support: Riser clamp.
  9. Floor Supports: Adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or stainless steel support.
- C. Performance and Design Criteria:
1. Pipe Hangers
    - a. Allow for expansion and contraction of piping while eliminating undue stress on piping appurtenances and equipment.
    - b. Provide linkage to permit lateral or axial movement where anticipated.
    - c. Where horizontal pipe movement is greater than ½-inch (12 mm), or where hanger rod deflection from the vertical is greater than 4° from cold to hot position of pipe, hanger rod and structural attachment shall be offset to maintain rod vertical in hot position.
  2. Riser Supports: Support risers on each floor with riser clamps and lugs, independent of connected horizontal piping.
  3. Point Loads
    - a. Support plastic piping containing meters, valves, appurtenances, and other point loads on both sides.
    - b. Avoid point loads on plastic piping by providing extra wide pipe saddles or galvanized steel shields.

## 2.2 HANGER RODS

- A. Hanger Rods
1. ASTM F593 Grade 316L, stainless steel.
  2. Threaded both ends.
  3. Diameter: ASME B31.1; as indicated on Drawings.

## 2.3 STRUCTURAL ATTACHMENTS

- A. Concrete Inserts
1. Available 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. Hilti, Inc.
    - b. Powers Fasteners.
    - c. Simpson Strong-Tie.
  2. Description:
    - a. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.
    - b. Size inserts to suit threaded hanger rods.
- B. Mounting Brackets: ASTM A240 (A240M), Type 316L, welded stainless steel.
- C. Beam Clamps:
1. Available 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. Piping Technology and Products, Inc..

- b. Anvil International.
- c. Empire Industries, Inc.
- 2. ASTM A240 (A240M), stainless steel; MSS SP-58.
- 3. Clamp Size: Based on load to be supported and load configuration.
- 4. Anchoring: Locknuts and cup-point set screws.
- 5. Reversible top or bottom flange.

D. Riser Clamps:

- 1. Available 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. Piping Technology and Products, Inc.
  - b. Anvil International.
  - c. Empire Industries, Inc.
- 2. ASTM A240 (A240M), Type 316L stainless steel.
- 3. Support of Copper Tubing: Provide copper-plated clamps.

E. Offset Clamps:

- 1. Available 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. Piping Technology and Products, Inc..
  - b. Anvil International.
  - c. Empire Industries, Inc.
- 2. Double leg, two-piece.

## 2.4 FORMED STEEL CHANNEL

- A. Available 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:
  - 1. Unistrut Inc.
  - 2. Thomas and Betts, Kindorf.
  - 3. Power Engineering Co., Inc.
- B. Description:
  - 1. Stainless Steel 12-gage (2.8 mm)-thick steel.
  - 2. Include holes 1½-inch (38 mm) o.c.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify field dimensions as indicated on Drawings.

### 3.2 INSTALLATION

- A. Obtain permission from Engineer before using powder-actuated anchors.



- B. Do not drill or cut structural members without prior written approval from Engineer.
- C. Inserts:
1. Install inserts for placement in concrete forms.
  2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4-inch (100 mm) and larger.
  4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- D. Pipe Hangers and Supports:
1. Install according to: MSS SP 58.
  2. Support horizontal piping as indicated on Drawings.
  3. Install hangers with minimum ½-inch (13 mm) space between finished covering and adjacent Work.
  4. Place hangers within 12-inch (300 mm) of each horizontal elbow.
  5. Use hangers with 1½-inch (38 mm) minimum vertical adjustment.
  6. Support horizontal cast iron pipe adjacent to each hub, with 5-feet (1.5 m) maximum spacing between hangers.
  7. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
  8. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
  9. Support riser piping independently of connected horizontal piping.
  10. Provide sheet lead packing between hanger or support and piping.
  11. Design hangers for pipe movement without disengagement of supported pipe.
  12. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
  13. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
  14. Use beam clamps where piping is to be suspended from building steel.
  15. Insulated Piping: Provide two bolted clamps designed to accommodate insulated piping.
  16. Use offset clamps where pipes are indicated as offset from wall surfaces.
- E. Insulation:
1. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- F. Equipment Bases and Supports:
1. Provide equipment/housekeeping pads as detailed on Drawings.
  2. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.
  3. Construct supports of stainless steel members. Brace and fasten with flanges bolted to structure.
  4. Provide rigid anchors for pipes after vibration isolation components are installed.

**END OF SECTION 400507**

## **SECTION 400523 – STAINLESS STEEL PROCESS PIPE AND TUBING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Stainless-steel pipe and fittings.
  - 2. Accessories.

#### **1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's catalog information on pipe materials, tube materials, and fittings.
- B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials lists.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Welders' Certificate: Submit welders' certification of compliance with AWS D1.1, verifying qualification within previous 12 months.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of valves, fittings, and appurtenances.

#### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- A. Tools: Furnish special wrenches, gages and other devices required for Owner to maintain fittings and appurtenances.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's packaging including handling instructions.
- B. Inspection: Accept piping and appurtenances on-Site. Inspect for damage.
- C. Store piping and appurtenances according to manufacturer's instructions.
- D. Protect piping and appurtenances from oxidation by storing off the ground.

## 1.6 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 STAINLESS-STEEL PIPE AND FITTINGS

- A. General Service Piping:
  - 1. Schedule: Schedule 5S for low-pressure air, Schedule 40S for water, unless indicated otherwise on Drawings.
  - 2. ASTM A312 (A312M) welded.
  - 3. Dimensions: ASME B36.19 (36.19M).
- B. Fittings:
  - 1. General:
    - a. Piping 2-inches (50 mm) and Smaller: Socket-welding type.
    - b. Piping 2½-inches (65 mm) and Larger: Butt-welding type.
    - c. Flanged Connections: As required to connect stainless-steel piping to fittings and equipment.
    - d. Dimensions: ASME B36.19 (36.19M).
  - 2. Threaded Fittings:
    - a. ASME B16.11; ASTM A182 (A182M), Type 316L.
    - b. Threads: ASME B1.20.1 (B1.20.2M).
  - 3. Butt-Welding Fittings:
    - a. ASTM A403 (A403M), Type 316L.
    - b. Class ASME B16.9.
  - 4. Socket-Welding Fittings:
    - a. ASTM A403 (A403M), Type 316L.
    - b. Class ASME B16.11.
  - 5. Flanged Fittings:
    - a. Socket welding.
    - b. Class 150.
    - c. ASTM A182 (A182M); Type 316L.
    - d. Facing and Drilling: ASME B16.5 with a flat face.
    - e. Backing Flanges:
      - 1) Class 150; 316L stainless steel.
      - 2) ASTM A351 (A351M).
      - 3) Van Stone type.
      - 4) Drilling: ASME B16.5.

### 2.2 ACCESSORIES

- A. Polytetrafluoroethylene (PTFE) Pipe-Thread Tape: ASTM D3308.
- B. O-Ring Seals: Ethylene propylene diene monomer (EPDM).

- C. Flange Gaskets:
  - 1. ASME B16.5.
  - 2. Nonmetallic Gaskets: ASME B16.21.
  - 3. Metallic Ring Joint Gaskets: ASME B16.20; constructed of 316L stainless steel.
  - 4. Raised-Face Flanges: Flat ring type.
  - 5. Flat-Face Flanges: Full-face type.
- D. Dielectric Fittings: Provide between dissimilar metals.

### 2.3 SOURCE QUALITY CONTROL

- A. Certificate of Compliance: When fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that field dimensions are as indicated on Drawings.
- B. Inspect existing flanges for nonstandard bolthole configurations or design, and verify that new pipe and flange mate properly.

### 3.2 PREPARATION

- A. Ream pipe ends. Remove burrs. Bevel plain end pipe.
- B. Thoroughly clean pipe and fittings before installation.
- C. Prepare piping connections to equipment with flanges or unions.

### 3.3 INSTALLATION

- A. Run piping straight along alignment indicated on Drawings with minimum number of joints.
- B. Install piping and components according to ASME B31.3.
- C. Fittings:
  - 1. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
  - 2. Install fittings according to manufacturer's instructions.
  - 3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer's recommendations.
- D. Provide required upstream and downstream clearances from devices as indicated.

- E. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.
- F. Support exposed piping as specified in Division 40 Section “Hangers and Supports for Process Piping and Equipment”.
- G. Field Cuts: According to pipe manufacturer's recommendations.
- H. Field welding of stainless steel is permitted.

#### 3.4 FIELD QUALITY CONTROL

- A. Inspect for damage to pipe lining or coating, or other defects that may be detrimental as determined by the Engineer. Repair damaged piping, or provide new, undamaged pipe.
- B. After installation, inspect for required supports and anchoring, interferences, and damage to pipe, fittings, or coatings.

#### 3.5 CLEANING

- A. Keep pipe interior clean as installation progresses.
- B. Clean pipe interior of soil, grit, loose mortar, and other debris after pipe installation.

**END OF SECTION 400523**

## **SECTION 400553 – IDENTIFICATION FOR PROCESS PIPING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Nameplates.
  - 2. Tags.
  - 3. Pipe markers.
  - 4. Labels.
- B. Related Requirements:
  - 1. Division 09 Section “High-Performance Coatings.”

#### **1.2 REFERENCE STANDARDS**

- A. American Society of Mechanical Engineers:
  - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.

#### **1.3 SUBMITTALS**

- A. Product Data: Submit manufacturer's catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color-coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

#### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Stock Materials: Furnish two containers of spray-on adhesive.
- B. Tools: Furnish special crimpers and other devices required for Owner to reinstall tags.

## 1.6 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

## 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

## PART 2 - PRODUCTS

### 2.1 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved black letters on light, contrasting background color.

### 2.2 TAGS

- A. Metal Tags:
  - 1. Description:
    - a. Stainless-steel construction; stamped letters.
    - b. Minimum Tag Size and Configuration: 1½-inches (38 mm); square with finished edges.
- B. Information Tags:
  - 1. Description:
    - a. Clear plastic with printed CAUTION and message.
    - b. Minimum Tag Size: 3¼- by 5-5/8-inch (83 by 143 mm).
    - c. Furnish grommet and self-locking nylon ties.
  - 2. Tag Chart: Typewritten, letter-size list of applied tags and location, plastic laminated.

### 2.3 PIPE MARKERS

- A. Color-Coding and Lettering Size: Conform to ASME A13.1.
- B. Plastic Pipe Markers:
  - 1. Description:
    - a. Factory-fabricated, flexible, semirigid plastic.
    - b. Preformed to fit around pipe or pipe covering.
    - c. Larger sizes may have maximum sheet size with spring fastener.
- C. Plastic Tape Pipe Markers:
  - 1. Description: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- D. Plastic Underground Pipe Markers:
  - 1. Description:

- a. Brightly colored, continuously printed plastic ribbon tape.
- b. Minimum 6-inches (150 mm) wide by 4 mil (0.1 mm) thick.
- c. Manufactured for direct burial service.

2.4 LABELS

- A. Description:
  - 1. Laminated Mylar construction.
  - 2. Minimum Size: 1.9-by-0.75-inches (48 by 19 mm).
  - 3. Adhesive backed, with printed identification.

2.5 PIPING COLOR SCHEDULE

**Piping Color Schedule**

Type of Line	Content of Line	Color of Pipe
Water Line	Filtered	Light Blue
	Finished or Potable Water	Dark Blue
Chemical Lines	Polymer	Red-Orange with Blue Band
Waste Lines	Return Waste Line	Olive with Pink Band
	Sanitary Sewer	Dark Gray
	Storm Drain	Dark Burgundy

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces as specified in Division 09 Section “High Performance Coatings.”

3.2 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.
- C. Labels:
  - 1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
  - 2. For unfinished covering, apply paint primer before applying labels.
- D. Tags:
  - 1. Install tags using corrosion-resistant chain.
  - 2. Number tags consecutively by location.



- E. Install underground plastic pipe markers 6-to 8-inches (150 to 200 mm) below finished grade, directly above buried pipe.
- F. Identify valves in main and branch piping with tags.
- G. Piping:
  - 1. Identify piping, concealed or exposed, with plastic tape pipe markers.
  - 2. Identify service, flow direction, and pressure.
  - 3. Install in clear view and align with axis of piping.
  - 4. Locate identification not to exceed 20-feet (6 m) on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

**END OF SECTION 400553**

## SECTION 400554 – PROCESS VALVES AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 DESCRIPTION OF WORK

- A. The work under this Section includes the furnishing and installing of all valves and related accessories either indicated or necessary for a complete and working installation.
- B. All valves listed under any one of the following general types shall be products of one manufacturer except where valves by two or more manufacturers are specified within a single type. It is not mandatory for units of different types to be of the same manufacturer.
- C. All buried valves and appurtenances shall have a bitumastic coating.

#### 1.2 SUBMITTALS

- A. Product Data:
  - 1. Materials list of items proposed to be provided under this Section.
  - 2. Detailed instructions on installation requirements, including storage and handling procedures, anchoring, and layout.
  - 3. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
- B. Operation and Maintenance Manuals: Submit operation and maintenance manuals in accordance with Division 01 Section "Operation and Maintenance Manual".
- C. Warranty Document: Submit warranty document in Owner's name in accordance with Division 01 Sections.

#### 1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. NSF Compliance: Comply with NSF 61 for materials for potable water service piping and specialties.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves according to the following:
  - 1. Ensure that valves are dry and internally protected against rust and corrosion.
  - 2. Protect valves against damage to threaded ends and flange faces.
  - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves according to the following:
  - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Protect flanges, fittings, and specialties from moisture and dirt.

## PART 2 - PRODUCTS/INSTALLATION

### 2.1 PLUG VALVES

#### A. Standard Plug Valves:

1. Subject to compliance with requirements, acceptable manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. DeZURIK/APCO/Hilton.
  - b. Milliken Valve Company.
  - c. McWane, Inc.; M & H Valve Company Div.
  - d. Pratt, Henry Company.
  - e. Val-Matic Valve & Manufacturing Corp.
2. Description:
  - a. Standard: MSS SP-108.
  - b. Body: Cast iron.
  - c. Pressure Rating: 175 psig (1207-kPa) minimum CWP.
  - d. Seat Material: Suitable for potable-water service.
3. Valves shall be non-lubricated, eccentric plug valves and shall have a cylindrical seating surface eccentrically offset from the center of the shaft. Plug shall not contact the seat prior to 90% closed. Plug facing shall be Chloroprene (CR) or other resilient facing suitable for the application.
4. Valves shall have replaceable stainless steel permanently lubricated upper and lower plug stem bushings.
5. Valves shall be furnished with 95% Nickel Seats which comply with AWWA Standard C507, Section 7 and with AWWA Standard C504, Section 9.
6. Valve shaft seals shall comply with AWWA Standard C507, Section 10 and with AWWA Standard C504, Section 11.
  - a. Area of port opening for all valves larger than 1-inch shall be not less than 80% percent of full pipe area. Where indicated on the Drawings, valves shall be full-port, with port opening not less than 100% of full pipe area.
  - b. Valves with flange ends shall be provided where indicated. Flanges shall be in accordance with ANSI B16.1 except that the four (4) holes straddling the principal axis of the valve may be tapped and connected to the adjacent piping with cap screws of adequate size as recommended by the valve manufacturer and approved by the Engineer.
7. Plug valves shall be provided with means of operation as indicated on the drawings and as specified herein.
  - a. Valves larger than 3-inches that are installed in easily accessible locations, but not including buried or submerged locations shall be gear/hand wheel operated unless otherwise indicated or specified. Plug valves installed in pipelines where the

centerline of the actuator stem is 6 feet or more above the floor shall be chain wheel operated with chain of proper size and length to operate the valve from a standing position below.

8. Extension stems, stem guides, operating levers, and other miscellaneous items required for a complete installation shall be provided in accordance with the requirements and recommendations of the valve manufacturer.
9. Gearing shall be provided where either indicated, specified, or recommended by the valve manufacturer. All gearing shall be provided in enclosed gear cases.

B. Full-Port Plug Valves:

1. Plugs shall be solid one-piece, cast of ASTM A536 ductile iron. The plug shall have a cylindrical seating surface eccentrically offset from the center of the shaft. Plug shall not contact the seat prior to 90% closed. Plug facing shall be Chloroprene (CR) or other resilient facing suitable for the application.
2. Bodies shall be of ASTM A126 Class B cast iron. Port shall be rectangular. Port area shall be 100% of standard class pipe area. Bearings shall be sleeve type and made of sintered, oil-impregnated permanently lubricated type 316 stainless steel per ASTM A743 Grade CF8M.
3. Seats shall be 1/8-inch thick welded overlay of not less than 95% pure nickel. Seat shall be at least 1/2-inch wide and raised. The raised surface shall be completely covered with nickel to ensure that the resilient plug face contacts only the nickel seat.
4. Adjustable packing shall be of the multiple V-ring type, with a packing gland follower. Shaft seals shall permit inspection, adjustment or complete replacement of packing without disturbing any part of the valve or actuator assembly except the packing gland follower.
5. Grit excluders made of PTFE shall be provided to prevent the entry of grit and solids into the bearing areas.
6. Pressure-ratings shall be bi-directional and 175 psi on sizes up to 12-inch and 150 psi for larger valves. Every valve shall be given a certified hydrostatic and seat test, with test reports being available upon request.
7. Worm gear actuators shall be provided on all valves six inches and larger. Actuators shall be enclosed in a cast iron housing, with outboard seals to protect the bearings and other internal components. The actuator shaft and gear quadrant shall be supported on permanently lubricated bronze bearings.
8. Actuators for buried applications shall be 90% grease filled. Input shaft and fasteners shall be stainless steel. Actuator mounting brackets shall be totally enclosed.
9. Eccentric plug valves and actuators shall meet or exceed the latest revision of AWWA C517 and other applicable standards. Flanged ends shall be per ANSI B16.1 and mechanical joint ends per AWWA C111.

## 2.2 BUTTERFLY VALVES

A. 3-inch to 20-inch Butterfly Valves

1. Butterfly valves 3-inch to 20-inch (80 mm – 500 mm) shall meet or exceed the latest revision of AWWA Standard C504 for Class 150B butterfly valves and shall meet or exceed the requirements of this specification.
2. Valve bodies shall be of cast iron per ASTM A126 Class B. Flange end valves shall be of the short body design with 125 pound flanged ends faced and drilled per ANSI B16.1 standard for cast iron flanges. Mechanical Joint end valves shall meet the requirements of AWWA C111/ANSI 21.11.

3. Discs shall be cast iron per ASTM A48 Class 40C. The disc seating edge shall be solid 316 stainless steel. The disc shall be securely attached to the valve shaft utilizing a field removable/replaceable 316 stainless steel torque screw or a tangential pin locked in place with a set screw.
4. Valve shaft shall be type 304 stainless steel. Valve shaft seals shall be self-compensating V-type packing with a minimum of four sealing rings. One-piece molded shaft seals and o-ring shaft seals are not acceptable.
5. The seat shall be of Buna-N for water, EPDM for air, or as required for other services, and shall be molded in and vulcanized to the valve body. The seat shall contain an integral shaft seal protecting the valve bearings and packing from any line debris. Seats vulcanized to cartridge inserts in the valve body and seats on the disc are not acceptable.
6. Valve shaft bearings shall be non-metallic and permanently lubricated.
7. Unless otherwise specified, exterior and interior metallic surfaces of each valve shall be shop painted per the latest revision of AWWA C504.
8. Per AWWA C504, the valve actuator shall be sized to operate the valve at the rated working conditions of the valve. Each valve and valve actuator shall be assembled, adjusted, and tested as a unit per the latest revision of AWWA C504, by the valve manufacturer.
9. Valves 3-inch to 20-inch (80 mm – 500 mm) shall have traveling nut manual actuators designed and tested per the requirements of AWWA C504. Housings shall be cast iron and shall be available in both weatherproof and buriable constructions with handwheel, chainwheel, or 2-inch (50 mm) square AWWA nut inputs. All units shall have adjustable open and closed position stops.

## 2.3 PVC BALL VALVES

### A. Description:

1. Standard: MSS SP-122.
2. Schedule 80
3. Pressure Rating and Temperature: 250 psig at 73°F.
4. Body Material: PVC.
5. Body Design: as shown on Drawings
6. End Connections for Valve: as shown on the Drawings
7. Ball: PVC; full port.
8. Seals: EPDM-rubber O-rings.
9. Handle: Tee shaped, quarter-turn.

## 2.4 AIR SERVICE BALL VALVES

### A. Description:

1. Standard: MSS SP-110.
2. Pressure Rating and Temperature: 150 psig (steam) at 350°F.
3. Body Material: Bronze.
4. Body Design: two piece cast
5. End Connections for Valve: as shown on the Drawings
6. Ball: stainless steel with vent, standard port
7. Seals: TFE
8. Handle: steel lever, quarter-turn.

## 2.5 AIR SERVICE PRESSURE RELIEF VALVES

- A. Description:
  - 1. Standard: ASME Section VIII
  - 2. Pressure Rating and Temperature: 0-60 psig at 400°F.
  - 3. Body Material: Iron.
  - 4. Disc: Bronze
  - 5. Spring: Stainless Steel
  - 6. Brass set screw
  - 7. End Connections for Valve: as shown on the Drawings
  - 8. Ball: stainless steel with vent, standard port
  - 9. Steel lift pin for manual testing/venting
  - 10. Setting: coordinate with manufacturer of protected equipment

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving".

### 3.2 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use corporation valves with ends compatible with piping, for NPS 2 and smaller installation.

### 3.3 VALVE INSTALLATION

- A. AWWA Valves Other Than Gate Valves: Comply with applicable AWWA standard (C600, M44, C508, C517) and manufacturer's instructions.
- B. Install plug valves in horizontal piping with stem horizontal. Install plug valves such that plugs are on top when open and on pressure side when closed (downstream side for pump isolation). Install plug valves in vertical piping with plug at top when closed (seat up).
- C. Corporation Valves: Install each underground corporation valve with head pointed up.

### 3.4 FIELD QUALITY CONTROL

- A. Hydrostatic Tests for Valves
  - 1. Valves shall be field tested as directed by AWWA Specification C500 and C517 as applicable.
    - a. During the last stages of the test and without any reduction in pressure, first the valves will be closed, then progressing in an orderly manner from the end opposite from the test pump, each main line valve will be closed and pressure released to determine if it is holding pressure (minimum 30 minutes).

2. Provide Engineer/Owner a minimum 48 hour notice (2 business days), so they can be present to witness tests.

B. Prepare reports of testing activities.

### 3.5 CLEANING

A. As specified in Division 33 Section “Water Distribution Piping”.

### 3.6 DISINFECTION

A. For potable waterlines only: As specified in Division 33 Section “Water Distribution Piping”.

**END OF SECTION 400554**

## SECTION 400557.23 – ELECTRIC MOTOR ACTUATORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section addresses electric motor actuators for valves and gates, and includes the electric motor, power transmission, position indicator, electronic torque sensor, control module, motor controller, emergency shut down (ESD), actuator control panel and module, handwheel, and declutch lever.

#### 1.2 QUALITY ASSURANCE

- A. Electric Actuators shall be as manufactured by Limatorque, Rotork, or EIM. The basis of this specification is Limatorque. Equals not named above will not be accepted.
- B. All equipment and appurtenances specified in this Section comprise a system and shall be provided by a single manufacturer or supplier who assumes functional responsibility for that system.
- C. Factory Testing
  - 1. Every actuator shall be factory dynamometer tested to verify: rated output torque, output speed, handwheel operation, local control, control power supply, valve jammed function, all customer inputs and outputs, motor current, motor thermistor, LCD and LED operation, direction of rotation, microprocessor checks, and position-sensor checks.
  - 2. A report confirming successful completion of testing shall be included with each actuator.
- D. Technical services: The manufacturer's representative shall provide not less than one (1) half-day (4-hours) of on-site services to confirm proper installation, operation, and performance of the provided equipment. Provide Engineer with representative's written statement of complete and proper installation. If required, follow-up services to correct deficiencies identified during a first visit shall be provided at no additional cost to the Owner.

#### 1.3 SUBMITTALS

- A. Product Data:
  - 1. Materials list of items proposed to be provided under this Section.
  - 2. Electrical characteristics and connection requirements.
  - 3. Detailed instructions on installation requirements, including storage and handling procedures, anchoring, and layout.
  - 4. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
  - 5. Name, address, and contact information of the nearest manufacturer-authorized service provider.
- B. Provide Operation and Maintenance Manuals complying with Division 01 Section "Operation and Maintenance Data".



## 1.4 WARRANTY

- A. Comply with provisions of Division 01 Section “Closeout Procedures”.
- B. Provide two (2) year manufacturer’s warranty.

## PART 2 - PRODUCTS

### 2.1 ELECTRIC MOTORS

- A. The motor shall be induction type labeled as NEMA “Special Purpose” capable to energize on 480V, three-phase, 60-Hertz incoming AC power, or brushless DC motors. Motor shall permit a global range of 3-phase AC voltages to be connected without modification. Single phase motors using capacitors shall not be allowed. Brushed DC motors are not permitted.
- B. The motor must have as a minimum class F insulation and a thermistor embedded within the motor windings to prevent damage due to over-load.
- C. The motor shall be easily removed through the use of a plug-in connector and shaft coupling located in the motor chamber.
- D. The enclosure shall meet NEMA 7 (explosion proof) as required for classified spaces.

### 2.2 POWER TRANSMISSION

- A. The power transmission shall be completely bearing-supported, and consist of a hardened alloy steel worm and alloy worm gear, and spur gear reduction, all immersed in an oil-bath lubricated using a synthetic oil designed specifically for extreme pressure worm and worm gear transmission service.

### 2.3 POSITION INDICATION

- A. Valve position shall be sensed by an absolute position encoder, employing system-on-chip technology using a contactless magnet that excites Hall effect devices to provide redundant, 12-bit resolution over 360°.
- B. Each of the position sensing circuits shall be redundant, permitting up to 50% fault tolerance before the position is incorrectly reported.
- C. B.I.S.T. – A built-in self-test feature shall discern which failures signal a warning only and which require a warning plus safe shutdown of the actuator.
- D. Open and closed positions shall be stored in permanent, nonvolatile memory.
- E. The encoder shall measure valve position at all times, including both motor and handwheel operation, with or without power present, and without the use of a battery.

- F. The absolute encoder will be capable of resolving down to 0.1% of output shaft position over 360°.

#### 2.4 ELECTRONIC TORQUE SENSOR

- A. The torque limit shall be able to be adjusted from 40 to 100% of rating in 1% increments.
- B. The motor shall be deenergized if the torque limit is exceeded.
- C. A boost function shall be included to prevent torque trip during initial valve unseating and during extreme arctic temperature operation (down to -60°C), and a “Jammed Valve” protection feature, with automatic retry sequence, shall be incorporated to de-energize the motor if no movement occurs.
- D. Mechanical springs shall not be used for torque measurement.

#### 2.5 CONTROL MODULE

- A. The control module shall include logic circuit boards mounted to a steel plate and attached in the control compartment with captive screws.
- B. The use of O-rings or other such devices to secure the control boards shall not be permitted.
- C. The module shall be easily removed through the use of plug-in connectors.
- D. All internal wiring shall be flame-resistant, rated 105°C, and UL/CSA listed. Voltage shall be selectable via jumper on the power board and configurable via the main board.

#### 2.6 MOTOR CONTROLLER

- A. The reversing contactor shall be mechanically and electrically interlocked to prevent simultaneous energizing of the open and close coils.
- B. The control module shall also include an auto reversal delay to inhibit high current surges caused by rapid motor reversals.

#### 2.7 PHASE CORRECTION CIRCUIT

- A. A phase correction circuit shall be included to correct motor rotation faults caused by incorrect site wiring. The phase correction circuit shall also detect the loss of a phase. The monitor relay shall trip and a warning shall be signaled.

#### 2.8 MULTI-MODE REMOTE CONTROL

- A. Multi-mode remote control shall be included which permits discrete and analog/digital command signals for open-stop-close control.
- B. The actuator shall respond to the last signal received.

- C. Remote control functions shall be able to be powered by external 24-115v supply or the actuator's internal 24 VDC supply. The voltage values for signal threshold shall be 19.2 VAC/VDC and 5.0 VAC/VDC, respectively.
- D. The internal control supply shall be protected against over current and short circuit faults by a resettable fuse and utilize optical isolation to minimize electromagnetic interference.
- E. Discrete control shall have an isolated common.

## 2.9 MODULATING CONTROL.

- A. Modulating Option: For Modulating applications, a controller that alters valve position in proportion to a 4-20 mA analog command signal shall be included. Positioning shall be accomplished by comparing the command signal to an internal position feedback. The internal feedback shall be of the non-contacting type. An automatic pulsing feature to prevent overshoot at the setpoint shall be included. Proportional bands, deadband, signal polarity, motion inhibits time, and fail position shall be adjustable through the LCD. Deadband shall be adjustable to 0.5% of full span.
- B. Analog Position transmitter [APT]: A non-contacting, internally powered, electrically isolated position transmitter shall be included to provide a 4-20mA signal that is proportional to valve position.

## 2.10 EMERGENCY SHUT DOWN (ESD)

- A. The actuator shall permit up to three inputs for ESD and they shall be configurable.
- B. The ESD signal shall override any existing signal (except LOCAL, STOP, and INHIBIT) and send the valve to its configured emergency position. The ESD may also be configured to override LOCAL, STOP, and/or INHIBIT.
- C. Provision for an isolated common shall also be provided.

## 2.11 INHIBIT MOVEMENT PROVISION

- A. The actuator shall permit up to three inputs for Inhibits and they shall be configurable.
- B. Provision for an isolated common shall also be provided.

## 2.12 TERMINALS

- A. Terminals shall be included for an external UPS to connect the electronic controls package, including display, to a backup 24 VDC power source.
- B. The actuator shall have the ability to maintain the status and alarm contacts in order to update status remotely and also provide status visibility on the LCD screen without main power applied.

## 2.13 DEDICATED CIRCUIT

- A. A dedicated circuit to prevent undesired valve operation in the event of an internal circuit fault or erratic command signal shall be included.
- B. A single point failure shall not result in erratic actuator movement.
- C. An open or short circuit in the internal circuit board logic shall not energize nor de-energize the motor controller.
- D. The command inputs shall be optically coupled and require a pulse width from at least 250 ms to 350 ms to turn on or off.
- E. In the event of an internal circuit fault, an alarm shall be signaled by tripping the Monitor Relay and through LCD indication.

## 2.14 FOUR LATCHED STATUS CONTACTS

- A. Four latched status contacts rated 125 VAC, 0.5 A and 30 VDC, 2 A shall be provided for remote indication of valve position, configured as 1-N/O and 1-N/C for both the open and closed positions.
- B. Two contacts shall be able to be configured to represent any other actuator status; mid-travel position, switched to local, overtorque, motor over temperature, manual operation, switched to remote, switched to stop, valve moving, close torque switch, open torque switch, hardware failure, ESD active, inhibits active, valve jammed, analog IP (input) lost, lost phase, and network controlled. The other two will be complementary.

## 2.15 MONITOR RELAY

- A. A monitor relay shall be included and shall trip when the actuator is not available for remote operation.
- B. Both N/O and N/C contacts shall be included, rated 125 VAC, 0.5 A and 30 VDC, 2 A.
- C. The monitor relay shall be configurable for three additional fault indications: lost phase, valve jammed, and motor over temperature.
- D. The monitor relay configuration shall provide provision to be disabled.

## 2.16 ACTUATOR CONTROL PANEL (ACP) COVER AND MODULE

- A. The ACP cover and module shall use solid-state Hall-effect devices for local communication and configuration.
- B. The use of reed switches on the module is prohibited.
- C. An LCD display shall be included to indicate valve position and current actuator status.

- D. If the actuator is not operable, the appropriate alarm shall be displayed. The alarm shall be continuously displayed until the actuator is operable.
- E. Red, green, and yellow LEDs shall be included for open, close, stopped, and moving indication. The Red and Green LEDs shall be reversible.
- F. A padlockable LOCAL-STOP-REMOTE switch and an OPEN- CLOSE switch shall be included for local valve actuator control.
- G. The control switches shall not penetrate the controls cover and shall be designed to electrically isolate the actuator's internal components from the external environment.
- H. The OPEN-CLOSE switch may be configured for maintained or push-to-run (inching) control.

#### 2.17 NON-INTRUSIVE DEVICE

- A. All calibration/configuration and product software updates shall be accomplished without removing any covers.
- B. All calibration shall be performed in clear English text languages; no icons or setting tools shall be required.
- C. All calibration shall be performed by answering the "YES" and "NO" questions displayed on the LCD. "YES" is signaled by using the OPEN switch and "NO" by using the CLOSE switch, as indicated adjacent to the switches.
- D. A configurable password option shall be available to prevent unauthorized changes.

#### 2.18 DOUBLE SEALED TERMINAL COMPARTMENT AND TERMINAL BLOCK

- A. All external connections shall be located in a terminal chamber that is separately O-ring sealed from all other actuator components, gasket or foam seals shall not be allowed.
- B. Site wiring shall not expose actuator components to the environment.
- C. The internal sealing within the terminal chamber shall be suitable for NEMA 4, 6, and IP66.
- D. The terminal block shall include screw-type terminals, three for power and 54 for control, for site connections. It shall have provisions for the addition of a safety shield to be attached over the incoming power terminals. The use of plug-in connectors is prohibited.

#### 2.19 FOUR CONDUIT ENTRIES

- A. Available as: (1) -1.25-inch NPT (M32) and (3) -1.0-inch NPT shall be located in the terminal chamber.

## 2.20 COATINGS

- A. The actuator shall be coated with a polymer powder coat. The coating system shall be suitable for an ASTM B117 salt spray test of 1500 hours.
- B. External fasteners shall be stainless steel. The fasteners shall be suitable for an ASTM B117 salt spray test of 500 hours.

## 2.21 HANDWHEEL AND DECLUTCH LEVER

- A. A handwheel and declutch lever shall be provided for manual operation. The handwheel shall not rotate during electric operation nor shall a seized motor prevent manual operation.
- B. Changing from motor to manual operation shall be accomplished by engaging the declutch lever. Energizing the motor shall return the actuator to motor operation.
- C. The lever shall be padlockable to permit motor operation only.

## 2.22 TORQUE BUSHING

- A. The actuator shall include a removable torque bushing to mate with the valve shaft.

## 2.23 DIAGNOSTIC FACILITIES

- A. Diagnostic facilities shall be included to accumulate and report the performance of the motor, encoder, contactor, cycle time, handwheel operations, actuator ID, firmware revision, and output turns. In addition, a torque profile of the reference baseline valve stroke and the last valve stroke shall be included. A feature for reset shall be provided.
- B. All diagnostic information shall be displayed on the LCD.
- C. Diagnostics shall also include a Frequency Domain Analysis (FDA) feature. The FDA methodology shall capture torque, position or speed values at regular time intervals while the actuator is motoring, and calculate the resulting data set with a Fast Fourier Transform (FFT). The resulting information shall be used to isolate any components in the mechanical drive train that may exhibit excessive wear or may affect normal actuator operation.
- D. The actuator shall contain the ability for diagnostics information to be downloaded to a PC or PDA via both IRDA and Bluetooth ports in the actuator.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply fully with manufacturer's installation instructions. Test and adjust accordingly.

## **END OF SECTION 400557.23**

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## SECTION 407113 – MAGNETIC FLOW METERS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The Contractor shall furnish, test, install and place in satisfactory operation the magnetic flow meters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

#### 1.2 SUBMITTALS

- A. Comply with pertinent provisions of Division 01 Section “Submittal Procedures”.
- B. Product data: Within 60 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
  - 1. Materials list of items proposed to be provided under this Section.
  - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
  - 3. Name, address, and contact information of the nearest manufacturer-authorized service provider.
- C. Provide Operation and Maintenance Manuals complying with Division 01 Section “Operation and Maintenance Data”.

#### 1.3 QUALITY ASSURANCE

- A. Ensure that materials of construction of wetted parts are compatible with process liquid.
- B. Technical services: The manufacturer’s representative shall provide not less than one (1) 8-hour day of on-site services to confirm proper installation and operation of the provided equipment. Provide Engineer with representative’s written statement of complete and proper installation. If required, follow-up services to correct deficiencies identified during a first visit shall be provided at no additional cost to the Owner.
- C. Sensors/transmitters shall be as manufactured by Rosemount, Endress+Hauser, or Engineer-approved equal. The basis of this specification is Rosemont Model 8750W. To be considered as an “Equal”, other products must meet all the requirements of this Section, and must be approved in writing by the Engineer. Products not meeting all of the requirements of this Section will not be approved.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.



- B. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## 1.5 WARRANTY

- A. Furnish two (2)-year manufacturer's warranty for magnetic flow meters.

## PART 2 - PRODUCTS

### 2.1 MAGNETIC FLOW METER SYSTEMS

- A. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. Magnetic flow meters shall utilize the characterized field principle of electromagnetic induction, and shall produce DC signals directly proportional to the liquid flow rate.
- B. Each meter shall be furnished with a stainless steel or carbon steel metering tube and carbon steel flanges with a polyurethane, ceramic, neoprene, or Teflon liner as required by the application and/or as specified herein. Liner shall have a minimum thickness of 0.125-inches. The inside diameter of the liner shall be within 0.125-inches of the inside diameter of the adjoining pipe. Liner protectors shall be provided on all flow tubes.
- C. The flow tube shall be provided with flush mounted electrodes. Ultrasonic electrode cleaning shall not be acceptable.
- D. Grounding rings shall be provided for all meters.
- E. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer.
- F. Flow tube shall be rated for pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -30 to +65°C. Meter and transmitter housings shall meet NEMA 4X requirements as a minimum. When meter and transmitter are located in classified explosion hazard areas, the meter and transmitter housings shall be selected with rating to meet the appropriate requirements for use in those areas. Non-metallic transmitter housings shall not be acceptable.
- G. The transmitter shall provide pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self-diagnostic routines and report errors via English language messages.

- H. The transmitter's preamplifier input impedance shall be a minimum of 10<sup>9</sup>-10<sup>11</sup> ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.
- I. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external contact operation.
- J. Each flow tube shall be factory calibrated and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes.
- K. The transmitter shall be capable of communicating digitally with a remote configuration device via a frequency-shift-keyed, high frequency signal superimposed on the 4-20 mA output signal. The remote configuration device shall be capable of being placed anywhere in the 4-20 mA output loop. A security lockout feature shall be provided to prevent unauthorized modification of configuration parameters.
- L. Accuracy shall be 0.50% of rate over the flow velocity range of 1 ft/sec to 30 ft/sec. Repeatability shall be 0.1% of rate; minimum turndown shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 1-second and 100-seconds as a minimum. Transmitter ambient temperature operating limits shall be -10 to +50°C. Power supply shall be 120 VAC, 60 Hz.
- M. The transmitter shall be furnished with licensed option for continuous flow meter and system verification and shall be activated as required by the specification or instruments list. The meter verification function shall be internal to the transmitter continuously comparing the transmitters current signature values with those set to establish a baseline and will provide an alert should meter determine it is operating outside configurable limits.
- N. Flow tubes shall be 150-lb carbon steel flange mounted unless otherwise noted. The cables for interconnecting the meter and transmitter shall be furnished by the manufacturer. Transmitter shall be mounted integrally on flow tube, wall, or 2-inch pipe mounted as shown in the Drawings and/or as specified.

## PART 3 - EXECUTION

### 3.1 REQUIREMENTS

- A. Ground magnetic flow meter flow tubes and grounding rings in strict accordance with the manufacturer's recommendations.

## END OF SECTION 407113

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## **SECTION 407213 - ULTRASONIC LEVEL METERS (CONTINUOUS AND POINT TYPE)**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Ultrasonic-level measurement devices.
  - 2. Transmitters.
- B. Related Requirements:
  - 1. Division 26 Section "Wiring Devices".

#### **1.2 REFERENCE STANDARDS**

- A. National Electrical Manufacturers Association:
  - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. NSF International:
  - 1. NSF 61 - Drinking Water System Components - Health Effects.
  - 2. NSF 372 - Drinking Water System Components - Lead Content.

#### **1.3 COORDINATION**

- A. Coordinate Work of this Section with tank work.

#### **1.4 SUBMITTALS**

- A. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.
- B. Shop Drawings:
  - 1. Indicate system materials and component equipment.
  - 2. Submit installation requirements and other details.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

- G. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

#### 1.6 QUALITY ASSURANCE

- A. Ensure that materials of construction of wetted parts are compatible with process liquid.
- B. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.
- C. Maintain one copy of each standard affecting Work of this Section on Site.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

#### 1.9 WARRANTY

- A. Furnish five year manufacturer's warranty for ultrasonic-level measurement devices.

### PART 2 - PRODUCTS

#### 2.1 ULTRASONIC-LEVEL MEASUREMENT DEVICES

- A. Description:
  - 1. Measuring Range: Up to 35 feet.
  - 2. Operating Temperature Range: Minus 40°F to plus 170°F.

- B. Operation: Menu guided.
- C. Transmitters:
  1. Selected by sensor manufacturer to match sensor.
  2. Visual Display: Four digit.
  3. Output Signal: 4- to 20-mA dc.
  4. Location: As indicated on Drawings.
  5. Control Power:
    - a. Wiring: As specified in Division 26 Section "Wiring Devices".
    - b. 120-V ac, single phase, 60 Hz.
    - c. Furnish local transformers as required.
  6. Enclosures: NEMA 250 Type 4X.
  7. Mounting:
    - a. Integral with sensor.
    - b. Pipe.
  8. Furnish cable, field preamplifiers, and signal conditioners as required to maintain accuracy from sensor to terminal device.

## 2.2 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of completed assembly.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

### 3.2 INSTALLATION

- A. Coordinate location and orientation of level probe assemblies with final equipment installations.
- B. Ensure that instruments are located to be easily accessible for maintenance.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than one day on Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.
- B. Equipment Acceptance:
  1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
  2. Make final adjustments to equipment under direction of manufacturer's representative.

- C. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

#### 3.4 DEMONSTRATION

- A. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

**END OF SECTION 407213**

## SECTION 412100 – SHAFTED SCREW CONVEYORS

### PART 1 - GENERAL

#### 1.1. WORK OF THIS SECTION

- A. The Contractor shall furnish, install, and place in satisfactory operation shaftless screw conveyors complete with all supports, spare parts, accessories and appurtenances as specified herein, show on the Drawings, and as required for a complete and operable system.
- B. All necessary safety equipment and guards to meet OSHA requirements shall be provided.
- C. The Contractor shall be responsible for coordinating the placement all supports necessary to tie the equipment together and shall have the undivided responsibility for the system's structural integrity.

#### 1.2. REFERENCES

- A. The following is a list of standards which may be referenced in this section:
  - 1. American Society for Testing and Materials (ASTM)
  - 2. National Electrical Manufacturers Association (NEMA)
  - 3. American Gear Manufacturers Association (AGMA)
  - 4. American Welding Society (AWS)
  - 5. Conveyor Equipment Manufacturers Association (CEMA)

#### 1.3. SUBMITTALS

- A. Submit for approval the following:
  - 1. Drive details, including calculations and procedures used for selection of drive components, service factor of gear reducer based on absorbed horsepower and installed motor horsepower.
  - 2. Manufacturer's literature, illustrations, specifications, and engineering data including total weight of each unit, structural loads at supports, connection details, and performance data.
  - 3. Drawings shall show dimensions, overall arrangement of equipment and materials of construction.
  - 4. Control diagrams and panel layout.
- B. Operations and Maintenance Manuals: Submit operation and maintenance manuals in accordance with Division 01 Section "Operation and Maintenance Manual".

#### 1.4. PERFORMANCE AND DESIGN REQUIREMENTS

- A. Shaftless Screw Conveyor
  - 1. Number of units: 1
  - 2. Designation: CON1
  - 3. Operating schedule: Continuous duty
  - 4. Design handling capacity: 150 cu ft/hr



5. Maximum incline: 21 degrees
6. Length of trough/screw: 40-feet
7. Minimum screw diameter: 12-inches
8. Material density: 60 lb/cu ft
9. Percent solids: 15% – 20% solids by dry weight
10. Maximum screw rotation speed: 20 rpm
11. Minimum drive horsepower: 5.0 hp
12. Trough bottom drain size: 4-inch
13. Spray washwater connection: ¾-inch

## 1.1 SUBSTITUTIONS

- A. Manufacturers and products other than those listed herein or added by Addendum during the bidding process must meet EVERY provision of this specification Section except those expressly attributed herein to a particular manufacturer or product. Such Substitutions not meeting EVERY provision will be rejected without further consideration, and Contractor shall thereafter promptly submit one of the named products.
- B. Engineer will consider other Substitutions ONLY if a complete PRE-QUALIFICATION PACKAGE is received at the office of the Engineer at least twenty (20) days prior to the bid. Any such package must contain as a minimum:
  1. Detailed layout drawings
  2. Welder certifications
  3. Evidence of a recognized ongoing quality assurance program.
  4. Detailed component specifications and catalog cuts as required.
  5. Detailed list of ALL VARIATIONS required from the original design, referencing appropriate sections of the specifications and locations on the drawings.
    - a. Copy of Contract Drawings, illustrating all such variations
    - b. Copy of this Specification Section, highlighting and detailing all such variations
  6. Full installation list of proposed equipment including six (6) user references.
  7. Bidder's certification that Bidder shall bear all costs associated with any redesign required for use of the Substitution.
- C. Qualifying Substitutions will be recognized by Addendum a minimum of (7) days prior to the bid.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. The equipment shall be manufactured by one supplier.
- B. The equipment shall be the product of a manufacturer engaged in the design and manufacture of similar equipment in successful operation in similar applications. The manufacturer shall have a minimum of 10 years of United States municipal wastewater experience with 10 installations of the same type of equipment as specified herein with documented successful operation.

- C. Equipment shall be manufactured in the USA.

## 2.2 GENERAL

- A. All parts furnished shall be amply designed and constructed for the maximum stresses occurring during fabrication, transportation, erection and continuous operation. All materials for the conveyors shall be new and shall be of the very best quality, entirely suitable for the service to which the units are to be subjected and shall conform to all applicable sections of these specifications.
- B. The screw conveyor equipment shall be factory pre-assembled, factory pre-wired, and factory tested to the greatest extent practical.

## 2.3 EQUIPMENT

### A. Spiral Flighting

1. Spiral shall be manufactured from chromium nickel alloy steel with a brinell hardness of 250 and maximum yield strength of 80,000 psi.
2. Spiral flighting shall be designed to convey material without a center shaft.
3. The spiral flights shall be designed with the stability to prevent distortion and jumping in the trough. The torsional rating of the spiral shall be such that, at 150% of the motor nameplate horsepower, the drive unit cannot produce more torque than the torsional rating of the flighting. Spiral flights shall be 1-inch thick x 3-inches wide. Sectional flighting, formed from plate, shall not be permitted. Dual ribbon spirals may be provided when recommended by the manufacturer.
4. Connect spiral flighting to drive shaft by welding spirals to minimum  $\frac{3}{4}$ -inch circular torque plate reinforced with curved gusset plate for 180°. Drive shaft shall have a mating flange for bolting to the spiral flighting.
5. A gland packing ring consisting of two Teflon fiber packing rings shall seal the drive shaft at its penetration through the end plate, along with a greased labyrinth sealing system.
6. Compression and/or elongation: Less than 0.08-inch per 1-foot at maximum loading
7. Edges: Smooth in the as-rolled condition
8. Spirals shall be manufactured in a two-stage process. Single stage forming of diameter and pitch is not acceptable. Manufacturer shall certify the two-stage forming process, and this certification shall be included in the submittal information. Such two stages shall first consist of tightly cold rolling at zero pitch on a mandrel which uses a device to control the plastic flow of the spiral during forming and maintain a uniform outside and inside diameter thickness with no neck-down. The second stage of spiral forming shall consist of pulling the closely wound spiral in tension to the specified pitch in a device permitting free spiral rotation.

### B. Troughs

1. Trough shall conform to CEMA Standards and be manufactured from T-304 stainless steel.

2. Troughs shall have formed top flanges.
3. Minimum trough thickness: 3/16-inch
4. A neoprene or rubber gasket shall be provided at each trough flange and between trough top and covers.
5. 12 gage covers shall be provided over the top of trough to enclose unit.
6. CEMA standard trough end plates shall be provided with a split gland packing ring consisting of two (2) Teflon coated packing rings shall seal the drive shaft at its penetration through the end plate.
7. UHMW-PE Liner: Minimum 3/8-inch thick, in 4-foot long sections, and held in place with T-304 stainless steel clamping bars that utilize neoprene compression pads and T-304 stainless steel bolts. Bolting or bolt holes thru the liner are not acceptable; liner retainer method must allow for differential expansion of the UHMW liner and the steel trough.
8. Stiffeners shall be placed across the top of the trough and fastened to both sides of the trough to maintain trough shape.
9. Drain: 3-inches from driven-end trough flange, bottom mounted, and welded perpendicular to the trough.
10. Each trough shall be equipped with filling and/or discharge spouts at the location shown on the drawings. If required, each filling and discharge spout shall be flanged suitable for interconnection to other devices.

#### D. Supports

1. Provide supports suitable for mounting as shown on the drawings and as required by supplier's design. The supports shall be capable of supporting the equipment weight when fully loaded. The supports shall be fabricated from structural steel shapes and plates. Supports shall be match marked and shipped to the job site for installation in the field.
2. At a minimum, each conveyor shall be provided with supports at the inlet and discharge end, with intermediate supports at 10'-0" on center.
3. Provide baseplates at each support leg for anchor bolting
4. Height of support legs as indicated on Drawings
5. The supports shall be designed to avoid interference with other equipment or equipment supports.
6. Supports shall be manufactured from carbon steel and hot dipped galvanized after fabrication.
7. All structural supporting members shall be designed such that the ratio of the unbraced length to least radius of gyration (slenderness ratio) shall not exceed 120 for any compression member and shall not exceed 240 for any tension member. In addition, all structural members and connections shall be designed so that the unit stresses will not exceed the American Institute of Steel Construction allowable stresses by more than 1/3 when subject to loading of twice the maximum design operating torque of the spiral conveyor drive motors.

#### E. Drive System

1. Drive assembly shall consist of an integral gearmotor, mounted directly to the screw shaft. Gear housing shall be cast iron, furnishing complete protection under all conditions of service. Gears shall be manufactured and rated for continuous duty in accordance with AGMA Standards, of heat-treated alloy steel. Provide splash type gear lubrication. Gear reducer shall be Class II speed reducer as manufactured by Eurodrive.
2. The gear reducer and drive shall be designed to provide an applied torque adequate to start a full loaded conveyor.

3. Drive shall have an AGMA service factor of 1.4 and shall operate on 460V/3 phase/60 Hz power. Motors provided with a 1.15 service factor.
4. The drive system shall be provided with an instantaneous trip current relay for torque overload protection. The relay shall be provided with a time delay (adjustable) to short the relay on start-up and initial motor amp draw.
5. In the event of a prolonged power failure or emergency system shutdown, the drive system shall be designed, at a minimum, to start the conveyor from a dead stop with the trough filled at 2 times the design load.
6. Gearboxes and motors shall be factory-assembled on the conveyor, factory-tested and shipped fully assembled with the conveyors.

F. Safety Devices

1. Each conveyor shall be furnished with a pull cord emergency stop switch. The cord shall run the full length of each conveyor. The trip switch shall immediately stop all conveyors when the switch is actuated. This device shall be in NEMA 4 enclosure.
2. A zero speed switch shall be provided. The switch shall be housed in a NEMA 4 enclosure, mounted on the side of the conveyor U-trough with a stainless steel bracket. The switch shall be a Milltronics ZSS or equal.

G. Hardware

1. All fasteners shall be hot dip galvanized or stainless steel. Zinc plated fasteners shall not be used.
2. All stainless steel bolts shall be assembled using an anti-seize compound.
3. All structural bolts shall be A-325, hot-dip galvanized.

H. Fabrication

1. All parts and components shall be factory-assembled in sections convenient for field handling and installation but requiring the minimum amount of work for field assembly. No cutting or welding should be required on either field assembly or erection.
2. Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.
3. All assembled parts and components ready for shipment shall be securely bundled, coiled, or crated and adequately protected from damage and corrosion during shipment and storage.

I. Surface Preparation

1. Fabricated carbon steel components shall be shop blasted & hot dipped galvanized.
2. Drive unit shall include manufacturer's standard wash down duty paint system.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. The screw conveyor shall be installed in accordance with the manufacturer's written recommendations.

### 3.2 WARRANTY

- A. The supplier shall guarantee in writing that the equipment furnished is appropriate for the intended service and shall be free of manufacturing and fabrication defects in material and workmanship for a period of 1 year after the equipment is satisfactorily placed in service. If the equipment is not placed in service within 6 months of delivery, the 1 year guarantee period shall commence 6 months after delivery.

### 3.3 MANUFACTURER'S SERVICES

- A. Manufacturer's Field Services: The Contractor shall provide the following services in addition to any other services specified herein, and required by these Specifications.
  - 1. A factory trained manufacturer's representative shall be provided for a minimum of two (2) trips and a minimum of three (3) eight hour days to provide installation supervision, start-up and field testing services, and O&M training services. The installation services shall be coordinated between the Contractor and the manufacturer. The start-up and field testing services, and the O&M services shall be coordinated with the Engineer.
  - 2. After installation supervision and field testing services by the manufacturer, the 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 per the manufacturer's recommendations.
  - 3. The manufacturer shall provide operator training to all required plant personnel.
- B. All costs, including travel, lodging, meals and incidentals for manufacturer service shall be included in the Contractor's bid

**END OF SECTION 412100**

## SECTION 467010 – CONTAINER HANDLING SYSTEM

### PART 1 - GENERAL

#### 1.1 ACCEPTABLE MANUFACTURERS

- A. The basis of this Specification is the Dumpster-Veyor as manufactured by D. R. Cordell & Associates, Inc., Chalfont, PA 18914, (215) 822-9345, www.cordellmfg.com. Equipment of other manufacturers shall be required to meet all requirements of this Section in order to be considered equals.
- B. The container handling system is designed to provide the operator a means to evenly distribute material into a roll-off container being deposited from a conveyor or chute. The system has a rated capacity of 10 tons.
- C. The components of the container handling system include two (2) runs of runway track with anchors, two (2) drive tracks, one (1) idler articulating carriers, one (1) drive articulating carrier, one (1) positive control dual directional closed loop drive system with controls and one (1) return sheave.

#### 1.2 SUBSTITUTIONS

- A. Manufacturers and products other than those listed herein or added by Addendum during the bidding process must meet EVERY provision of this specification Section except those expressly attributed herein to a particular manufacturer or product. Such Substitutions not meeting EVERY provision will be rejected without further consideration, and Contractor shall thereafter promptly submit one of the named products.
- B. Engineer will consider other Substitutions ONLY if a complete PRE-QUALIFICATION PACKAGE is received at the office of the Engineer at least twenty (20) days prior to the bid. Any such package must contain as a minimum:
  - 1. Detailed layout drawings
  - 2. Welder certifications
  - 3. Evidence of a recognized ongoing quality assurance program.
  - 4. Detailed component specifications and catalog cuts as required.
  - 5. Detailed list of ALL VARIATIONS required from the original design, referencing appropriate sections of the specifications and locations on the drawings.
    - a. Copy of Contract Drawings, illustrating all such variations
    - b. Copy of this Specification Section, highlighting and detailing all such variations
  - 6. Full installation list of proposed equipment including six (6) user references.
  - 7. Bidder's certification that Bidder shall bear all costs associated with any redesign required for use of the Substitution.
- C. Qualifying Substitutions will be recognized by Addendum a minimum of (7) days prior to the bid.

## PART 2 - PRODUCTS

### 2.1 COMPONENTS

#### A. Runway and Drive Tracks

1. The runway track shall be manufactured using 304 stainless steel and be a built-up fabricated section, providing a track system on which the drive and idler carts operate. Tracks shall be positioned under a discharge point so that the track extends in either direction from the discharge point as shown on the drawings. Track length shall be as indicated on the drawings spaced at approximately 7'-6".
2. Track joints are spliced using a lap joint. Ends of adjoining tracks manufactured to allow the square bar to overlap the base plate. Track ends are shop fabricated to permit smooth transition from track section to track section during carrier travel. No field welding at track joints is required. The base plate is drilled at regular intervals for mounting to a flat concrete surface using expandable anchors or an epoxy anchor system.
3. The drive track shall be manufactured using a UHMW guide channel bolted directly to the concrete floor. The guide channel is drilled at regular intervals for mounting to a flat concrete surface using an expandable anchoring system or the epoxy system. Two tracks running from the drive winch to the idler sheave are required spaced at approximately 9-inches apart. The drive chain rides in the guide channel.

#### B. Idler Carriers

1. One (1) low profile, heavy duty painted steel idler carrier having a capacity of 10 tons, and a nominal plan size of 8'-3" by 2'-8" shall be provided for the container handling system. The idler carrier shall be assembled to prevent skewing and racking and to accurately accept the articulating wheel assemblies.
2. The carriers shall be drilled to ensure articulating axle alignment. The axles shall be held in place by retainer plates which are easily removable to allow component inspection. Dual wheel stops shall be provided to prevent wheel overload and container roll off when traveling. Stops shall be factory welded and located to clear any obstruction on the underside of the container.
3. The idler carrier shall be equipped with eight (8) double flanged, 304 stainless steel wheels assembled into articulating trolley assemblies. Articulating trolley assemblies are designed to maintain equal wheel loading at all times during carrier travel. Wheels shall interface with the runway track to allow easy tracking and eliminate binding during travel.

#### C. Drive Carrier

1. One (1) low profile, heavy duty painted steel drive carrier having a capacity of 10 tons and a nominal plan size of 8'-3" by 2'-8" shall be provided for the container handling system. The unit shall be assembled to prevent skewing and racking and to accurately accept the articulating wheel assemblies.
2. The carriers shall be drilled to ensure articulating axle alignment. The axles shall be held in place by retainer plates which are easily removable to allow component inspection. Dual wheel stops shall be provided to prevent wheel overload and container roll off when traveling. Stops shall be factory welded and located to clear any obstructions on the underside of the container.
3. Center portion of the drive carrier shall be equipped with steel welded lugs for connection of drive chain and swiveling clevis connectors.

4. The drive carrier shall be equipped with eight (8) double flanged, 304 stainless steel wheels assembled into articulating trolley assemblies. Articulating trolley assemblies are designed to maintain equal wheel loading at all times during carrier travel. Wheels shall interface with the runway track to allow easy tracking and eliminate binding during travel.

D. Articulating Trolley Assemblies

1. Each articulating trolley assembly shall consist of 304 stainless steel top pivoting shaft, two (2) 304 stainless steel heavy-duty side plates, two (2) 304 stainless steel double flanged wheels with stainless steel sealed bearings and two (2) 304 stainless steel wheel axles. The top pivoting shaft shall secure the assembly in place on the carrier frame and allow articulating motion for equal wheel loading.
2. Wheels shall be double flanged, 5-inch tread diameter for operation of 1½-inch bar track, with sealed roller bearings. Wheels to be manufactured from 304 stainless steel. Wheels are to be mounted on the free-floating axles and mounted in the heavy-duty side plates. All components are easily removable for inspection and replacement if required.

E. Closed Loop Winch

1. A single speed, base mounted, positive control, dual directional electric motor driven carrier puller shall be furnished with the drive carrier. The puller shall operate at a speed to move the container at approximately 18 FPM unless otherwise indicated.
2. The puller base frame shall be a fabricated steel weldment designed for easy access to motor, gearbox and drive wheel.
3. The electric motor shall be single speed, 30 min duty rated with high starting torque characteristics. Motor shall be C-Face mounted design with minimum class B insulation. Enclosure shall be NEMA 7.
4. The gearbox shall be cycloidal type design providing high reduction with minimal space requirements. Cycloidal drive shall be Sumitomo, with grease lubrication. Bearings shall be rated for 5000 hours, L-10 bearing life.
5. A Zinc plated steel chain seated in a type 304 stainless steel pocket wheel mounted to the output shaft on the cycloidal gearbox shall connect to the idler sheave, also having a 304 stainless steel pocket wheel. The drive sheave and idler sheave shall be mounted in the horizontal plane for a low-profile configuration. Drive chain shall run in UHMW guide channel described previously in this specification.
6. The electric motor shall be TENV 30 min. duty rating, 2 HP, single speed with high starting torque characteristics. Motor shall be C-face mounted design with minimum class B insulation. Motor shall operate on 460 volts, 3 phase, 60 hertz, and control voltage to be reduced to 120 volt single phase.
7. Two magnetically operated travel limit switches shall be provided to stop carrier movement at extreme ends of the track. Steel lugs are welded to the drive and idler carriers. The steel lugs trip magnetically activated proximity switches, one mounted at each end of the track length.

F. Return Idler Sheave

1. The return idler sheave shall be mounted horizontally inside a heavy duty steel weldment designed for low profile and able to withstand truck traffic. Idler sheave is a stainless steel pocket wheel operating on roller bearings. The heavy-duty steel housing includes holes for mounting the unit to concrete floors.



## 2.2 INSTRUMENTATION AND CONTROL SYSTEM

- A. The container handling system manufacturer shall design, furnish and shop wall mounted control station for control of system movement. Controls shall include a 3 phase power circuit controlled by a single-phase control circuit with step down transformer. The control system shall be designed to handle the expected duty cycle of the container handling system. Power supply is 460 volts 3 phase 60 hertz and the control circuit will be 120 volts 1 phase 60 hertz.
- B. Control schematic shall include a variable frequency drive (VFD) used for smooth acceleration and deceleration. The inverter detects over-torque situations and opens the directional circuit, and provides dynamic braking to stop carrier movement. Other control features include a warning horn, warning light, power on indicating light and on off switch.
- C. All controls are to be located in a NEMA 4 enclosure. Heaters shall be included in control enclosures. Push buttons for control of the system movement shall be mounted in the enclosure door, with indicating lights for “power on”, “power off”. Enclosure shall be wall mounted and located as directed by the engineer.
- D. A warning horn and light shall be included with the control system. The warning horn shall sound for 15 seconds prior to the system moving, and shall be activated by the forward and reverse buttons. The warning light shall flash during horn signal, and stay flashing during system movement. Light and horn shall be mounted and located as directed by the engineer.
- E. AutoFILL (optional)
  - 1. Provide container handling system AutoFILL feature designed to automatically fill the container evenly. AutoFILL shall include all hardware, software and programming necessary to allow automatic filling and movement of the container handling system.
  - 2. Elevation Sensors positioned around the fill source shall detect piles created inside the dumpster and activate container movement when activated.
  - 3. Container sensors are positioned in the area to confirm the presence of a container prior to AutoFILL execution
  - 4. Elevation and container sensors are mounted in the area directly adjacent to the container loading bay, and are field adjustable up, down and left, right for optimal performance.
  - 5. The control panel shall include an AutoFILL/Manual two position selector switch allowing operators to put the system into either operating mode. When in AutoFILL, the elevation sensors will detect when a pile reaches a determined height, and activate system movement for a timed distance. Prior to movement the horn and light will sound.
  - 6. Movement will only occur if the container sensors are providing the necessary feedback indicating the presence of a container.
  - 7. When the container is full throughout the length, a container sensor will signal such an event and terminate the AutoFILL sequence.

## 2.3 PAINTING

- A. Stainless steel surfaces shall not be painted. The motor shall be provided with the manufacturer’s standard finish. Surfaces shall be hand cleaned with a wire brush and wiped with solvent prior to painting equipment.
- B. Equipment shall be touch painted in the field after installation. All marks and abrasions shall be primed if required, and finish coated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's recommendations, and performed with qualified persons. Tracks shall be anchored to the building floor with stainless steel threaded rod and Epcon Epoxy System, or expansion anchors depending on surface conditions.
- B. The Epcon mounting system incorporates a leveling nut under track to set elevation of track along the length. After installation, grout shall be installed under track along the entire length. Drive winch and idler sheave shall be installed the same way if the Epcon system is used.
- C. The concrete floor shall have a constant slope in one direction, not exceeding ¼-inch per 10'-0" of run for run-off purposes. Trench drains running perpendicular to the tracks at intervals dictated by the engineer is the preferred method for drainage in a new facility.
- D. Track, guide channel, drive and idler shall be installed at the same elevation  $\pm\frac{1}{4}$ -inch. Care should be taken to ensure alignment of guide track to drive chain during installation.

### 3.2 TESTING AND START-UP

- A. The container handling system shall be tested for proper operation prior to being put into service. All controls, lights, horns, limit switches and stops shall be tested in a no-load situation.
- B. A container to be provided by others can be used to perform a partial load test. The container, delivery of the container and removal of the container is to be provided by the owner. An operational and partial load test will be performed with an empty container. The owner is responsible for obtaining a loaded container to perform a full load test.
- C. Tests shall include operating the equipment the full length of the tracks, checking travel limit switches and carrier operation.

**END OF SECTION 412110**

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## SECTION 431133 – ROTARY LOBE BLOWER PACKAGE

### PART 1 - GENERAL

#### 1.1 THE REQUIREMENT

- A. Furnish, install, test, adjust, and place in satisfactory operation two (2) three-lobe low pulsation heavy duty positive displacement blower systems in acoustical enclosures complete with all accessories including motors, steel bases, inlet filters, inlet silencers, discharge silencers, relief valves, check valves, flexible connectors, V-belt drive, guards, vibration isolation, and other components required for a complete and operable blower system as shown on the Drawings and as specified herein.
- B. The blower package shall be installed outdoors on a raised concrete pad. The blower package shall interface with plant communications and electrical systems, as shown in the Drawings.

#### 1.2 SUBMITTALS

- A. Shop drawings for the blower packaged systems shall include blower, electric motors, silencers, flexible connectors, controls and accessories. Submit motor suppliers data sheets, dimensioned drawings, wiring diagrams identifying electrical characteristics and design, mechanical construction, manufacturer's name, type and pertinent specifications for the use intended.
  - 1. Equipment and motor protective device details. Connection diagrams for motor, enclosure cooling fan and all other protective devices.
  - 2. Equipment shop and final coating systems, interior and exterior.
  - 3. Control panel layout drawings, wiring diagrams, network interface diagram, and component product data sheets for control panels.
  - 4. Support locations and loads that will be transmitted to bases and foundations. The total weight of the operating blowers.
  - 5. Complete electrical field termination drawings.
  - 6. Alarm and control set points.
  - 7. Electrical equipment product data sheets.
  - 8. Overall equipment layout and piping interconnection drawings.
  - 9. Shop Test Plan (see Paragraph 3.1)
  - 10. Factory blower package ISO 1217 certified shop test reports.
  - 11. Class zero oil free ISO 8573 certificate.
  - 12. Declaration of Conformity, per Machinery Directive 2006/42/EC, Annex 11, No.1 A.
  - 13. Site verification check list.
  - 14. Field test results.
  - 15. Spare parts list.
  - 16. Blower package performance curves including capacity/pressure/speed curves and horsepower/pressure/speed curves at standard conditions of 14.7 psia inlet pressure, 68°F inlet temperature, and 36% relative humidity.
  - 17. Blower package performance technical data including capacity/pressure/speed curves and horsepower/pressure/speed curves at peak and minimum operating conditions.

### 1.3 QUALITY ASSURANCE

- A. All equipment shall be designed, engineered and manufactured by the blower packaged system manufacturer.
- B. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the drawings and written instructions.
- C. The blower packaged system shall undergo a factory test to assure mechanical integrity and insure conformance to the specified performance characteristics. A certified report of the ISO 1217 package test shall be considered as the basis for acceptance by the Engineer.
- D. The blower packaged system shall be covered by a warranty for 12 months from the date of substantial completion or 18 months from date of shipment, whichever occurs first.
- E. Delivery, storage and handling to comply with O&M manual instructions.

### 1.4 OPERATION AND MAINTENANCE MANUALS

- A. Manufacturer to furnish operation and maintenance manuals, shop drawings and other material required as specified in Division 01 Section "Operation and Maintenance Data"
- B. Submit a complete list of additional spare parts beyond those specified herein, which the manufacturer recommends to be kept on hand.

### 1.5 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All equipment, materials, components and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, and standards.

### 1.6 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. Provide the services of qualified technical representatives with at least (5) years' experience who are regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of positive displacement blower systems. The technical representative shall.
  - 1. Witness and check blower package installation and start-up of the system.
  - 2. Assist in conducting field tests and in making adjustments and modifications as necessary to optimize operation of system components
  - 3. Troubleshoot and correct any mechanical or control problems that are noted during tests and start-up.
  - 4. Instruct Owner personnel in the operation and maintenance of the equipment.
  - 5. Submit written certification that the systems have been properly installed, tested, and adjusted to ensure all controls and protective devices operate properly, including date of final acceptance test, as well as a listing of all persons present during the tests. Attach a complete signed report of the results of manufacturer's on-site inspection, operation,

adjustments, and testing, including detailed descriptions of the points inspected, tests and adjustments made, and any quantitative results obtained.

6. Investigate and supervise correction of any operating problems that may arise up to the end of the warranty period of the equipment.

## 1.7 SUBSTITUTIONS

- A. Manufacturers and products other than those listed herein or added by Addendum during the bidding process must meet EVERY provision of this specification Section except those expressly attributed herein to a particular manufacturer or product. Such Substitutions not meeting EVERY provision will be rejected without further consideration, and Contractor shall thereafter promptly submit one of the named products.
- B. Engineer will consider other Substitutions ONLY if a complete PRE-QUALIFICATION PACKAGE is received at the office of the Engineer at least twenty (20) days prior to the bid. Any such package must contain as a minimum:
  1. Detailed layout drawings
  2. Welder certifications
  3. Evidence of a recognized ongoing quality assurance program.
  4. Detailed component specifications and catalog cuts as required.
  5. Detailed list of ALL VARIATIONS required from the original design, referencing appropriate sections of the specifications and locations on the drawings.
    - a. Copy of Contract Drawings, illustrating all such variations
    - b. Copy of this Specification Section, highlighting and detailing all such variations
  6. Full installation list of proposed equipment including six (6) user references.
  7. Bidder's certification that Bidder shall bear all costs associated with any redesign required for use of the Substitution.
- C. Qualifying Substitutions will be recognized by Addendum a minimum of (7) days prior to the bid.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. The basis of this Specification is three lobe low pulsation positive displacement blower packages shall be Model ES 85/3P as manufactured by Robuschi by Gardner Denver. Equipment of other manufactures shall be required to meet all requirements of this Section in order to be considered equals.
- B. Substitutions will be considered as follows:
  1. Comply with relevant provisions of the General Conditions (Paragraph 7.05 et seq.)
  2. Provide Engineer with a Substitution request not later than fifteen (15) days after Notice of Award. Include the following as a minimum:
    - a. Detailed component specifications and catalog cuts as required.
    - b. Detailed layout drawings
    - c. Evidence of a recognized ongoing quality assurance program.

- d. Detailed list of ALL VARIATIONS required from the original design, referencing appropriate sections of the specifications and locations on the drawings.
    - 1) Copy of Contract Drawings, illustrating all such variations
    - 2) Copy of this Specification Section, highlighting and detailing all such variations
  - e. Full installation list of proposed equipment including six (6) user references.
  - f. Certification that Contractor shall bear all costs associated with any redesign required for use of the Substitution.
3. If a Substitution request is denied, no further Substitution requests for the same purpose will be considered. Thereafter, submit equipment fully meeting all requirements of this Section (specification basis or equal).

## 2.2 PERFORMANCE REQUIREMENTS

- A. The Performance requirements are provided in the table below. The blowers shall be capable of providing the specified blower capacity at the design discharge pressure, (at the design temperature, relative humidity and minimum barometric pressure) specified below. The discharge pressure specified below is the required pressure at the end of the blower package discharge pipe. The design pressures given below do not account for blower package inlet losses (inlet filter, inlet piping, silencer, etc.) or discharge losses (silencer, check valve, etc.) within the blower package, and manufacturer shall account for all of these in determining the total differential pressure to be provided by the blower.
- 1. Process Air Blowers: Quantity – 2
  - 2. Site / Operating Conditions
    - a. Elevation: approximately 740 feet above sea level
    - b. Ambient Operating Temperature Range: 0-104°F
    - c. Operating Barometric Pressure Range: 28.1-30.1 in Hg Abs.
    - d. Operating Relative Humidity Range: 0-100%
  - 3. Design Minimum Performance Point (Summer Conditions)
    - a. SCFM minimum delivery: 1080 SCFM
    - b. Discharge Pressure: 4.40 psig
    - c. Design Temperature at minimum SCFM delivery: 104°F
    - d. Maximum Inlet-Outlet Temperature Rise: +65°F
    - e. Design Humidity: 95%
    - f. Minimum Inlet Pressure, 13.8 psia
  - 4. Design Maximum Performance Point (Winter Conditions)
    - a. SCFM minimum delivery: 1440 SCFM
    - b. Discharge Pressure: 4.40 psig
    - c. Design Temperature at minimum SCFM delivery: 0°F
    - d. Maximum Inlet-Outlet Temperature Rise: +60°F
    - e. Design Humidity: 20%
    - f. Minimum Inlet Pressure, 13.8 psia
  - 5. Equipment Parameters
    - a. Maximum Blower speed: 3600 rpm
    - b. Maximum Allowable Motor Horsepower (each unit): 50 Hp
    - c. Minimum Blower Pressure Capability (equipment package outlet) at 1.0 Motor Service Factor: 4.70 psi
    - d. Maximum Sound Pressure Level at 1 meter: 75 dBA

- B. Package Performance shall be certified in compliance to ISO 1217 with a tolerance of  $\pm 5\%$  on volume flow and  $\pm 5\%$  on package horsepower.
- C. Sound Pressure Level data dB (A)  $\pm 3$  dB (A) at 1 meter free field with sound proof piping shall previously been collected from an ISO 2151 method of measurement, in an ISO 3745 qualified test facility. Estimated sound data shall be compliant with a Declaration of Conformity assessment standard.

### 2.3 BLOWER CONSTRUCTION

- A. A welded steel fabricated base or combination base frame and discharge silencer shall be provided for mounting the blower, electric drive and driver base. The base shall be of a rigid box section shape. The box section shall be properly stiffened and present large bearing areas for carrying the load on the foundation. The base shall be rigid to prevent deflection during start-up and normal operation that would affect alignment. Resilient isolation pads shall be provided between the concrete mounting or bottom of the blower enclosure and the base of the blower unit provided. The base shall support the blower and a pivoting motor base. The motor shall be mounted on the pivoting base. The weight of the motor, in conjunction with spring (if needed) shall provide 100% maintenance free automatic belt tensioning. Installation shall conform to recommendations of the blower and V-belt component manufacturers including motor, V-belt drive, guard, controls, and all necessary items. V-belts shall be of the stretch resistant type with an adjustable belt tensioning mechanism.
- B. The blower casing shall be of one piece with separate head plates, and shall be made of close-grained cast iron suitably ribbed to prevent distortion under the specified operating conditions. Inlet and outlet shall be flanged connections. The casing shall incorporate a proven means of pulsation cancellation. The vibration level as measured at the blower casing, in the X/Y planes of the bearings, shall not exceed 0.55-inch/sec RMS when operating at the specified maximum operating pressure and speed in the actual blower package.
- C. Each rotor shall be made from a ductile iron casting. Shafts shall be alloy steel forgings. Alternatively the rotor and shaft shall be of one piece construction that is machined together. The rotor shall be of the straight, tri-lobe involutes type and shall operate without rubber or liquid seals or lubrication and shall be positively timed by a pair of accurately machine heat-treated alloy steel, helical tooth or straight cut timing gears. The timing gears shall be mounted on the rotor shafts with a press fit and keyed or mounted by hydraulic expansion onto the blower shafts with a tapered interference fit. One gear shall be equipped with a hub and a gear to facilitate accurate and easy timing. Each rotor/shaft shall be supported by cylindrical roller bearings sized for a minimum of 100,000 hours B-10 life.
- D. The lube oil system shall be supplied with a sight glass and ample oil reservoir capacity. Piston ring oil seal shall be provided at each bearing, designed to prevent lubricant from leaking into the air stream. Rotary piston ring shaft seals shall be provided at the point where the shaft passes through the head plate (air seal). A total of 16 piston ring seals shall be provided for each blower. Further provision shall be made to vent lubricant to the impeller side of the oil seal to atmosphere to eliminate any possible carryover of lubricant into the air stream. Lip seals inside the blower shall not be acceptable. Lip seal is allowed at the drive shaft only, complete with wear sleeve.



- E. The timing gears and the bearings shall be splash oil lubricated from oil slingers mounted on the input driven shaft and dipping in oil. Grease lubricated bearings shall not be acceptable. Each bearing shall be equipped with an oil deflector disc if necessary to further reduce oil leaks
- F. Blower package shall be designed to allow ease of access to oil drain plugs. Drains shall be piped outside of sound enclosure for easy access.

#### 2.4 BLOWER ACCESSORIES

- A. Each blower shall be supplied with one combination inlet filter silencer. The inlet filter silencer shall be mounted directly to the inlet flange of the blower. Filter element shall be washable by maintenance personnel as a preventative maintenance procedure.
- B. The filter element shall be removable without the need for special tools. Filter element efficiency shall meet the requirements of 93% for particles  $\geq 10$  microns.
- C. Each blower shall be supplied with one combination base frame and discharge silencer. The silencer shall feature a single or double shell of pressure vessel quality steel with continuous welds. The temperature rating shall be 300°F. The design of the silencer/base assembly must accommodate being bolted directly to the blower discharge flange with no intermediary pieces, and shall be designed to assure that there will be no disturbing pipe beating noise or pipe harmonics whether one blower or multiple blowers are running.
- D. The blower system, inlet filter silencer discharge silencer/base assembly and acoustic enclosure shall be designed to reduce the sound pressure level emitted by the blower package over the entire range of operation qualified as per ISO 3745/6 Sound Pressure Level dB (A) at 1 meter  $\pm 3$  dB (A) “ free field” with sound proof piping.
- E. The blower manufacturer shall provide a lug or threading to attach ground strap from the discharge silencer base to the sound enclosure.
- F. Each blower package shall be connected to the plant piping via flexible connector(s) located downstream of the discharge silencer and flapper non return check valve. The flexible connectors shall be suitable for the maximum operating temperature and pressure ratings of the equipment in the air stream.
- G. Each blower shall be supplied with a belt transmission drive group and OSHA belt guard. Drive shall be designed for a minimum service factor of 1.4 times the maximum blower horsepower. Belt tensioning shall be easily adjustable for maintaining proper tension. Sheaves shall be dynamically balanced regardless of the operating speed.
- H. Each blower shall be supplied with vibration isolating mounts.
- I. Each blower shall be supplied with Pressure Relief Valve (PRV) consisting of a spring loaded-type pressure relief valve located inside the enclosure and installed at the factory by the blower manufacturer. The valve shall be field adjustable, spring loaded type and have a proportional operating characteristic with respect to the pressure set point. Initial setting of the spring loaded-type relief valve shall be as required by the manufacturer to protect the blower from exceeding its maximum rated pressure capacity. The spring loaded pressure relief valve shall be sized to pass 110% of the design flow.

- J. Check valves shall be provided on the discharge of each blower unit within the acoustic enclosure. Check valve shall be of the full-bore low pressure drop, flapper type design with a steel body and steel flap embedded in EPDM with full contact seal all suitable for 300°F.
- K. Each blower shall be supplied with an enclosure cooling fan control module and instrumentation panel providing the following functions and features:
  1. Discharge Pressure 2.5-inch gauge in a glycerin bath for measuring blower outlet pressure, precision class 1.6 with a dial scale 0/23.2 psi
  2. Inlet Filter Vacuum 2.5-inch gauge measuring filter clogging with a dial scale 0/-0.87 psi. Vacuum gauge divided into sectors. 0/-0.50 psi White NORMAL. 0/0.65 psi Yellow CLOGGED Replace Filter. 0/-0.87 psi Red STOP blower and replace filter element
  3. Discharge Temperature 2.5-inch gauge expansion thermometer with stainless steel case and capillary with a dial scale 30°/400°
  4. Discharge Digital Temperature Switch 115VAC & 230 VAC, ambient temperature 32°/132°F. Output 16A @ 250 VAC SPDT Relay. Temperature input PTC, NTC, PT100, PT1000, 4-20 mA, 0/10VAC.
  5. Noise Enclosure High Temperature Bi-metal snap switch. NC (Normally Closed). Contacts Open on a temperature rise @ 140°F +/- 5°F. Contacts Close @ 125°F. Contacts Rated @ 120VAC, 15 A resistance load and 3A inductive Load, 100,000 cycles, 6-inch wire leads.
  6. Noise Enclosure Cooling Fan Delay Timing Relay plugs in type 100 VAC/240 VAC. 0.1 second to 600 hours (on or off delay). 2-Form "C" DPDT Delayed Output. Contacts Rated 10A, 240VAC Coil. UL/CSA/CE.
  7. Noise Enclosure Cooling Fan Control Module components 1 thru 6 contained in a NEMA 3R enclosure. Connection diagrams shall include complete electrical field termination drawings.
- L. Each blower shall receive its initial oil filling at the factory prior to testing. Oil shall be drained prior to shipping. Sufficient oil shall be provided for start-up by the authorized service technician. AEON XD oil shall be available from a local source.

## 2.5 BLOWER MOTORS

- A. The process air blower motor shall be premium efficiency/inverter duty. The blower manufacturer shall be responsible for the proper selection, installation, and operation of the motors.
- B. Motors shall be asynchronous horizontal squirrel cage rotor construction induction motors designed in accordance with the latest ANSI, NEMA, and IEEE standards. Motors shall be suitable for 460 V, 60 Hz power supply. Minimum protection grade IP 54. Motors shall be designed and manufactured for continuous duty for operation under the following conditions:
  1. Elevation of 740 feet above mean sea level.
  2. Ambient temperature ranging -12°F - 104°F.
  3. Voltage variations of ±10%.
  4. Frequency variation of ±2%.
  5. Combined voltage and frequency variation of ±10% with frequency variation not exceeding ±2%.
- C. Inverter duty motors shall have a minimum service factor of 1.15. Motor horsepower shall be equal to or greater than the load over the full range of operating conditions. Motor speed shall not exceed 3,600 rpm.

- D. Motor enclosure shall be TEFC corrosion protected. Minimum protection grade IP 54.
- E. Motors shall provide premium efficiencies and power factors throughout their operating range. The power factors specified shall be achieved without the use of power factor correction capacitors. Motors shall provide minimum efficiencies and power factors as follows:

<b>Full Load</b>	<b>Minimum Efficiency</b>	<b>Minimum Power Factor</b>
100%	94.5%	85.7%
75%	94.8%	81.7%
50%	94.4%	72.5%

- F. Efficiencies and power factors for each motor shall be verified by submittal of certified test reports for similar motors provided by the motor manufacturer.
- G. Motor insulation shall be Class F for inverter duty motors. However, temperature rise shall be limited to that of Class B insulation. Manufacturer's premium grade insulation shall be used.
- H. Bearings shall be grease lube ball bearings. Drive side bearing must be able to support the radial load induced by V-belt transmission.
- I. Motor leads shall be suitably marked and identified. Each motor shall be provided with an NEMA F3 located terminal box (Top mount)
- J. Motors shall be designed and manufactured for operation in the direction required to drive the blower.

2.6 ACOUSTICAL ENCLOSURE (CLOSE-FITTING TYPE)

- A. Each blower shall be supplied with a sound enclosure hood made up of self-supporting panels. The sound enclosure must be designed for easy inspection and maintenance of all blower package components.
- B. Panels shall be made of steel sheet in galvanized plate type Z200 EN 10142 with a premium externally coated system.
- C. Sound enclosure acoustic material shall consist of open cell polyurethane foam thickness no less than 2-inches with profiled finish. As a minimum sound absorbing foam shall comply with fire resistant according to ISO 3795 (MVSS TN 302) or UL 94 or UL 723 for fire-retardant, self-extinguishing, non-dripping materials. Materials with a lesser rating shall not be acceptable.
- D. Enclosure hood ventilation air inlet and outlet ducts shall be silenced with a lined single-chamber plenum and lined bends.
- E. Quick release panels for routine maintenance operations, each less than 50 lbs. shall provide easy and quick access for routine maintenance operations from the front or opening hood top on smaller packages. For panels heavier than 50 lbs., hinged doors shall be supplied, with the appropriate frame, reinforcements and supporting elements.

- F. Enclosure perimeter panels shall be supported directly on the foundation pad. Seals between panels shall be by means of rubber joints to ensure airtight closure for packages installed outdoors.
- G. A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts.
- H. A high efficiency electric motor driven ventilation fan shall provide ventilation and cooling integral to the sound enclosure, and shall operate whenever the blower is operating. There shall be an electrical interlock between the 110V cooling fan and the 480 volt starter for the blower. The cooling fan shall be capable of limiting the temperature within the acoustical enclosure to 125°F +/- 5°F with an outside temperature of 104°F. Cooling fan shall be sized for sufficient heat removal from the sound enclosure.
- I. All enclosure fasteners and anchor bolts shall be made from corrosion resistant materials. Anchor bolts shall be as required by the manufacturer.

## 2.7 SPARE PARTS

- A. The Blower system manufacturer genuine original equipment spare parts shall be supplied in secure clearly labeled packaging for easy identification without opening the packaging. The Contractor shall provide the following spare parts:
  1. Two (2) filter elements per blower
  2. One oil change per blower supply of manufacturers recommended oil.
  3. One complete set of belts per provided blower.

## PART 3 - EXECUTION

### 3.1 SHOP TESTING

- A. A detailed shop test plan shall be submitted with the Shop Drawings. The shop test plan shall fully describe the manufacturer's test facilities and the test procedure to be used.
- B. Each blower system shall be factory lubricated, aligned and operationally tested. Run time on each blower shall be at least one (1) hour after which each blower shall be rechecked for belt alignment and belt tension, and adjusted if necessary. If adjustments are made, the blower(s) shall be restarted and run an additional 15 minutes, shut down and rechecked again.
- C. Each blower system shall be provided with a package test in accordance with ISO 1217 to demonstrate compliance with all specified performance requirements.
- D. A report on each blower system shall be furnished with the O&M manuals giving as a minimum the following readings taken during shop tests at or near the end of the one hour run time.
  1. Motor current, per phase.
  2. Applied motor voltage, phase-to-phase
  3. Discharge pressure, psi
  4. Air Flow, scfm
  5. Air Flow, icfm
  6. Blower discharge air temperature °F

7. Barometer, psia
8. Atmospheric air temperature °F
9. Relative humidity, %
10. Blower fixed speed at 60 Hz, rpm
11. Motor speed at 60 Hz, rpm

- E. The blower manufacturer shall prepare and submit test results, performance curves at standard conditions, and all calculations with a statement certifying that shop tests were successfully conducted in accordance with the test requirements and that all specified performance conditions were demonstrated for each blower system.

### 3.2 INSTALLATION AND FIELD TESTING

- A. Furnish and install the blower packages and all related items in strict accordance with manufacturer's instructions including proper support and anchoring of the blowers. All supports, fasteners, anchors, and equipment, hardware, etc. shall be furnished by Contractor for a complete installation.
- B. The Manufacturer's authorized service technician shall verify proper installation, electrical connections and equipment alignment prior to start-up.
- C. Prior to blower package field testing, the Contractor shall take all necessary precautions to insure that the air piping is completely clean and free of any debris, dirt, or other foreign materials which could clog downstream equipment or interfere with acceptable operation.
- D. After each blower unit and its accessories have been completely installed and the electrical connections have been made, it shall be subjected to field tests conducted by the Contractor and witnessed by the Engineer to determine if blower package is free from all objectionable vibration, bearing heating, noise, or other defects. Each blower package shall be subjected to running tests under actual operating conditions when technician determines blower has warmed up completely.
- E. The Manufacturer's representative shall provide operations and maintenance training to the plant personnel. The training shall consist of at least 1 hour of classroom training using the Operation and Maintenance Manual for reference and 2 hours of hands on training at the blower package.
- F. Make such changes or alterations in the blower packages or their auxiliaries necessary for satisfactory operation as directed by the Engineer based on the results of the field tests.
- G. The Manufacturer shall provide a written field test/startup report after completion of testing and operations and maintenance training

### 3.3 PAINTING

- A. Blowers shall be coated with the manufacturer's recommended premium paint system suitable for the blowers' intended use.
- B. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high quality epoxy

polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.

#### 3.4 EQUIPMENT IDENTIFICATION

- A. The blower packagers shall be provided with a substantial nameplate, securely fastened in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, design air flow in scfm and icfm, discharge pressure and rpm.

**END OF SECTION 431133**

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**SECTION 432300 – SLUDGE FEED PUMP**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies a positive displacement progressing cavity pump, complete with electric motor with variable frequency drive, and all specified appurtenances, as shown on the plans and specified herein.
- B. The pumping unit shall be of the self-priming, positive displacement, progressing cavity type specifically designed for pumping bulk liquid or polymer solutions, as specified and/or waste water sludge.
- C. **EQUIPMENT LIST**
  - 1. Two (2) Self-Priming, Positive Displacement, Progressive Cavity Right Angle Drive Feed Pump for Sludge Handling.
- D. **PERFORMANCE AND DESIGN REQUIREMENTS**
  - 1. The progressing cavity pump for sludge handling shall be specifically designed and selected for continuous duty pumping of liquids with the following properties:
    - a. Percent Solids: Up to 8%
    - b. Specific Gravity: 1.30
    - c. Solids Size: < 0.75
    - d. pH: 8
  - 2. The pump shall be of the compact, close-coupled design. The gear reducer shall be sized for a minimum service factor of 1.5 and designed with a thrust load capability of 150 percent of the actual thrust load.
  - 3. The pump, along with associated drive appurtenances, shall be mounted on common fabricated vertical steel baseplates.
  - 4. Manufacturers must currently have installations for the same liquids and of the same model pump unit, in service for a minimum of three (3) years. Manufacturers not named in this specification must also provide a pre-submittal package to the engineer no less than three (3) weeks prior to the bid date for approval. The pre-submittal package must include, at minimum, the following: dimensional drawing, performance curve, O&M manual, electrical/drive details, installation list (for the same liquids as specified) with minimum three contacts and phone numbers.
- E. The progressing cavity pump shall have the following operating characteristics:

Equipment Service	Rated Capacity (gpm)	Differential Pressure (psi)	Max/Min Pump Speed (rpm)	Suction and Discharge Port Size (in)	Minimum Motor HP	Drives
Sludge Feed						
High Flow	150	10	245	5	10.0	<input type="checkbox"/> Constant
Low Flow	50	10	123	5	10.0	<input checked="" type="checkbox"/> Variable Speed



## 1.2 REFERENCES

- A. This section contains references to the following documents. They are part of this section as specified and modified. In case of conflict between the requirements of the section and those of the listed documents, the requirements of this section shall prevail.
- B. Reference Title
1. AGMA 6010-E-88 Spur, Helical, Herringbone, and Bevel Enclosed Drive
  2. AGMA 6019-E-89 Gear Motors Using Spur, Helical, Herringbone, Straight Bevel or Spiral Bevel Gears
  3. AGMA 6023-A88 Design Manual for Enclosed Epicyclic Gear Drives

## 1.3 ENVIRONMENTAL CONDITIONS

- A. Pumps to be provided under this section will be installed in the Centrifuge Building.

## 1.4 SUBMITTALS

- A. Manufacturer's data including materials of construction and equipment weight.
- B. Predicted performance curves developed for the specific application. Performance curves shall plot speed, capacity, head, and horsepower required for the specified operating range.
- C. Universal joint warranty.
- D. A copy of this specification section with addenda updates, and all referenced sections with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE PRODUCTS

- A. The progressing cavity pump shall be Seepex Series BN or approved equal.

### 2.2 MATERIALS

- A.

<b>Component</b>	<b>Material – Sludge Pumps</b>
Rotor	316ss - Duktal Coated (1250 Vickers hardness)
Stator	NBR - Perbunan
Pump Body	Cast iron
Shaft Sealing	Burgmann MG1 Q1Q1VGG

## 2.3 EQUIPMENT

### A. Rotor and Stator

1. The pump shall be a one stage design employing a convoluted rotor operating in a similarly convoluted stator. The convolutions shall be configured to form a cavity between the rotor and stator, which shall progress from the pump's inlet to discharge port with the operation of the rotor. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form a seal and to prevent leakage from the discharge back to the inlet end of the pumping chamber. The stator shall be molded with a seal integral to the stator elastomer preventing the metal stator tube and the bonding agent from the elastomer from contacting the pumped liquid. Gaskets or "O" rings may not be used to form this seal. Stators for sludge pumps shall have Buna elastomer. The sludge pump rotors shall be constructed of 316 Stainless Steel. Additionally, the sludge pump rotors shall have a chromium nitride coating (Duktil) with a hardness of 1250 Vickers and a minimum thickness of 0.0108-inch. Hard chrome plating or ceramic coatings are not acceptable due to the ease at which this coating will crack and the lack of diffusion into the rotor base metal.

### B. Rotor and Drive Train

1. The rotor drive train shall be warranted for three (3) years from acceptance and shall consist of the following:
  - a. Each pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod. The pin shall be constructed of high speed steel, air hardened to 60-65 HRc. The joint shall be grease lubricated with a high temperature (450°F), PTFE filled synthetic grease, covered with Buna N sleeve and positively sealed with hose clamps constructed of 304 stainless steel. A stainless steel shell shall cover the rotor side universal joint assembly to protect the elastomer sleeve from being damaged by tramp metals or glass. The universal joints shall carry a separate warranty of 10,000 operating hours. This warranty shall be unconditional in regards to damage or wear.

### C. Casing

1. A 150-pound (ANSI B16.5) flanged connection shall be provided at both the inlet and discharge ports. The suction and discharge casings shall each be provided with a 3/8-inch (or larger) tap to permit installation of pressure instruments.

### D. Bearings

1. Each pump shall be provided with oil lubricated thrust and radial bearings, located in the gear motor, designed for all loads imposed by the specified service.

### E. Shaft Sealing

Shaft shall be sealed using a single internal mechanical seal as specified in Part 2.2. The shaft shall be solid through the sealing area, but of a two part design which allows the rotating unit to be removed from the pump without disassembly of the gear motor bearings. Seal materials shall be solid silicon carbide faces with 316 stainless steel metal parts and Viton elastomers.

### F. Motor and Drive Unit

1. Gear motor or gear reducer shall be designed in accordance with AGMA 6019-E (Class II). Unless otherwise noted, motor shall be energy-efficient, TEFC motor, 460 V, 60 Hz, 3 phase. The drive unit shall be a right angle gear motor.
2. Gear motor shall be powered by a constant torque, variable frequency drive controlled from the centrifuge control panel. The pump supplier shall be responsible for the provision of the fixed reduction between the motor and pump. The reduction ratio shall be that required to operate the pump at its maximum operating speed when the motor is operating at its nominal rated full speed in accordance with the schedule in Part 1.1.E. ASD-driven units may be operated at up to 90 Hz at the maximum speed.

## 2.4 ACCESSORIES

### A. Run Dry Protection

1. The stator shall be fitted with a sensor sleeve and thermistor sensor. A controller shall also be provided and shall be installed by the contractor in the motor control center. The controller shall monitor the stator temperature and activate a shutdown and alarm sequence if the stator temperature reaches the adjustable limit on the controller. The controller shall include a manual local and remote reset function. Input to the controller shall be 1x115VAC/60 Hz.

### B. Over Pressure Protection

1. Each pump unit shall be supplied with a silicone-filled isolation ring with a dual mounted gauge and single point pressure switch. The pressure ranges for the switch and gauge shall be selected specifically for each specified service. The isolation ring shall be mounted between ANSI flanges, be sized according to the discharge pipe as shown on the plans, and be constructed with a carbon steel body and fittings with a Buna sleeve. The switch shall be SPDT, NEMA 4.

## 2.5 PRODUCT DATA

- A. Mill certifications confirming hardness of rotor.

## 2.6 STANDBY COMPONENTS

- A. One set of special tools shall be provided to service the pumps. In addition, the following shall be provided for each pump size (as appropriate for type of drive provided):
  1. One (1) – Stator Assembly with TSE Sensor Sleeve
  2. One (1) – Rotor
  3. One (1) – Set Universal Joint Assemblies

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. The pumps shall be installed as specified and in accordance with manufacturer's written recommendations.

### 3.2 TESTING

- A. After completion of installation, the pumps shall be completely tested to demonstrate compliance with operating requirements as specified.

## PART 4 - CERTIFICATION

### 4.1 DESCRIPTION

- A. Consideration will be given only to products of manufacturers who can demonstrate that their equipment fully complies with all requirements of the specifications and contract documents. The equipment shall be supplied by a firm which has been regularly engaged in the design, fabrication, assembly, testing, start-up, and service of progressive cavity pumps, of the same model and size as proposed, operating in the U.S., with similar materials, for a period of not less than ten (10) years prior to the bid date of this contract. To insure that the highest standards are met each bidder shall be certified to ISO 9001 quality standards as a progressive cavity pumps manufacturer in the United States. The bidder shall submit data to substantiate the manufacturers experience in accordance with the contract documents.
- B. If a bidding progressive cavity pump manufacturer does not have a formal quality system in place, or documentation to prove so, a performance/maintenance bond in the amount of 100% of the installed price (including equipment, labor, piping, and wiring associated with the equipment covered under this specification) shall be included in the bid proposal. The bond should be made out to the owner for 100% of the amount bid, and shall be in force for a minimum of five (5) years from the date of first beneficial use of the equipment. The five (5) year minimum is to cover all warranties listed under this specification.

**END OF SECTION 432300**

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## SECTION 432310 – CENTRIFUGE DISC SLUDGE FEED PUMP

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

##### A. Scope of Work

1. Furnish all labor, materials, equipment and incidentals required and install, test and make completely ready for operation, two (2) centrifuge disc sludge feed pumps, including all appurtenances as required by manufacturer and specified herein. Bases of design for equipment is contained in Division 43 Section “Sludge Feed Pump” and any modifications to piping, valves, electrical and structure shall be included in alternate bid.
2. All equipment and accessories shall have approved manufacturer's shop drawings prior to installation and shall be tested (field and/or factory) as in conformance with these Specifications prior to acceptance and final payment by Owner.

##### B. General Design

1. The disc pumps shall be designed to pump at the specified conditions. The contract shall be awarded on the basis of the base bid. Any alternate deductive pumps shall be considered only after the contract is awarded and must be quoted at bid time. The engineer shall be reimbursed for his review of alternative systems and any savings will be shared with the owner.

#### 1.2 QUALITY ASSURANCE

##### A. Qualifications

1. All of the equipment specified under this Section shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the production of the equipment to be furnished.
2. All equipment furnished under this Specification shall be new and unused and shall be the standard product of manufacturers having a successful record of designing and servicing boundary layer equipment for a minimum of five (5) years.

##### B. Standards

1. NEMA
2. NEC
3. ANSI
4. Hydraulic Institute

- C. Equipment Manufacturer: The BASE BID and bases of design for sludge pump shall be as stated in Division 43 Section “Sludge Feed Pump”.

### 1.3 SUBMITTALS

- A. Materials and Shop Drawings: Copies of all materials required to establish compliance with the Specifications shall be submitted in accordance with the provisions of the General Conditions: Shop Drawings, Working Drawings and Samples. Submittals shall include at least:
  - 1. Certified shop drawings showing all important details of construction, dimensions, and weight.
  - 2. Descriptive literature, bulletins, and/or catalogs of the equipment.
  - 3. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves, based on actual shop tests which show that they meet the specified requirements. Curves shall be submitted on 8½-inch by 11-inch sheets, at as large a scale as is practical.
  - 4. A complete total bill of materials for all equipment.
  - 5. A list of manufacturers recommended spare parts to be supplied.
  - 6. Complete motor data.
  
- B. Operations and Maintenance Manuals: Submit operation and maintenance manuals in accordance with Division 01 Section "Operation and Maintenance Manual".
  - 1. The manual shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, and information necessary to instruct operating and maintenance personnel unfamiliar with such equipment.
  - 2. A factory representative with complete knowledge of proper operation and maintenance shall be provided for one (1) day to instruct representatives of the Owner and the Engineer on proper operation and maintenance. This work may be conducted in conjunction with the inspection of the installation and test run as provided under PART 3 - EXECUTION, herein.

### 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- B. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- C. Finished surfaces of all exposed openings shall be protected by blanks.
- D. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.
- E. Each box or package shall be properly marked to show its contents.

### 1.5 WARRANTY AND GUARANTEES

- A. The equipment manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and material for a period of one (1) year from the date of equipment start-up not to exceed 15 months from date of shipment. In the event that the equipment fails to perform

as specified, the equipment manufacturer shall promptly repair or replace the defective equipment.

## PART 2 - PRODUCTS

### 2.1 DESIGN CRITERIA

#### A. Centrifuge Disc Sludge Feed Pumps

1. Two (2) Centrifuge Disc Sludge Feed Pumps
2. Liquid pumped will be 3-8% municipal water plant alum sludge.
3. Flow rate will be 50-150 GPM with variable speed drive unit.
4. Discharge pressure will be 3-20 feet TDH
5. Suction will be flooded.
6. VFD controlled.

### 2.2 PUMP CONSTRUCTION

- A. The disc pumps shall be of the frame mounted design, constructed for heavy duty operation with horizontal back pull out, clock-wise rotation, disc type Boundary-Layer/Viscous-Drag pumps. The pumps shall have tangential discharge for ease of priming and for extended life. Centrifugal pumps using internal volute cut water discharge will not be acceptable. The pumps will include replaceable one piece mechanical seal chambers, and will be provided with replaceable hook type 316SS shaft sleeve.
- B. The casing shall be of a circular concentric design so as to provide for long life in abrasive services, and to produce minimum shear to the product. The casing and mechanical seal housing shall be 0.75-inch minimum thick walled abrasion resistant high chrome iron Maxalloy 350 (350 BHN Hardness) for maximum wear resistance and shall have a minimum of 0.375-inch, wear allowance. All cast parts shall be smooth and free from defects.
- C. The suction and discharge connections shall be ANSI 150# flat faced flanges and shall be positioned in accordance with the drawings covering the equipment in this specification.
- D. The discpac (rotor) shall be constructed for maximum wear life provided from the Boundary-Layer/Viscous-Drag principle of operation. The discpac material shall be an abrasion resistant hardened Maxalloy 350 (350 BHN Hardness) 23-25% High Chrome Iron for maximum wear resistance.
- E. The stuffing box housing shall be designed for use with an AST 80 Dual Cartridge Seal with Hard Silicon Carbide inner and rotating faces. As instructed by the manufacturer, Contractor shall provide flush piping with appropriate pressure reducing and throttle valve, pressure gauge, and flow indicator.
- F. The pump bearings shall be of the heavy duty antifriction type, oil lubricated and capable of handling all hydraulic thrust, radial and axial, produced by the rotor.



- G. The pump shall be mounted on a fabricated steel base suitably constructed to support the entire weight of the pump and motor assembly. The pump/motor arrangement shall be an inline configuration with spacer coupling with full OSHA type guard or side x side with V-belt drive.
- H. The pump shall be DISCFLO Model GPi403-12-2D.

### 2.3 MOTOR

- A. Motor shall be as manufactured by Baldor or equal and meet IEEE 841 standards. The motor shall be rated 7.5 HP 1800 RPM 460v-3ph-60hz suitable for centrifugal pump variable speed operation by a variable frequency drive inverter.
- B. Mechanical features to include all cast iron construction, TEFC enclosure, stainless steel nameplate, Drive-end Inpro Seal bearing isolator, Corrosion resistant hardware
- C. Electrical features to include ISR spike resistant copper windings, Class F insulation, Class B temperature rise, 1.15 service factor, non-wicking polymeric lead wire material, phase insulation between all phase windings.
- D. Inverter ready per NEMA STD MG1 Part 31.4.4.2

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the drawings for pumps shown for Division 43 Section "Sludge Feed Pump". Installation shall include furnishing the required oil and grease for initial operation by contractor. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.
- B. The Contractor shall submit a certificate from the equipment manufacturer stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

### 3.2 INSPECTION AND TESTING

- A. General
  1. A factory representative shall be provided for one (1) day and shall have complete knowledge of proper operation and maintenance to inspect the final installation and supervise the test run of the equipment. With the permission of the Owner, these services may be combined with those provided under Paragraph 1.3.B.2, herein.
  2. Shop testing shall include hydrostatic test per Hydraulic Institute standards.
  3. Unless otherwise specified certified performance curves will be acceptable in lieu of a shop performance test.
  4. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.

5. The field test shall demonstrate that all items of these Specifications have been met by the equipment as installed and:
  - a. The unit has been properly installed and is in correct alignment.
  - b. The unit operates without overheating or overloading any parts and without objectionable vibration as defined by Hydraulic Institute standards.
  - c. There are no mechanical defects in any of the parts.

**END OF SECTION 432310**

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## SECTION 460000 – FLOATING SWIVEL DECANT PIPE

### PART 1 - GENERAL

#### 1.1 WORK OF THIS SECTION

- A. Contractor shall furnish all labor, materials, equipment, and incidentals as shown, specified and required to provide three floating swivel decant pipes.
- B. Each mechanism shall be as specified herein and will be designed for installation in a basin having the dimensions indicated on the drawings.
- C. The manufacturer of the equipment shall be vested with unit responsibility for the proper function of the complete system including the pipe, winch, and swivel mechanism. The equipment covered by this specification is intended to be standard equipment of proven ability as manufactured by reputable concerns having extensive experience in the production of such equipment.

#### 1.2. REFERENCES

- A. The following is a list of standards which may be referenced in this section:
  - 1. The Society for Protective Coatings (SSPC).
  - 2. ASTM International (ASTM)
    - a. A276, Standard Specification for Stainless Steel Bars and Shapes.
    - b. A36/A36M, Standard Specification for Carbon Structural Steel.
    - c. The Society for Protective Coatings (SSPC)

#### 1.3. SUBMITTALS

- A. Submit for approval the following
  - 1. Provide four (4) complete approval submittal manuals. Manuals shall be in a white 3-ring binder, and include tabbed sections defining scope, process calculations, mechanical and structural calculations, catalog cuts, and drawings.
  - 2. All process design calculations (velocity gradient, tip speed, horsepower requirements, and paddle arrangement) shall be prepared by the manufacturer and sealed by a registered professional engineer.
  - 3. Manufacturer's literature, illustrations, specifications, and engineering data including total weight of each unit, structural loads at supports, connection details, and performance data.
  - 4. Drawings shall show dimensions, overall arrangement of equipment and materials of construction.
  - 5. Control diagrams and panel layout.
- B. Operations and Maintenance Manuals: Submit operation and maintenance manuals in accordance with Division 01 Section "Operation and Maintenance Manual".

#### 1.4. PERFORMANCE AND DESIGN REQUIREMENTS

- A. Mixing Tank (New Tank)
  - 1. Maximum High Water Elevation will be: 746.00 ft.
  - 2. Maximum Low Water Elevation will be: 741.00 ft.
  - 3. Decanter Flow Rate: 150 GPM
  
- B. Decant Sludge Tank No. 1 (Existing Tank)
  - 1. Maximum High Water Elevation will be: 724.50 ft.
  - 2. Maximum Low Water Elevation will be: 716.92 ft.
  - 3. Decanter Flow Rate: 1,200 GPM
  
- C. Decant Sludge Tank No. 2 (Existing Tank)
  - 1. Maximum High Water Elevation will be: 724.50 ft.
  - 2. Maximum Low Water Elevation will be: 716.92 ft.
  - 3. Decanter Flow Rate: 1,200 GPM

#### PART 2 - PRODUCTS

##### 2.1 ACCEPTABLE MANUFACTURERS

- A. All costs associated with any deviation from this specification shall be the sole responsibility of the Contractor.
  
- B. The equipment shall be the product of a manufacturer engaged in the design and manufacture of similar equipment in successful operation in similar applications. The manufacturer shall have a minimum of 5 years of United States municipal water experience with 5 installations of the same type of equipment as specified herein with documented successful operation.
  
- C. Pre-qualification requires manufacturers to submit the following 20 days prior to bid:
  - 1. A list of at least 5 previous installations, including contact information, of similar size, design, and complying with the requirements as set forth within this specification.
  - 2. Preliminary drawings and process calculations specific to this project.
  
- D. Equipment shall be manufactured in the USA.

##### 2.2 PRODUCTS

- A. Decant Pipe
  - 1. The decant pipe shall be schedule 10, T-304 stainless steel pipe with dimensions as shown on the drawings.
  
- B. Swivel Joint:
  - 1. Shall consist of a T-304 stainless steel (or carbon steel) flexible hinged support assembly, flanged both ends (standard ANSI 150 #).
  - 2. EPDM (NSF-61) or corrugated PVC flexible hose shall provide the flexible connection and will provide a water seal.
  - 3. Rotation is provided in a single plane.

- a. Elbows are provided to offer swivel in a different plane.
- C. Float
  - 1. Shall consist of a stainless steel pontoon housing with closed cell foam filling to prevent submersion even in the event of a small leak in the exterior housing. To include T-304 stainless steel frame assembly.
  - 2. T-304 stainless steel inlet pipe with orifices.
- D. Support stop
  - 1. T-304 stainless steel floor or wall mounted support stand for resting decanter at stop point
- E. Hardware
  - 1. All field assembly bolts and anchor bolts, nuts, and washers shall be Type 316 stainless steel.
  - 2. All submerged connections shall utilize Type 316 stainless steel nylon insert locknuts.

## 2.3 FABRICATION

- A. All welded joints that will be fully or partially submerged shall be sealed watertight with continuous welds. All welding shall be performed in accordance with AWS standards.
- B. All parts and components shall be factory-assembled in sections convenient for field handling and installation but requiring the minimum amount of work for field assembly. Any field assembly work shall be bolted. No cutting or welding should be required on either field assembly or erection.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. The Contractor shall install the paddlewheel skimmer equipment in strict accordance with the manufacturer's drawings and recommendations.
- B. Anti-seize thread lubricant, which is NSF-61 approved, shall be applied to the male threads of all stainless steel bolts at the time of the assembly.

### 3.2 WARRANTY

- A. The supplier shall guarantee in writing that the equipment furnished is appropriate for the intended service and shall be free of manufacturing and fabrication defects in material and workmanship for a period of 1 year after the equipment is satisfactorily placed in service. If the equipment is not placed in service within 6 months of delivery, the 1 year guarantee period shall commence 6 months after delivery.

### 3.3 MANUFACTURER'S SERVICES

- A. Manufacturer's Field Services: The Contractor shall provide the following services in addition to any other services specified herein, and required by these Specifications.
1. Installation and training service:
    - a. A factory trained manufacturer's representative shall be provided for a minimum of two (2) trips and a minimum of one (1) eight hour day per trip to provide installation supervision, start-up and field testing services, and O&M training services. The installation services shall be coordinated between the Contractor and the manufacturer. The start-up and field testing services, and the O&M services shall be coordinated with the Engineer.
    - b. After installation supervision and field testing services by the manufacturer, the 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 per the manufacturer's recommendations.
    - c. The manufacturer shall provide operator training to all required plant personnel.
  2. All costs, including travel, lodging, meals and incidentals for manufacturer service shall be included in the Contractor's bid.

**END OF SECTION 460000**

## SECTION 460803 – COMMISSIONING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Pre-commission and commission (collectively referred to as “Commissioning”) of the Filter Backwash and Solids Handling Systems and equipment, ensuring proper connectivity, communication, installation, and operation in a systematic manner in order to assure quality of mechanical, electrical, and controls work.

#### 1.2 OVERVIEW

- A. Pre-commissioning activities ensure that equipment is completely and properly installed and ready for initial operation and functional testing. Each step of pre-commissioning activities shall be documented to assure Owner of the quality of installation.
- B. Commissioning activities ensure that equipment operates as intended, and that systems are brought on-line for intended operation in proper sequence and in coordination with Owner’s constraints.

#### 1.3 SUBMITTALS

- A. At least 45 days prior to Commissioning any system of equipment, submit to Engineer the following:
  - 1. Names and qualifications of Contractor’s personnel overseeing Commissioning activities.
  - 2. Pre-commissioning and commissioning checklists, including for each item of equipment:
    - a. Schedule of pre-commissioning and commissioning activities
    - b. Identification of parties required to be present during Commissioning activities (e.g., Owner’s staff, Engineer, subcontractors, equipment manufacturer’s representative, etc.)
- B. Make corrections to submittals and resubmit fully compliant items no later than 15 days prior to Commissioning. No system shall be Commissioned prior to Engineer’s acceptance of related submittals.
- C. Within 15 days of completion of Commissioning of any system, provide Engineer with completed checklists, test results, and specified certifications.

#### 1.4 CONSTRUCTION & COMMISSIONING SEQUENCE

- A. No more than two (2) filters may be offline for performance of the Work at any given time.
- B. The Contractor is responsible for sequencing the Work, within constraints established by the Owner. The Contractor shall be cognizant of the Owner’s obligations regarding continued operation of adjacent, upstream and downstream facilities and compliance of same with all



regulatory permits. The sequencing identified in this Section is provided to make Contractor aware of currently known constraints. Engineer- and Owner-approved means and methods may be employed by the Contractor to overcome such constraints and sequence the Work in an order that is more advantageous to the Owner. Owner reserves the right to veto such suggestions should Owner believe that such alternatives pose added risk to the continuous operation or reliability of adjacent, upstream and/or downstream facilities and/or permit compliance.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

3.1 The activities described in this Section are general in nature, but apply specifically to each item of electrical/mechanical equipment that comprises the Work.

### 3.2 PRE-COMMISSIONING ACTIVITIES

#### A. Mechanical

1. Each run of pipe between points of connection to equipment items or structures.
  - a. Flush water pipes thoroughly with clean water to remove dirt and/or construction debris (achieve a minimum of 3 feet per second flushing velocity). Flush air pipes thoroughly with clean oil-free air and with at least twice the design operating air flowrate (proposed Blowers – if fully commissioned already – can be operated manually in parallel to achieve this flowrate). Flush individual branches separately and in direction of intended flow, through check valves to ensure proper orientation and function.
  - b. Perform pressure tests (or vacuum tests, only for gravity pipelines intended to flow partially full) in accordance with Division 33 or Division 40, as appropriate. Conduct separate tests for sections of runs divided by isolation valves. Manifolds containing numerous isolation valves in immediate vicinity to one another may be tested as an assembly, but sequentially through successive valves to ensure that each valve holds pressure. Perform pipe tests prior to making final connection to equipment.
2. Verify manufacturer's equipment is installed in absolute compliance with manufacturer's recommendations. Where manufacturer's certification of proper installation is required in relevant specification Sections, do not proceed to subsequent Commissioning steps until certification is received.
3. Verify that shipping blocks and other temporary movement locking devices have been removed. Where possible, rotate equipment manually.
4. Verify that equipment has been mounted securely.
5. Manually operate valves and gates to ensure free movement across their entire range of operation.
6. Verify ease of removal/reinstallation of retrievable equipment (e.g., rail-mounted pumps). Ensure that equipment moves freely on its guides, and rests securely in its operating position.

- B. Electrical
  - 1. Verify proper voltage and phase connections. Bump motors to ensure proper connection and direction of rotation.
  - 2. Test hardware interlocks to ensure interruption of power for safety devices (e.g., over-temperature).
- C. Controls
  - 1. Verify clear transmission of each signal from each equipment item and control device to the LCP and to the MASTER SCADA PLC. Test every condition available (analog and discrete) and verify receipt of same.
  - 2. Verify receipt of each control signal from the MASTER SCADA PLC to the LCP and to each equipment item controlled. Test every command (analog and discrete) and verify receipt of appropriate signal at equipment. Ensure connection of signal wires to appropriate point of contact at equipment.
  - 3. Simulate each warning and alarm condition, and ensure that proper responses result (equipment power-down, horn/light, SCADA HMI indications).

### 3.3 COMMISSIONING ACTIVITIES

- A. The following steps shall not be taken on any particular item of equipment until the Pre-commissioning activities for that equipment have been completed and signed off on the respective checklist.
- B. Mechanical
  - 1. Make final connections to equipment. Fill piping with clean water up to connected equipment, bleeding out air before final tightening.
  - 2. Ensure that valves and gates are in their normal operating or default position.
  - 3. Fill tanks to operating levels sufficient to test equipment. Provide a source of supply (e.g., pump around from discharge location to suction location) for equipment to be tested. Use only clean water until equipment has been verified fully functional and operating as intended. Temporary connections may be required for test purposes only.
  - 4. Operate equipment manually, starting at minimal speeds for VFD-driven equipment, and then increasing speed through the full range of operation. Verify flow and pressure signals consistent with operating curves at minimum and maximum operating points and multiple points between.
- C. Electrical
  - 1. Verify amperage drawn during equipment operation is consistent with manufacturer's data.
- D. Controls
  - 1. Verify proper operation of each individual function described in Division 25 Section "Sequence of Operation". Simulate conditions described which are not readily available as a normal occurrence, and ensure that results ensue as described.

### 3.4 FINAL SYSTEM STARTUP

- A. Coordinate with Engineer and Owner for scheduling of final startup. Do not commence startup of equipment without Engineer and Owner present and where applicable, relevant equipment manufacturers' startup personnel shall also be present.
- B. Make equipment adjustments as directed by Owner, or assist Owner in doing so, to achieve desired operating results.
- C. In coordination with the Engineer and Owner, establish operational and equipment minimum and maximum setpoints defined in Sequence of Operation. Document such values in the Operation and Maintenance manuals for the respective item of equipment.

**END OF SECTION 460803**

## SECTION 462423 – INLINE ELECTRIC GRINDER

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This section of the specification describes the grinder and controller. The equipment shall be installed as shown on the plans, as recommended by the supplier, and in compliance with all OSHA, local, state and federal codes and regulations.

#### 1.2 REFERENCES

- A. The grinder shall, as applicable, meet the requirements of the following industry standards:
  1. American Society for Testing and Materials (ASTM) A36: Carbon Steel Plate
  2. American Society for Testing and Materials (ASTM) A536-84: Ferritic Ductile Iron Castings
  3. American Society for Testing and Materials (ASTM) A48-83: Grey Iron Casting
  4. American National Standards Institute (ANSI) B16.42-1979, Class 150 Flanges
  5. American Iron and Steel Institute (AISI) 303 Stainless Steel
  6. American Iron and Steel Institute (AISI) 304 Stainless Steel
  7. American Iron and Steel Institute (AISI) 316 Stainless Steel
  8. American Iron and Steel Institute (AISI) 4130 Heat Treated Alloy Steel
  9. American Iron and Steel Institute (AISI) 4140 Heat Treated Alloy Steel
  10. American Iron and Steel Institute (AISI) 8620 Heat Treated Alloy Steel
  11. American Iron and Steel Institute (AISI) 17-4 Stainless Steel
  12. Society of Automotive Engineers (SAE) 660 Bearing Bronze
- B. The controller shall, as applicable, meet the requirements of the following Regulatory Agencies:
  1. National Electrical Manufacturer’s Association (NEMA) Standards
  2. National Electric Code (NEC)
  3. Underwriters Laboratory (UL and cUL)
  4. International Electrotechnical Commission (IEC)

#### 1.3 DOCUMENTS

- A. Submittals
  1. Submittals shall include equipment descriptions, functional descriptions, dimensional and assembly drawings, catalog data, and job specific drawings.
- B. Operation and Maintenance Manuals: Submit operation and maintenance manuals in accordance with Division 01 Section “Operation and Maintenance Manual”.

#### 1.4 QUALITY ASSURANCE

- A. Identification

1. Equipment shall be identified with a corrosion resistant nameplate affixed in a conspicuous location.
2. Nameplate information shall include manufacturer's name and address, equipment model number, and serial number.

B. Manufacturer

1. Supplier shall be ISO9001 certified and have a minimum 30 years experience as a manufacturer of municipal waste water equipment and a minimum 5,000 prior installations of similar equipment.
2. Supplier shall provide a list of reference sites for similar equipment for verification by the Engineer or Owner's Representative.
3. Supplier shall conduct factory testing and verification of equipment prior to shipment.
4. Supplier shall have factory owned bi-coastal service centers.

C. Installation & Start-up

1. Supplier shall provide services of a factory trained representative to check installation and review start-up of equipment and controls.
2. Supplier Representative shall inspect and approve site installation and supervise a review of the operation of the equipment.
3. Supplier Representative shall provide training on operation and maintenance requirements of the equipment.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging

1. Containers or skids shall be constructed for normal shipping, handling, and storage.
2. Containers shall provide adequate protection for the equipment in a dry indoor environment between 40°F (4.5°C) and 100°F (37.8°C).

## 1.6 WARRANTY

- A. Manufacturer's standard 12-month after start-up or 18-months after shipment, whichever occurs first, limited warranty shall be provided on equipment.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Grinder and controller shall be in accordance with these specification and plans and shall be supplied by one manufacturer.

### 2.2 GRINDER

A. General

1. Grinder shall reduce or shred influent solids for protection of downstream equipment. Grinder shall be two shafted design consisting of individual cutters and spacers. Grinder shall have a single piece main body housing consisting of pipe flanges and inspection

ports. Cutter cartridge shall be removable with the main body housing remaining in situ. Grinder shall have motor and speed reducer for cutter drive.

B. Components

1. Cutters and Spacers

- a. Cutting stack shall be a nominal height of 12-inches (305 mm).
- b. Cutter shall be an individual disk constructed of ASTM 4130 alloy steel surface ground to thickness of 0.310-inches +0.000/-0.001 (7.9 mm +0.000/-0.003).
- c. Cutters shall be heat treated to produce a hardness of 45-50 Rockwell C.
- d. Cutters shall have 11 cam shaped teeth. Tooth height shall not be greater than ½-inch (13 mm) above the root diameter of the cutter.
- e. Spacers shall be an individual disk constructed of ASTM 4130 alloy steel surface ground to a thickness of 0.319-inches +0.001/-0.000 (8.1 mm +0.003/-0.000).
- f. Spacers shall have a hardness of 32-38 Rockwell C.
- g. Spacers shall have a smooth outside diameter with no tooth profiles.

2. Shafts

- a. Shafts shall be ASTM 4140 alloy steel with a minimum tensile strength of 149,000 PSI (1,027 kPA).
- b. Shafts shall measure nominal 2-inches (51 mm) across flats of hex.
- c. Shafts shall be hardened to 38-42 Rockwell C.

3. Intermediate Shaft Supports

- a. Intermediate shaft supports shall be ASTM A351 stainless steel, AISI 17-4 stainless steel and SAE 660 bearing bronze.
- b. Shaft supports shall be lubricated with high temperature marine grade grease at the factory.
- c. Intermediate shaft supports shall provide additional support to the shafts during severe grinding demands.
- d. Intermediate shaft supports shall be provided only for cutter stacks of 24-inches (610 mm).

4. Seal Cartridges

- a. Seal cartridges shall be rated to a maximum of 90 PSI (620 kPA).
- b. Seal cartridges shall not require flushing.
- c. Dynamic and rotating seal faces shall be tungsten carbide with 6% nickel binder.
- d. O-rings shall be Buna-N (Nitrile).
- e. Radial and axial loads shall be borne by sealed, oversized, deep-groove ball bearings.

5. Housings and Covers

- a. Main body, gear, base, and end housings shall be ASTM A536-84 ductile iron.
- b. Top cover and inspection port covers shall be ASTM A536-84 ductile iron.
- c. Main body housing shall have inlet and outlet flanges with bolt pattern machined to 4-inch pipe flange size.
- d. Main body housing shall have integral side wall deflectors to direct solids into cutters.
- e. Inspection port covers shall be on both inlet and outlet sides of main body housing.
- f. End housing shall have integral bushing deflectors to guide solids away from seal cartridges.

6. Speed Reducer

- a. Reducer shall be manufactured by Sumitomo Machinery Corporation of America.
- b. Reducer shall be internal planetary mechanism with trochoidal curved tooth profile.
- c. Reducer shall be a vertically mounted with 29:1 single reduction.

- d. Reducer shall be grease lubricated.
- 7. Motor
  - a. Motor shall be 3 hp, TEFC, 1725 rpm, 230/460 volt, 3 phase, 60 Hz
  - b. Motor shall have a minimum service factor of 1.15, 87.5% minimum efficiency factor at full load, minimum 78% power factor at full load.

C. Performance

- 1. Grinder shall be capable of processing 100 GPM (6.31 L/S) with a maximum headloss of 1.1 psi (774 mm of water column).
- 2. Grinder shall provide peak shaft torque of 4,756 lb-in/hp (721 Nm/kW).
- 3. Grinder shall provide peak force at cutter tip of 2,051 lb<sub>f</sub>/hp (12,234 N/kW).

## 2.3 CONTROLLER

A. General

- 1. Controller shall provide control of the grinder and be designed to control one (1) 3 hp motor at 460 volts, 3 phase, 60 Hz. The controller shall have an indicator lights, switches and other control devices.

B. Components

- 1. All electrical components shall be NEMA rated and U.L. listed.
- 2. Enclosures
  - a. Enclosure shall be fiberglass reinforced polyester NEMA 4X .
  - b. Enclosure shall house the control devices, motor starters, and PLC.
- 3. Grinder ON-OFF/RESET-REMOTE three-position 22mm type, NEMA 4X selector switch
  - a. In the OFF/RESET position, the grinder shall not run.
  - b. In the ON position, the grinder shall run continuously.
  - c. In the REMOTE position, the grinder shall start and stop as controlled by an external device.
  - d. Selector switch shall be the only method for resetting the controller after failure.
- 4. Pilot Lights
  - a. Lights shall be LED type 22 mm, rated NEMA 4X.
  - b. Lights shall indicate POWER ON, RUN, and FAIL.
- 5. Programmable Logic Controller (PLC)
  - a. PLC shall be manufactured by Panasonic.
  - b. PLC shall have a minimum of 16K of memory.
- 6. Motor Starter
  - a. Starter shall be a full-voltage reversing type with 120 volt operating coils.
  - b. Overload relays shall be adjustable and sized to full load amperes (FLA) of the motor.
- 7. Control Transformer
  - a. Control transformer shall be minimum 130 VA.
  - b. Control transformer primary and secondary shall be fused for over current protection.
- 8. Current Transducer
  - a. Current transducer shall be manufactured by Veris Industries.
  - b. Current transducer shall have adjustable set point from 1-135A with 200 ms or less response time.

C. Performance

1. When a grinder jam obstruction occurs, the controller shall stop the grinder and reverse the rotation to clear the obstruction. If the obstruction is cleared, the controller shall return the grinder to normal operation. If three (3) reverses occur within a 30 second interval, the controller shall stop the grinder motor in a jam condition and activate the grinder FAIL indicator and relay.
2. When a power failure occurs while the grinder is operating, the grinder will resume operation once power is restored.
3. When a power failure occurs while the grinder is in a fail condition, once power is restored the fail indicator shall reactivate and remain until reset.
4. Reset of the grinder shall be accomplished from the controller only.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Grinder(s) and controller(s) shall be installed in accordance with supplier's installation instructions, and in accordance with all OSHA, local, state, and federal codes and regulations.

3.2 TESTING

- A. Test of grinder(s) shall demonstrate correct alignment, smooth operation. Test period shall demonstrate simulated jam conditions for grinder.

3.3 TRAINING

- A. A field training course shall be provided for operation and supervisory staff members. Field instruction shall cover items for successful operation contained in the operation & maintenance manuals.

**END OF SECTION 462423**



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## SECTION 463333 – POLYMER FEED SYSTEM

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Equipment included with the polymer system includes:
  - 1. Motorized Mixing Chamber
  - 2. Dilution water controls
  - 3. Diaphragm Neat polymer pump
  - 4. System Controls
- B. The polymer system shall be a skid mounted system including all interconnecting piping and wiring.

#### 1.2 QUALITY ASSURANCE

- A. Manufacturer shall have experience in manufacturing polymer activation and feed systems.
- B. All equipment provided under this section shall be obtained from a single supplier or manufacturer who shall assume full responsibility for the completeness and proper installation of the polymer activation and feed system.
- C. To insure quality and unit responsibility, the polymer activation and feed system must be assembled and tested by the manufacturer at its facility and be a standard regularly marketed product of that manufacturer. The manufacturer must have a physical plant, technical and design staff and fabricating personnel to complete the work specified.

#### 1.3 SUBMITTALS

- A. Shop Drawings
  - 1. Complete catalog information, descriptive literature, specifications and identification of materials of construction.
  - 2. Detailed drawings and schematics showing the equipment dimensions, size and location of connections.
  - 3. Power and Control wiring diagrams, including terminal and numbers.

### PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

- A. True Multi-Zone Mixing Chamber
  - 1. Polymer and water shall be mixed in a chamber designed to create sufficient mixing energy.

- a. The chamber shall contain a minimum of three (3) chambers. Dual mixing chamber designs shall be unacceptable.
  - b. This design shall include motor-driven impeller that will create high fluid shear at point of polymer and water introduction.
  - c. Polymer solution shall undergo a tapered mixing intensity slope as it exits the initial shear zone and passes through a second, and third mixing zones isolated by baffles. Each zone shall include a mixing impeller to create a distinctive mixing energy within each respective zone.
  - d. Each chamber shall contain Polymer activation efficiency consistent over the entire dilution water range.
2. Mixing chamber shall be opaque to prevent solution degradation from ultraviolet light. Clear mixing chambers shall be unacceptable.
  3. Impeller shall be driven by a  $\frac{3}{4}$  HP maximum wash down duty motor.
    - a. Motor shall be TEFC.
    - b. Impeller speed shall be 1,730 rpm, minimum.
    - c. Motor shall be direct-coupled to impeller shaft.

**B. Dilution Water Control**

1. Dilution water shall be split into two (2) streams. Primary water flow shall supply the mixing chamber.
  - a. Secondary water flow shall be used to post dilute the activated polymer stream to desired feed concentration.
  - b. These two (2) streams shall be completely blended by an integrated static mixer prior to application injection point.
2. Unit shall have an electric solenoid valve for on/off control of total dilution water flow.
3. Flow meters and flow control valves shall be provided for each dilution water stream.
4. Unit shall include a transparent static mixer in the solution discharge line.

**C. Pump**

1. The system shall include a polymer metering pump for feeding emulsion polymers.
  - a. Diaphragm pump output range shall be 0.062-6.2 USGPH, with viscosities up to 40,000 cps.
  - b. Pump output shall be 102 psig maximum.
  - c. Pump liquid end material of construction shall be PVDF head with PTFE seals.
  - d. Pump shall have optoGuard technology to detect blocked metering points or broken lines and to detect airlocks within the pump. Pumps utilizing external flow switches shall not be acceptable.
  - e. Pump shall include optoDrive technology to allow user to set a slow pressure stroke for continuous dosing or quick stroke to prevent incomplete filling of the liquid end. Pumps that do not include this feature shall not be acceptable.

**D. Controls**

1. Unit shall include system controls housed in a Nema 4X polycarbonate enclosure.
2. Controller shall have a three position manual switch to select manual, auto, or off operation. User interface shall include a push button keypad, LCD display, status lights, and Ethernet connection to configure and monitor operation.
  - a. In the Auto switch position, the unit shall accept a remote run signal. Unit is locally controlled in the Manual switch position.
  - b. Percent polymer concentration shall be established via keypad in the Manual mode or by a remote 4-20 mA analog signal in the Auto mode.
  - c. Unit shall provide both pulse and 4-20 mA outputs to drive polymer pump.

- d. Unit shall automatically control the polymer pump speed to maintain the set point % concentration regardless of changes in dilution water flow.
- e. The unit shall have an input to monitor polymer pump feed verification and shall alarm if pump feed is not detected.
- f. Controller interrogation and configuration shall be possible via an Ethernet connection permitting a graphical user interface.
- g. Unit shall provide a running status indication via dry contact output.
- h. Polymer pump shall be configured for maximum dosage rate using the controller keypad and display.
- i. Unit shall detect loss of water flow, sensing that water flow has been interrupted for any reason, will place the polymer pump and mix chamber on standby and will restart it automatically when flow is restored.
- j. Unit shall have a red indicating light which is illuminated upon an alarm condition and a green indicating light when the system is running. Specific alarm status shall be available using the keypad and display.
- k. Unit shall provide for an adjustable delay of 30 seconds minimum upon initial power up to permit mix chamber water fill. Thereafter the refill of the mixing chamber without polymer feed shall not be possible without power reset.

## 2.2 TECHNICAL DATA

- A. Connections – Plumbing
  - 1. Dilution water inlet: 1½-inch FNPT
  - 2. Neat polymer inlet: ½-inch FNPT
  - 3. Solution discharge: 1½-inch FNPT
- B. Connections – Electrical
  - 1. Standard, grounded male plug: 120/1/60, 15 amps
  - 2. Plug in connection: 4-20 mA signal input
  - 3. Terminal blocks: Dry contact input for remote start
- C. Dimensions
  - 1. 40-inches wide x 34-inches deep x 72-inches high
- D. Materials of Construction
  - 1. Structural frame: 304 stainless steel
  - 2. Plumbing: PVC
  - 3. Mixing chamber: PVC
- E. Performance
  - 1. Dilution water: 2½ – 25 gpm primary mixing  
2 ½ – 25 gpm post dilution
  - 2. Metering pump: 0.31 – 6.2 gph neat polymer

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. The equipment shall be installed per the contract documents and manufacturer's recommendations.

### 3.2 WARRANTY

- A. Polymer feed system shall be warranted for a period of 12 months from the date of start-up by authorized technician.
- B. Damage due to makeup water particulates will not be considered as a warranty defect and will be the responsibility of the owner.
- C. In addition, supplier shall warrant the system to operate in accordance with owner's expectation and performance.
- D. If dissatisfied with system performance for any reason, the owner shall have the right to return the system to vendor for a refund of vendor's sale price any time during the first 30 days following start-up.

### 3.3 MANUFACTURER'S SERVICES

- A. Manufacturer's Certificate
  - 1. Provide a manufacturer's certificate showing the equipment has been satisfactory calibrated and tested.
  - 2. An authorized manufacturer's representative shall inspect the installation of all work furnished under this section and shall provide a certificate of proper installation.
- B. Manufacturer's Services
  - 1. The manufacturer shall provide the services of an experienced, authorized manufacturer's representative (salesperson does not qualify) for the equipment specified herein who shall be present at the jobsite designated by the City for the minimum man-days listed for the services shown below, time travel excluded:
    - a. One (1) man-day per site for inspection, start-up, functional testing and certificate of proper installation.
    - b. One (1) man-day per site for Training and Commissioning.

## PART 4 - ACCESSORIES

- 4.1 Calibration Cylinder: A suitably sized calibration cylinder shall be supplied for the neat polymer feed pump. Cylinder shall be mounted to frame with PVC isolation ball valves. Cylinder shall be calibrated in mL, and be constructed of clear PVC with slip on cap and ½-inch NPT vent connection.

- 4.2 Plastic Ball and Ball Check Valves: Plastic valves shall be PVC (polyvinylchloride) Type 1, Grade 1 with all classification conforming to ASTM D 1784. Ball valves shall be either safeblock true union type having socket ends or threaded ends as required, Viton ring seals, and teflon seats. Ball valves shall be rated for 150 psi water-working pressure at 75°F. Check valves shall be double union, ball type rated at 150 psi water-working pressure at 75°F.

**END OF SECTION 463333**

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## SECTION 464111 – SLUDGE TANK MIXER

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This specification covers the supply of one (1) Mixer.
  - 1. Each basin is 18'-0" wide, by 18'-0" long with a side water depth of 18'-0" and with a distance from the water surface to the mounting surface of the mixer of 2-feet.
  - 2. The unit(s) will be designed to meet the following requirements:
    - a. Minimum Flow 0.072 MGD
    - b. Normal Flow 0.108 MGD
    - c. Maximum Flow 0.216 MGD
    - d. Mean Velocity Gradient "G" 1000 Sec<sup>-1</sup>
    - e. Design Water Temperature 5°C
  - 3. Each mixer assembly shall consist of a heavy-duty gearbox, electric motor connected by a flexible coupling, baseplate, mixing shaft and mixing impellers.

#### 1.2 GENERAL

- A. Bridge support for rapid mixer(s) shall be constructed from aluminum material and design shall be sealed by a North Carolina Registered Engineer.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. The upper mixing impeller shall be of the pitched blade flow design with a minimum impeller diameter of 84-inches and a maximum operating speed of 30 RPM. The lower mixing impeller shall be of the radial blade design with a minimum impeller diameter at 40-inches and a maximum operating speed of 30 RPM. The impeller shall be constructed of 316 stainless steel material with the blades bolted to the hub and with the hub fixed to the shaft with a hook key and set screws for maximum security. An extended keyway shall be provided which will allow vertical adjustment of the impeller ±12-inches in 3-inch increments.
  - 1. The maximum combined stress in any impeller component shall not exceed 11,000 psi under maximum operating loads. The shaft/impeller design shall be such that its operating speed shall not exceed 70% of its first lateral critical speed. Upon request, stress and critical speed calculations supporting shaft and impeller design are to be supplied with the submittal package.
- B. The mixer gear reducer must be built in accordance with current AGMA standards. The reducer shall be a right angle design with horizontal input shaft and vertical output shaft. Speed reduction to be accomplished by use of a double reduction gearbox with high speed helical gearing and low speed spiral bevel gearing. The maximum ratio for any one gear set will be 6.2:1. Efficiency shall be no less than 98.5% efficiency per gear mesh. The housing shall be



fabricated steel. The housing shall have an enlarged low speed bore to allow for assembly and adjustment of the low speed bevels without disturbing the high-speed gearing.

1. The housing shall have a removable high-speed end for easy ratio change and assembly/disassembly of the high-speed end without disturbing the low speed gearing. Each unit will be provided with an integral or separate baseplate suitable for mounting as shown on the drawings.
  2. All gearing shall be lubricated by means of oil splash or immersion into the oil bath. The drive shall be equipped with a dipstick and/or an oil level sight glass to check the oil level. The drives must incorporate a drywell feature in the output area to eliminate the possibility of oil leakage down the shaft. Selected bearings may be grease lubricated provided they include a high quality seal to retain the grease.
  3. The drive's minimum AGMA service factor, based on motor nameplate horsepower, will be 1.5. Upon request, documentation supporting gear ratings are to be supplied with the submittal package. Thermal ratings shall be calculated for continuous operation per AGMA standards based on a maximum sump temperature of 200°F and an ambient temperature of 100°F.
  4. All drive bearings shall be of the antifriction type, ball or roller bearings. All bearings within the drive, including the output shaft bearings, shall have a minimum L-10 bearing life of 100,000 Hrs. when operating at full motor nameplate horsepower at the designed speed. Upon request, documentation supporting bearing life will be supplied with the submittal package.
- C. The mixing shaft shall be coupled to the gearbox output shaft by means of a rigid flanged coupling. Mating coupling faces shall have a male/female piloted connection for accurate concentricity and shall not require match marking for alignment.
1. The mixing shaft and coupling half shall be constructed of 316 stainless steel material. The shaft shall be designed such that the maximum combined stress does not exceed 9,000 psi under maximum operating loads. It shall be of overhung design; the use of underwater steady bearings is not permitted. Shaft straightness and rigid coupling squareness must be such that the maximum total indicated runout at the lower end of the shaft does not exceed 0.125-inches for every 10-feet of shafting, as measured when turning over by hand.
- D. The electric motor shall be rated for continuous duty in a humid corrosive environment. Insulation shall be class F with a Class B temperature rise at 40°C ambient at 1.0 service factor. Service factor will be 1.15.
1. The motor shall be squirrel cage induction type for operation on 3 PH, 60 HZ, 480 V. Synchronous speeds shall be 1800 RPM. All motors shall be designed with applicable IEEE, NEMA, and ANSI standards. Motor shall be inverter duty rated.
  2. Motors shall be connected to the reducer's input shaft with an easily accessible torsionally resilient flexible coupling protected by an OSHA coupling guard.
- E. The spare parts to be supplied are one set of bearings, oil seals and gaskets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Upon installation, this unit shall be run to demonstrate its ability to operate without overloading, jamming or excessive vibration during normal operation.
- B. Contractor shall provide in base bid, two (2) field days for start-up and one (1) field day of service.

**END OF SECTION 464111**

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## SECTION 466113 – FILTER MEDIA

### PART 1 - GENERAL

#### 1.1 DESCRIPTION:

- A. Remove and dispose (off-site) of the existing filter media in four (4) filters (or other quantity according to Owner's selection of Alternates, if Alternates are selected), each bay measuring eighteen (18) feet by twenty (20) feet, for a total filter area of 360 square feet. Existing media depth varies by filter, but is up to thirty-nine (39) inches.
- B. The media supplier shall also perform the media installation.
- C. Furnish, install, and test new filter media as indicated and specified. The filters shall consist of High Rate Dual Media; filter sand and filter anthracite, produced in the USA, with a MOH Hardness of 3.00 or more, as specified herein.
- D. Coordinate filter media replacement with filter rehabilitation work, to assure that the plant can remain operational, meeting all of the needs of the Owner. Owner will advise how many filters may be removed from service at any given time.

#### 1.2 SUBMITTALS

- A. Furnish test data from a licensed and recognized independent testing laboratory, detailing the following characteristics. The test data is to be submitted in the form of Shop Drawings, and approved prior to the commencement of work:
  - 1. Supplier's name
  - 2. Gradation
  - 3. Date of Sampling/Lot Number
  - 4. Complete Sieve Analysis of representative samples; Effective Size, Uniformity Coefficient, Specific Gravity, and Acid Solubility covering each of the filtering materials.
  - 5. In addition, MOH's Hardness, Friability, Carbon Content, and Volatile Matter, Ash Content of anthracite.
- B. Supply backwash data, expansion data, and headloss data for media supplied, prior to delivery to jobsite.
- C. Furnish an Affidavit of Compliance from the media supplier stating that the filter media furnished complies with the requirements of the contract specifications.
- D. Media for all filters shall be of a single supplier with at least ten (10) years' experience in manufacturing and furnishing high rate media systems. Submit detailed evidence of experience to the Owner prior to commencement of work. Furnish a Reference List, including at least 25 similar projects, where similar work has been successfully completed within the past five (5) years. Include filter dimensions, project identification, Owner, scope of work, and contact information.

- E. The schedule of work, testing, and installation procedure shall be submitted to the Owner/Engineer for approval prior to commencement of work.

### 1.3 STANDARDS:

- A. American Water Works Association B100 16; "Standard for Filtering Material."
- B. The filter media shall be listed by the National Sanitation Foundation under Standard 61 Process Media.

### 1.4 DELIVERY AND RECEIVING:

- A. Do not ship materials until the Owner approves Shop Drawings.
- B. Deliver filter media in "semi bulk" containers having lifting sleeves and bottom discharge spout, weighing approximately 2,000 - 4,000 pounds each or in one cubic foot bags and palletized. Delivery of "bulk" shipments will not be permitted, unless Engineer/Owner approves storage and handling procedures prior to commencement of work.
- C. Owner can provide outdoor storage space for filter media. Contractor shall be responsible for unloading and protection from weather.

### 1.5 REJECTION OF FILTER MEDIA:

- A. Failure of the filter media to meet the requirements of these specifications shall constitute cause for rejection. Filter media which has been rejected shall be removed from the site and replaced with acceptable material at the contractor's expense.

## PART 2 - PRODUCTS

### 2.1 FILTER MEDIA:

- A. Filter sand shall be composed of hard, durable, clean silicious particles, free of all mica, with an average specific gravity of 2.60 (or more) and shall be in strict accordance with AWWA B100 16. The effective size shall be 0.45 - 0.55 mm, with a uniformity coefficient of 1.65 or less. The acid solubility shall be less than 5%. The finished bed depth after backwashing and skimming of fines and debris shall be 12-inches.
- B. Filter anthracite shall be composed of specially selected and graded hard, durable anthracite coal particles. The anthracite shall have an average specific gravity of 1.60 (or more), with hardness (MOH Scale) of 3.00 or more, and shall be essentially free of iron, sulfides, clay, shale, extraneous dirt, and excessive dust and shall be in strict accordance with AWWA B100 16. Carbon Content shall be a minimum of 80 percent on a dry weight basis. Ash Content shall be a maximum of 15%. Volatile Matter shall be 7% maximum on dry weight basis. The effective size shall be 0.95 - 1.05 mm, with a uniformity coefficient of less than 1.40. There shall be not more than 3% float when placed in a fluid of specific gravity of 1.45, and not more than 3% sink when placed in a fluid of specific gravity of 1.95, when tested in accordance with

ASTM D4371 84, Methods for Determining the Washability Characteristics of Coal. The filter anthracite shall be processed with wet washing, screening, and biological neutralization. The finished bed depth after backwashing and skimming of fines and debris shall be 18-inches.

- C. The durability or friability of the anthracite grains may be determined by performing a paint shaker abrasion test as described hereinafter. The test shall be performed using filter anthracite typical of the anthracite to be utilized on this project. The certified pre-approved independent testing laboratory shall perform the paint shaker abrasion test as follows:
1. Measure 100 grams of a representative sample of coal to the nearest 0.01 gram  $\pm$ . Perform a sieve analysis of the sample using U.S. Screen Size Nos. 10, 12, 14, 18, 20, 30, and 40. After shaking the screens for 5 minutes using a sieve shaking machine, measure the amount of anthracite on each screen in grams.
  2. Compute the average grain size of the material retained on each screen by averaging the screen opening size of the adjacent screen, the material passed and the screen opening size of the screen on which the material was retained. Multiply the average size in mm by the amount in gram retained on each screen. Add the total products obtained above and divide this by the total volume retained in gram. The result is the average size of the anthracite.
  3. Carefully remove all of the anthracite retained on the screen and place in a quart can with lid. Shake the can containing the anthracite in a mechanical {Red Devil, Miller Paint Model U, Model #70511 or equal} paint shaker for 45 minutes. Perform a sieve analysis on the anthracite as before and recalculate the new average size of the anthracite. The percent reduction in grain size is the difference between the original and final average grain size divided by the original average size. Friability should be less than 3%.

## PART 3 - EXECUTION

### 3.1 REMOVAL AND INSTALLATION

- A. The filters shall be thoroughly cleaned prior to media placement and shall be kept clean throughout the operation. Materials made dirty in any way shall be removed and replaced with clean materials.
- B. Inspect and document conditions of facility prior to and after completion of work. Contractor is cautioned to perform work without damage to Owner's facility. Extreme care shall be taken in removing the existing material not to damage any components or systems that will remain. Coordinate with filter box demolition operations.
- C. Place materials through hydraulic installation equipment, directly into the filters from the shipping containers, without discharging contents onto belt conveyors of any type. Place filter material directly in the filters from the bags through a water slurry method utilizing an ejector system and an energy diffuser. Water to be furnished by the Owner at approximately 450 - 500 gpm during hydraulic installation process. Procedure to be approved by the Engineer and/or Owner prior to commencement of work.
- D. Obtain correct thickness of each layer by marking a level line on the side of the box. Then level the layer against a water surface held at the appropriate mark.

- E. Install all filtering materials per the instructions of the manufacturer's onsite technical representative. The manufacturer shall furnish a Certificate of Installation detailing that the filtering materials were installed in accordance with the manufacturer instructions, and that the manufacturer has performed the placement/installation specified herein.
- F. Carefully place material so as not to disturb the previous layers.
- G. Do not stand or walk directly upon the filtering materials, but on boards which will sustain the weight of the workmen without displacing the media.
- H. Measure depth of layer of media after media has been backwashed and skimmed as recommended by manufacturer.

3.2 DISINFECTION:

- A. After all work is completed and before the filter is placed in service, the Owner will disinfect the entire filter by chlorination.

**END OF SECTION 460803**

## SECTION 466119 – WASH WATER TROUGHS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes fiberglass reinforced plastic (FRP) troughs for clarifier effluent as shown on the Contract Drawings.

#### 1.2 QUALITY ASSURANCE

- A. The material covered by these specifications shall be furnished by a reputable and qualified manufacturer of proven ability that is regularly engaged in the manufacture and installation of FRP products.
- B. Fabricator shall be experienced in successfully producing FRP products specified for this project, with sufficient production capacity to produce required units without causing delay in the work.
- C. Fabricator shall provide a list of five (5) installations of comparable size in operation for at least three (3) years.
- D. All products shall be compliant with NSF for use with drinking water.

#### 1.3 SUBMITTALS

- A. The following shall be submitted in accordance with the General and Special Provisions.
  - 1. Shop Drawings
    - a. Dimensions.
    - b. Job specific layout.
    - c. Sectional assembly.
    - d. Location and identification mark.
    - e. Weir locations and attachment
    - f. Accessories, attachments, transition pieces.
    - g. Connection details.
  - 2. Manufacturer's catalog data showing:
    - a. Dimensions, spacing, and construction details
    - b. Materials of construction.
    - c. Description.
  - 3. Certificates
    - a. Submit Manufacturer's certification that all materials furnished are in compliance with the applicable requirements of this specification.
  - 4. Manufacturer's Instructions
    - a. Submit complete information and instructions relating to the storage, handling, installation, and inspection of all equipment related to this Section.



## 1.4 SHIPPING AND STORAGE INSTRUCTIONS

- A. All FRP components shall be shop fabricated and assembled into the largest practical size suitable for transporting.
- B. The parts and assemblies that are shipped unassembled shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final assembly in the field.
- C. All FRP materials shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials.

## PART 2 - PRODUCTS

### 2.1 DESIGN CRITERIA

- A. Gravity Load: Downward vertical loads shall include the weight of the trough and appurtenance attachments, such as weir plates, baffles and spreader bars, together with the weight of water to fill the trough. Any additional loads, such as piping, etc., shall also be considered.
- B. Buoyant Load: The buoyant load shall act vertically upward, its magnitude equal to the weight of displaced water (trough weight neglected). The line of action passes through the centroid of the submerged cross-sectional area.
- C. Lateral Load: Loads acting against the trough sidewalls; specifically those induced by differential water levels on either side of the trough walls. The maximum possible differential, existing when the trough is empty and the tank is full, or, when the trough is full and when the tank is empty, shall be used when calculating deflection, fiber stress, etc.
- D. Thermal Stresses: The troughs shall be designed to accommodate temperature induced stresses resulting from differences in coefficients of thermal expansion (contraction) between the trough and tank/support materials over temperature range of -10°F to 100°F.
- E. Torsional Stability: The trough system shall be designed to resist torsional oscillations induced by the flow of water over trough edges. Any or all of the following trough stabilization techniques shall be considered.
  - 1. Trough-to-trough stabilization
  - 2. Torsional stiffness
  - 3. Support spacing and rigidity
  - 4. Internal baffles and/or flow straighteners
- F. Deflection under Load: Maximum vertical deflection under full buoyant or gravity load shall be less than or equal to  $L/1000$ , where L is defined as the unsupported trough length in inches. Under no circumstances shall the maximum vertical deflection, measured at mid-point between trough supports, exceed 3/16-inches.
- G. Maximum trough sidewall horizontal deflection under full lateral load shall be less than or equal to  $D/100$ , where D is defined as the trough depth, in inches. Under no circumstances shall the maximum bottom deflection exceed 3/16-inches.

- H. Trough bottom deflection (oil canning) under full buoyant or gravity load shall be less than or equal to W/100, where W is defined as the trough width, in inches. Under no circumstances shall the maximum bottom deflection exceed 3/16-inches.
- I. Thermal Expansion/Contraction: The troughs shall be designed to accommodate a thermally induced expansion (contraction) of 1/8-inches per 20 foot length of trough over temperature range of -10°F to 100°F, without exceeding the deflection or strain limitations set forth in the preceding sections

2.2 MATERIALS

- A. The trough laminate shall meet the following minimum physical and mechanical requirements:

<u>Property</u>	<u>Test</u>	<u>Minimum Value</u>
Tensile Strength	ASTM D-638	25,000 psi
Flexural Strength	ASTM D-790	34,000 psi
Flexural Modulus	ASTM D-790	1.48 x 10 <sup>6</sup> psi
Barcol Hardness	ASTM D-2853	40
Notched Izod	ASTM D-256	20 ft-lbs/in
Water Absorption	ASTM D-570	0.1%

- B. Resin: The resin shall be a commercial grade isophthalic polyester thermosetting resin, Corezyn COR75-AQ-010 or equivalent, which has either been evaluated in a laminate, or which has been determined to be acceptable for use in a potable water treatment plant environment.
- C. Fillers: The resin shall contain no fillers. Thixotropic agents for viscosity control are acceptable. Colorants which have been determined by a least five years previous service to be acceptable for the service condition are acceptable. The standard color for the trough shall be green. Ultraviolet stabilizers are required in all trough laminates. Catalysts, accelerators and/or promoters shall be added to provide complete cure of the laminate and must meet the physical properties as indicated in 2.2A.
- D. Ultraviolet Resistance: Ultraviolet resistance is required in all laminates exposed to ultraviolet light, whether it be in the form of pigmentation or ultraviolet absorbers or a surface veil.
- E. Metal Reinforcement: When metal reinforcements are used, they shall be free of rust, oil and any foreign matter. They shall be completely encapsulated with a minimum of 1/8-inch thick laminate.
- F. Glass Mat Reinforcement: Glass mat reinforcement shall consist of chemically bonded surfacing mat and chopped strand or chopped strand mat as hereinafter described. Surfacing mat shall be 0.020-inches thick reinforced with a surfacing mat of Type C veil, 10 to 20 mils thick, with a silane finish and a styrene-soluble binder compatible with the resin; the glass content of this layer shall not exceed 20% by weight. Chopped strands shall be Type E glass, with silane finish and styrene-soluble binder.
- G. Woven Roving Reinforcement: The finished laminate shall include one layer of 24 ounce woven roving reinforcement over the entire trough surface.

- H. The content of the finished laminate shall be adequate to produce mechanical and physical properties conforming to the requirements in 2.2A.
- I. Other Reinforcement: Additional reinforcement in the form of foam or balsa sheet for high stress areas at the sides and bottom of the trough shall be completely encapsulated within the laminate. Care shall be taken to insure that these areas of the trough laminate are not designated as attachment points or drilled for any purpose.
- J. Laminate Construction
  - 1. Inner trough surface shall be a resin rich layer 0.020-inches thick reinforced with a 10-20 mil 'C' veil surfacing mat. This resin rich layer shall contain less than 20% by weight of the reinforcement veil. A gelcoat interior surface may be provided.
  - 2. Structural layers shall consist of plies of chopped strand mat with a maximum of 2 ounces per square foot per spray-up pass. Inter-layered between two layers of mat shall be one layer of 24 ounce woven roving over the entire trough structure. Each successive pass of reinforcement shall be thoroughly wetted with resin and shall be well rolled to exclude all air pockets and bubbles prior to the application of additional reinforcement.
  - 3. Outer trough surface shall consist of a resin rich layer not less than 0.020-inches thick. The outer layer resin shall be applied after cure of the structural layer and suitably embed all reinforcing fibers.
  - 4. Finished trough shall be a minimum of 30% fiber reinforced with a minimum thickness of not less than ¼-inch. The laminate tolerance thickness shall be +10%.
- K. Materials used in the manufacture of the FRP troughs shall be new stock of the best quality and shall be free from all defects and imperfections that might affect the performance of the finished product.

## 2.3 DESIGN AND MANUFACTURE

- A. The inner surface of the trough shall be smooth and resin rich. The outer surface shall be reasonably smooth, resin rich, and no glass fibers shall be exposed. The size and number of air bubbles shall be held to a minimum. Laminations shall be dense and without voids, dry spots, cracks or crazes.
- B. The top edges of the trough shall be level and parallel with a tolerance of ±1/8-inches (measured when the trough is not loaded).
- C. The length of a trough section shall have a tolerance of ±1/8-inches per 10 foot length.
- D. Horizontal stiffening flanges shall be integrally molded along the top edge of each trough side. These flanges shall be 1- to 3-inches wide, depending upon the trough configuration and shall face outward.
- E. End flanges, where required to bolt trough sections together, and blind ends for securing to a wall, shall be a minimum of 1½ times the nominal thickness of the trough.
- F. An integrally molded water stop shall be provided on the trough whenever the trough is grouted into and/or passes through a wall.

- G. Horizontal stiffeners shall be provided across the width of the trough to increase the structural rigidity of the trough system. The stiffeners shall be 1-inch diameter PVC pipe with an internal ½-inch stainless steel rod threaded on both ends and fastened through the trough walls on 2-foot centers, or as recommended by the manufacturer.
- H. After fabrication, all cut edges, holes and abrasions shall be sanded smooth and sealed with a compatible resin coating to prevent the intrusion of water.

#### 2.4 TROUGH SUPPORTS AND HARDWARE

- A. Manufacturer shall be responsible for the design and fabrication of supports suitable for installation of the troughs specified herein.
- B. Trough supports may be hot dip galvanized steel, type 316 stainless steel, or FRP.
- C. All trough mounting hardware shall be Type 316 stainless steel and shall be supplied by the trough manufacturer.

#### 2.5 GUARANTEE

- A. The equipment manufacturer shall guarantee each unit being supplied to the Owner against defects in workmanship and material for a period of two years under normal use, operation and service. The guarantee shall be in printed form.
- B. In the event a component fails to perform as specified or is proven defective in service during the guarantee period, the manufacturer shall provide a replacement part without cost to the Owner. Provide, without cost, such labor as may be required to replace, repair or modify all materials and equipment provided pursuant to this specification.

### PART 3 - EXECUTION

#### 3.1 STORAGE

- A. Should it be necessary to store product prior to installation, precautions should be taken to prevent cracking, twisting, warping, distortion, bending, breaking, chipping or damage of any kind to the materials.

#### 3.2 INSTALLATION

- A. Install troughs and supports in accordance with manufacturer's instructions and approved shop drawings.
- B. Do not field cut troughs except with prior written approval of the Engineer. All field cut edges and field drilled holes shall be sealed per the manufacturer's instructions.
- C. Ensure that troughs and supports are installed plumb and true, free of warp or twist, within the tolerances specified by the manufacturer and as shown on the drawings.

- D. After the manufacturer has approved the installation, and prior to startup, clean all surfaces in accordance with the manufacturer's instructions.

**END OF SECTION 466119**

## SECTION 466127 – HIGH RATE SAND FILTER UNDERDRAINS

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED:

- A. This section of the specifications covers the furnishing and installation of an Underdrain System replacement in water treatment plant high rate sand filters.

#### 1.2 DELEGATED DESIGN RESPONSIBILITY

- A. The following items are a part of this section and shall be furnished by one manufacturer to ensure a properly designed and integrated underdrain system. The number of basins is as indicated on the Drawings.
  - 1. Underdrain Laterals for a filter floor coverage area and lateral orientation as shown on the Drawings. The laterals shall be fitted for bottom center water and air connections.
  - 2. Bottom connections to laterals (including drop tubes, J-risers if applicable, and all necessary gasketing) shall be by a manufacturer-designed and manufacturer-provided insert installed into the filter floor over or integrated into the influent flume shown on the Drawings. The insert shall be designed to be fully compatible with the Engineer's flume design shown on the Drawings.
    - a. Engineer's design delivers air to, and water to/from the flume in bulk. Underdrain Manufacturer's design shall address proper and even distribution of air and water among the laterals.
  - 3. Manufacturer shall supply field devices and methods to inspect installation and verify air flow distribution prior to media placement.

#### 1.3 QUALITY ASSURANCE:

- A. The underdrain system shall be furnished by a single manufacturer who shall comply with the following:
  - 1. The equipment manufacturer must maintain an ongoing quality assurance program, including ISO-9000 certification.
  - 2. All welders must maintain certification to ASME Section IX. Copies of certifications shall be provided upon request.
  - 3. The single manufacturer supplying this equipment must be able to furnish proof of over (50) installations and (10) years of manufacturing equipment of similar technology.

#### 1.4 SUBMITTALS

- A. Provide fully-dimensioned details of each component, identifying materials of construction
- B. Provide hydraulic calculations (CFD modeling) demonstrating adherence to maldistribution requirements
- C. Provide calculations demonstrating compliance with uplift design requirements

## 1.5 SUBSTITUTIONS

- A. Manufacturers and products other than those listed herein or added by Addendum during the bidding process must meet EVERY provision of this specification Section except those expressly attributed herein to a particular manufacturer or product. Such Substitutions not meeting EVERY provision will be rejected without further consideration, and Contractor shall thereafter promptly submit one of the named products.
- B. Engineer will consider other Substitutions ONLY if a complete PRE-QUALIFICATION PACKAGE is received at the office of the Engineer at least twenty (20) days prior to the bid. Any such package must contain as a minimum:
  - 1. Detailed layout drawings
  - 2. Welder certifications
  - 3. Evidence of a recognized ongoing quality assurance program.
  - 4. Detailed component specifications and catalog cuts as required.
  - 5. Detailed list of ALL VARIATIONS required from the original design, referencing appropriate sections of the specifications and locations on the drawings.
    - a. Copy of Contract Drawings, illustrating all such variations
    - b. Copy of this Specification Section, highlighting and detailing all such variations
  - 6. Full installation list of proposed equipment including six (6) user references.
  - 7. Bidder's certification that Bidder shall bear all costs associated with any redesign required for use of the Substitution.
- C. Qualifying Substitutions will be recognized by Addendum a minimum of (7) days prior to the bid.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All system components and equipment utilized in the underdrain system, including those described in Part 1 shall be furnished as a complete integrated system by one manufacturer. Pre-qualified manufacturers and products include:
  - 1. PVC Triton Underdrain Lateral system, product of Johnson Screens, New Brighton, MN.
  - 2. Type XA Underdrain Lateral system with I.M.S. 200 Media Retainer, product of Leopold (Xylem Water Solutions USA, Inc.), Zelenople, PA

### 2.2 UNDERDRAIN LATERALS, GENERAL

- A. Laterals shall supply water and air backwash together. Designs supplying air and water through separate lateral components are not allowed. The underdrains shall be specifically designed to provide uniform distribution of air, water and simultaneous air/water during backwashing through integral orifices.
- B. Underdrains shall be designed for direct filter media retention, requiring no media support gravel. Openings shall be no greater than 0.2 mm in width.

- C. Laterals shall be hydraulically capable of water-only backwash rates of up to 23 gpm per square foot, air-only backwash rates of up to 5 scfm per square foot, and simultaneous water/air backwash rates of 6 gpm per square foot (water) plus 5 scfm per square foot (air). These backwash rates are based on filter floor area, not effective plan area of the laterals themselves.
  - D. Maximum allowable headloss of the laterals shall not exceed the following (in inches of water column), between the entry to the flume and the underdrain-filter media interface.
    - 1. For water-only backwash:
      - a. 3.0-inches at 5.0 gpm/sf
      - b. 23.0-inches at 15 gpm/sf
      - c. 32.0-inches at 18 gpm/sf
      - d. 50.5-inches at 23 gpm/sf
    - 2. For simultaneous water/air backwash:
      - a. 4.5-inches at 5.0 gpm/sf plus 2.0 scfm/sf
      - b. 9.0-inches at 5.0 gpm/sf plus 4.0 scfm/sf
      - c. 10.9-inches at 6.0 gpm/sf plus 5.0 scfm/sf
    - 3. Maldistribution across the laterals (from inlet location to each end) shall not exceed  $\pm 3.0\%$  as proven by CFD modeling, across the full range of hydraulic conditions listed in this Section.
  - E. The plan (effective) area of the laterals through which water and air are introduced into the filter media (not including the space between laterals, edge portions of laterals that contain no provision for supply of water and air, or portions of the laterals blocked by hold-down devices) shall be at least 79% of the total filter floor area. Parallel spacing of laterals shall be even across the entire filter floor. Perimeter clearance from the filter walls shall be no greater than the spacing between laterals. Clearances shall be designed to eliminate backwash dead zones, or shall be grouted full.
  - F. Laterals shall be designed to withstand an internal-to-external differential pressure of at least 10 psi. Lateral hold-down system and installation hardware shall be by the Manufacturer, designed sufficient for a 15 psi (1 bar) uplift.
  - G. Underdrain system shall be suitable for installation on a concrete filter floor which is flat to within  $\frac{1}{4}$ -inch in total. Gasketed connections at lateral inlets shall provide positive seal to exclude air or water bypass of laterals under all flow and pressure conditions anticipated.
- 2.3 TRITON UNDERDRAIN SYSTEM (requirements of this Paragraph apply only to products of Johnson Screens)
- A. The filter underdrain system shall consist of Triton scallop laterals as shown on the plans. The laterals shall be unitized assemblies of Vee-Wire screen and perforated integral channel rod. The components shall be fabricated from non-metallic NSF approved material.
  - B. The media retention surface shall cover a minimum of 105% of the floor surface of the filter. The media retention surface shall be on the top half of the laterals only and have an open area of 6%.
  - C. Laterals shall have a maximum height of 5½-inches and be supplied fully assembled to full length.



- 2.4 LEOPOLD UNDERDRAIN SYSTEM (requirements of this Paragraph apply only to products of Xylem Water Solutions)
- A. The filter underdrain system shall consist of Leopold Universal Type XA Underdrain of the Dual/Parallel Lateral type, manufactured from corrosion resistant, high density polyethylene. Blocks shall be fitted at the factory with molded thermoplastic I.M.S. 200 media retainer prior to shipment.
  - B. Air entry into laterals shall be by J-risers attached to a stainless steel air header, all provided by the manufacturer. The header shall attach to the air supply pipe inside the flume.
  - C. Laterals shall have a maximum height of 10-3/8-inches.

### PART 3 - INSTALLATION:

#### 3.1 UNDERDRAIN COORDINATION WITH FILTER BOX

- A. Identify Underdrain manufacturer's requirements for filter floor (substrate) to which the laterals will be attached. Coordinate preparation of the floor with such requirements, including placement of flume insert(s), hold-down embedments, finish, etc. to ensure floor is fully compatible with underdrain installation.

#### 3.2 MANUFACTURER'S SUPERVISION

- A. Underdrain manufacturer shall provide step-by-step details of installation methods. Contractor shall adhere fully to these instructions. Provide services of a qualified manufacturer's factory representative on-site to continuously and personally monitor installation of at least all of the laterals in a single filter, instructing Contractor's personnel on proper installation.
- B. Provide manufacturer's certification of proper installation of the entire system (all filters retrofitted) prior to startup.

#### 3.3 FILTER START UP AND INSPECTION

- A. The filter underdrain manufacturer shall provide two (2) trips, three (3) days each trip of technical service during installation to inspect the equipment installation and perform a visual air distribution test prior to media installation.
- B. Following media placement, coordinate for final system startup as indicated in Division 46 Section "Commissioning"

#### 3.4 OWNER'S MANUALS

- A. Furnish Owner's Manuals in compliance with Division 01.

### END OF SECTION 466127

## SECTION 467010 – CHAIN & SCRAPER SLUDGE COLLECTOR

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Equipment included with the screw conveyor cross collector system includes:
1. Provide all labor, material and equipment to furnish and install sludge collection equipment suitable for installation in one (1) basin. The basin shall have a 15-foot maximum side water depth and contains two (2) settling tanks.
  2. Each settling tank shall have one (1) collector mechanism. Each mechanism bay shall measure 17½- feet wide by 70-feet long, including the cross collector.
  3. One (1) screw conveyor type cross collector 18-inch diameter by 17½-feet long. There shall be one (1) cross collector per tank.
  4. A total of two (2) longitudinal and two (2) cross collector mechanisms shall be furnished.
  5. Collector chains shall run over three (3) pairs of sprocket wheels at a speed of approximately 1 ft/s per minute so that the flights will clean the sludge from the tank bottom into cross collector. The screw conveyor cross collector shall run at a maximum speed of 5 rpm.
  6. The Manufacturer shall furnish the items listed below:
    - a. Collector chain
    - b. Flights
    - c. Wear shoes
    - d. Collector chain sprockets
    - e. Shafting, stub shafting, keys and set collars
    - f. Head shaft wall bearings
    - g. Sprocket bearing sleeves
    - h. Return tracks and support brackets
    - i. Deflector track angles and supports (if required, as determined by the Manufacturer, to clear obstructions inside collector tank)
    - j. Floor and track wear strips
    - k. Speed reducer and motor
    - l. Drive base
    - m. Drive sprocket, torque overload device and appropriate guards
    - n. Driven sprocket
    - o. Drive chain and drive chain tightener
    - p. Associated attachment bolts and anchor bolts
  7. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts and Manufacturer's service.
- B. System Responsibility – The chain and scraper sludge collector equipment (Division 46 Section “Chain and Scraper Sludge Collector”) and the screw conveyor cross collector equipment (Division 46 Section “Screw Conveyor Cross Collector”) are to be supplied by a single system supplier that is responsible for the proper operation of the entire sludge receiving, thickening and transfer system.
- a. System supplier to design and furnish a complete, integrated and functionally operating system warranted to perform the intended functions herein specified.

- b. The equipment supplier is responsible to the Contractor for the complete and satisfactory operation of the entire system.
- c. Provide all devices specified herein or required and provide all required and specified collateral services in connection with the system such as testing, calibration, start-up, operation and maintenance manuals.
- d. The equipment supplier is responsible for coordinating all I/O databases with the system integrator to ensure proper operation of the SCADA system.
- e. All submittals from the System Supplier must be sealed by a Professional Engineer who is registered in the State of North Carolina. This is required to prove the depth and design capabilities of the system supplier.

## 1.2 QUALITY ASSURANCE

### A. Collector Chain Quality Control

- 1. The collector chain manufacturer shall submit previously certified design documentation stating that the collector chain has been tested on an endurance testing apparatus at a minimum load of 1,800 lb and that the attachment link has been tested to a minimum 15° of twist. Collector chain that does not meet these requirements shall not be allowed.
- 2. Certified documentation shall be submitted at drawing submittal stating that the Manufacturer of the collector chain has an established quality control program for materials and manufacture. The program consists of proof load and ultimate tensile strength tests.

### B. The following standards apply to the work and products specified herein.

- 1. American Society for Testing and Materials (ASTM)
  - a. ASTM A36 – Standard Specification for Carbon Structural Steel
  - b. ASTM A48 – Standard Specification for Gray Iron Castings
  - c. ASTM D570 – Standard Test Method for Water Absorption of Plastics
  - d. ASTM D638 – Test Method for Testing Properties of Plastics
  - e. ASTM D785 – Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials
  - f. ASTM D2584 – Standard Test Method for Ignition Loss of Cured Reinforced Resins
  - g. ASTM D4020 – Standard Specification for Ultra-High-Molecular Weight-Polyethylene Molding and Extrusion Materials
  - h. ASTM A351 – Standard Specification for Stainless Steel Castings
- 2. American National Standards Institute (ANSI)
  - a. ANSI B15 – Ball Bearing, Load Ratings and Fatigue Life
  - b. ASME B29.21M-2013 – 700 Class Welded Steel and Cast Chains, Attachments and Sprockets for Water and Sewage Treatment Plants
- 3. The Society of Protective Coatings (SSPC)
  - a. SSPC-SP-10 – Surface Preparation Specification No. 10 Near White Blast Cleaning
- 4. National Electrical Manufacturers Association (NEMA)
- 5. American Welding Society (AWS)
- 6. American Gear Manufacturers Association (AGMA)
- 7. American Society of Mechanical Engineers (ASME)
- 8. American Bearing Manufacturers Association (ABMA)
- 9. National Sanitary Foundation (NSF)

10. North Carolina has adopted NSF/ANSI Standard 61 certification requirements for drinking water treatment equipment. The equipment supplier must submit documentation at drawing submittal that all equipment in contact with water has been NSF61 certified and all submerged castings, steel plates and shapes are coated with an approved NSF61 coating.

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

### 1.3 SUBSTITUTIONS

A. Manufacturers and products other than those listed herein or added by Addendum during the bidding process must meet EVERY provision of this specification Section except those expressly attributed herein to a particular manufacturer or product. Such Substitutions not meeting EVERY provision will be rejected without further consideration, and Contractor shall thereafter promptly submit one of the named products.

B. Engineer will consider other Substitutions ONLY if a complete PRE-QUALIFICATION PACKAGE is received at the office of the Engineer at least twenty (20) days prior to the bid. Any such package must contain as a minimum:

1. Detailed layout drawings
2. Welder certifications
3. Evidence of a recognized ongoing quality assurance program.
4. Detailed component specifications and catalog cuts as required.
5. Detailed list of ALL VARIATIONS required from the original design, referencing appropriate sections of the specifications and locations on the drawings.
  - a. Copy of Contract Drawings, illustrating all such variations
  - b. Copy of this Specification Section, highlighting and detailing all such variations
6. Full installation list of proposed equipment including six (6) user references.
7. Bidder's certification that Bidder shall bear all costs associated with any redesign required for use of the Substitution.

C. Qualifying Substitutions will be recognized by Addendum a minimum of (7) days prior to the bid.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

1. Evoqua Water Technologies, LLC of Waukesha, Wisconsin or approved equal.

### 2.2 DESIGN CRITERIA

A. The Manufacturer shall select the collector components based up design calculations incorporating the following criteria:

1. Operation under wet tank conditions
  - a. Wear strip friction factors:
    - 1) 0.20 to 0.30 (UHMW-PE on UHMW-PE)

- b. Bearing friction:
    - 1) 0.05 per shaft assembly
  - c. Shaft deflection:
    - 1) Not to exceed 0.033-inch per foot of shaft length
    - 2) Fiberglass: Not to exceed 0.008 inch per foot of shaft length
  - d. Sludge load – longitudinal collectors:
    - 1) 2 lb/ft of flight length – 8-inch tall flight
  - e. Sludge load – cross collectors:
    - 1) 55 lb/ft at 45% sludge loading
2. In no event shall the collector components be less than specified herein. Alternate manufactures shall submit complete design calculations in accordance with the Substitute Equipment Section of this specification.

## 2.3 SYSTEM OPERATION

- A. Sludge Basin Operation - When equipment is called for start-up operation the sequences shall be as follows:
1. Step 1: The following events shall occur to prepare for operating the upgraded solids handling system in the existing sludge basins:
    - a. Acknowledge water level within new sludge mixing tank and existing Sludge Basin No's. 1 and 2. If levels are at or below low level shut-off, the system controls will not activate existing sludge pumps and alarm will be sent to control panel.
    - b. If level in mixing tank is above the low level preset condition, the following equipment will be activated.
      - 1) Existing Sludge Pump No. 1
      - 2) Existing Sludge Pump No. 2
    - c. If the level within sludge new mixing tank is at the high level shut-off, the system controls will shut down the existing sludge pumps if running or lock out the existing sludge pumps until preset condition is reached within the new sludge mixing tank. The set condition for operation shall be adjustable in the field.
  2. Step 2: Existing Sludge Basin Operation - During the operation performed in Step 1 the control system will:
    - 1) Control system will monitor and adjust the operation of equipment to perform at optimum efficiency.
      - a) Control panel will monitor and display, two level sensors, two scraper motors, two screw conveyor motors, two existing sludge pumps and two existing recirculation pumps.
      - b) The control system will allow the sludge conveyor's and sludge scrapers to operate intermittently with 15 minute increments adjustable timers within the control cabinets.
      - c) The control panel shall contain the following components:
        - HOA switches for each chain and scraper sludge collector
        - HOA switches for each screw conveyor cross collector
        - Alarm horn
        - Alarm horn silence push button
        - Each chain and scraper sludge collector overload indicator light

- Indicator light for on/off position for each chain and scraper sludge collector
  - Indicator light for on/off position for each screw conveyor cross collector
  - All devices shall communicate with existing Plant SCADA system
  - Convert and display each floating decanter flow based on level of water in each sludge tank
  - Control existing sludge pumps by modifying existing starters for remote start/stop
- 2) All equipment monitored in the control cabinet provided by the new sludge control panel cabinet manufacturer. Contacts for equipment monitored and wiring shall be provided in the control cabinet to the PLC by the contractor. Information shall be displayed on HMI screen in the door of the local new control cabinet. The contractor will connect control panels PLC'S to SRU Water Treatment Plant fiber system.
  - 3) All information monitored will be transmitted to the existing water treatment plant control room.
- B. All available output variables from the Sludge Scraper System supplied PLC shall be transmitted to the SCADA system.

## 2.4 EQUIPMENT

### A. Collector Chain

1. Collector chain shall be NCS720S-NX non-metallic type having 6-inch pitch links with an average weight of 1.3 lb/ft. The chain shall have a published working load not less than 3100 Lbf and a minimum ultimate tensile strength of 6,000 lb. The chain shall be manufactured of unfilled acetal resin and molded with the barrel and side bars as an integral assembly. The chain shall be assembled with pins not less than 15/16-inch diameter, manufactured of reinforced nylon resin and designed to provide full dead load bearing capacity throughout the full length of the link side bar hubs. The pins shall have a T-head to engage retainer lugs molded integrally with one link side bar hub as a positive means to prevent pin rotation. The pins shall be locked in position by a retainer ring molded integrally with the opposite side bar hub and provide a positive locking contact around the full periphery of the pin. The pins shall be pressed into the link side bar hubs to exclude abrasives using a tool supplied by the Manufacturer. Pins having dual purpose retainer and anti-rotational lugs will not be acceptable.
2. The attachment links shall be of similar construction to the plain chain links, with the flight pusher plate extending the full depth of the flight and molded integrally with the link sidebars. The attachment mounting hole spacing shall conform to ASME B29.21M-2013 and shall accommodate four (4) 3/8-inch diameter Type 316 stainless steel hex head attachment bolts. Bolts shall be fastened with Type 316 stainless steel "Nylock" hex locknuts and Type 316 stainless steel flat washers. The attachment link shall be capable of twisting a minimum of 15° across the face of the attachment without failure.
3. Collector chain shall be tested and manufactured per the minimum quality assurance program specified under the Collector Chain Testing Section of this specification.

## B. Flights

1. Flight shall be 3-inch x 8-inch nominal size fiberglass construction, essentially rectangular in cross section of singular construction. The member shall have a product of the modulus of elasticity (E, psi) and the moment of inertia (I, in<sup>4</sup>) of not less than 6.83 x 10<sup>6</sup> lb-inch<sup>2</sup> about its minor y-y axis (parallel to the direction of flow). The flight shall be of pultruded isophthalic composite construction with a minimum fiberglass content of 55%, to insure member strength and total encapsulation of the glass fibers to prevent wicking. The use of extenders in the resin is prohibited.
2. Maximum water absorption shall be no greater than 0.6% after immersion for 48 hours at 73°F in accordance with ASTM D570. The flight section shall include a scraper lip on the leading edge of the flight to optimize cleaning of the tank floor. Polypropylene filler blocks shall be furnished to allow the flight to be securely bolted to the chain attachment. The blocks shall provide an interference fit with the flight to maintain proper positioning during assembly. Flight spacing shall be approximately 10-feet for longitudinal collectors for the entirety of the mechanism. Flights shall be accurately drilled and notched at the factory and banded together for shipment.
3. Wearing Shoes
4. Each flight shall be provided with ½-inch thick wearing shoes to run on floor wear strips and on support tracks of the return run. The shoes shall be molded of UHMW-polyethylene per ASTM D4020 with a minimum tensile strength of 6,000 PSI at 73°F. Wearing shoes running on the floor wear strips shall be located central to the chain attachment.
5. The return run wearing shoes shall include a guide lug to insure proper tracking of the flight while travelling on the return track.
6. All UHMW-PE wearing shoes shall be reversible providing two (2) usable wearing surfaces.

## C. Collector Chain Sprockets

1. Sprockets for the collector chains shall be molded totally of polyurethane. Sprockets shall be of split or solid construction and have double life tooth profile compatible with non-metallic chain.
2. Split sprocket halves shall be assembled on the shafting with Type 316 stainless steel clamping bands or bolts which exert compressive force around the full periphery of the hub. The clamping bands shall include provisions to restrict lateral movement. Type 316 stainless steel bolts shall be located along the split line near the periphery and so designed to draw the sprocket halves together in lateral alignment.
3. Solid sprockets shall be mounted on stub shafts with journal bearings and be held in place with two (2) set collars.
4. Head shaft sprockets shall have chain saver rims.
5. Head shaft sprockets shall have a keyway machined into the hub in such a way as to restrict lateral movement of the key or contain two (2) set screws to insure chain alignment.
6. Head shaft sprockets shall not be less than 22.24-inch pitch diameter and have 23 teeth.
7. Idler shaft sprockets shall rotate freely on sprocket bearing sleeves.
8. Idler shaft sprockets shall not be less than 16.61-inch pitch diameter and have 17 teeth.
9. Shaft, bearings and sprockets shall be shipped unassembled to prevent damage to bearings and sprockets during shipping and handling.

## D. Head Shaft

1. Head shaft shall be solid cold-finished steel straight and true.

2. Head shafts shall contain keyways with fitted keys and shall be sized to transmit the power required.
  3. The shaft assembly shall be held in alignment with split set collar; and, the driven sprocket or set collar for the driven end of the shaft.
- E. Idler Shafts
1. Longitudinal Collector Idler Shafts
    - a. The longitudinal idler shaft sprockets shall be mounted on stub shafts with sprocket bearing sleeves. The wall bracket shall be cast ductile iron tripod, attached to the wall with three (3) 3/4-inch diameter adhesive anchors. The stub shaft shall be 3 1/2-inch diameter stainless steel. The shaft shall be fixed to the base by three (3) 1/2-inch diameter set screws.
  2. Cross Collector Idler Shafts
    - a. The cross collector idler shaft sprockets shall be mounted on static shafts with sprocket bearing sleeves. Shafting shall be solid, cold-finished steel straight and true. Shafts shall be supported by minimum 1/4-inch thick fabricated steel support brackets. Each bracket shall be secured with minimum of two (2) 5/8-inch dia. anchors.
- F. Shafting Set Collars
1. Shafting set collars shall be molded of UHMW-Polyethylene. The collars shall be of split construction and shall include a shoulder at each end to contain the clamping band; or bolted and set screwed.
- G. Head Shaft Bearings
1. Steel head shafts, if applicable, shall be provided with wall bearings and shall be of cast steel per ASTM A216, Grade WCB, water lubricated, self-aligning type, having a split polyurethane hub ball. The housing shall be of split construction and specially designed to prevent the accumulation of settled solids on its surface. The housing shall have provisions for greasing when the tank is drained. These bearings shall be anchored directly to the concrete wall in a manner that shall permit their easy alignment.
  2. Fiberglass head shafts, if provided, shall be fitted with integral polymeric bearings that shall turn over 304 stainless steel stub shaft supports mounted on the tank walls.
- H. Idler Sprocket Bearing Sleeves
1. Idler sprocket bearing sleeves for split sprockets shall be molded of UHMW-polyethylene. UHMW-polyethylene shall be of 100% virgin. The sleeves shall be of split construction and shall include a shoulder at each end to restrict lateral movement of the sprocket. The two (2) sleeve halves shall be secured to the stub shaft by two (2) Type 316 stainless steel clamping bands which exert compressive force around the full periphery of each shoulder. The shoulders shall include retainer rings to contain the clamping bands.
  2. Solid idler sprockets shall rotate on polymeric journal bearings.
- I. Return Tracks
1. Return tracks shall be 3- x 3- x 3/8-inch fiberglass angles with non-metallic supporting brackets fastened by minimum two (2) 1/2-inch diameter anchor bolts to the channel walls. Each bracket shall be designed to cantilever the return track approximately 9-inches off the channel wall. UHMW-polyethylene wear strips and mounting hardware shall be provided. Support brackets shall be spaced approximately 10-feet apart.



J. Deflector Track Angles

1. Deflector track angles shall be provided, if determined by the Manufacturer to be required, to prevent flights from contacting other components within the collector tanks. Angles shall be 3- x 3- x 3/8-inch fiberglass or steel angles attached to the channel wall with non-metallic or steel brackets and fastened with minimum two (2) anchor bolts per bracket. UHMW-polyethylene wear strips and stainless-steel mounting hardware shall be provided.

K. Wear Strips

1. Removable wear strips shall be provided for the return tracks and deflector angles (if required) consisting of 5/8-inches thick UHMW-polyethylene material in 10-foot sections with each section having five (5) countersunk holes. UHMW-polyethylene shall be of 100% virgin material. Wear strips shall be field fastened with Type 316 stainless steel convex washers, self-drilling and tapping 10-foot diameter stainless steel fasteners. All splices shall be beveled at 45° to allow for a smooth transition of the wear shoes in the direction of flight travel to prevent the shoes from hanging up on an uneven edge.
2. Removable wear strips shall be provided for the floor consisting of 5/8-inches thick UHMW-polyethylene material in 10-foot sections with each section having five (5) countersunk holes. The floor shall have two (2) lines of wear strips and are secured with Type 316 stainless steel convex washers, 10-foot diameter Type 316 stainless steel pan head screws and vinyl anchors. Anchors shall be set in pre-drilled holes.

L. Drive Units

1. Each collector mechanism shall be operated by its own drive unit.
2. The motor shall be rated at ½ hp and 1.15 Service Factor, totally enclosed, fan cooled, ball bearing, constant speed of ample power for starting and continuously operating the mechanism under normal operating conditions without overloading. The motor shall conform to NEMA or IEC standards and be suitable for operation on 3-phase voltage and frequency in accordance with local practices.
3. The speed reducer shall be of the helical gear type, fully housed, running in oil, with anti-friction bearings throughout. The speed reducer shall be designed and manufactured to AGMA standards and sized based on calculated average sludge load, stated under Design Criteria of this Specification, and have a 1.25 Service Factor.
4. The motor shall be directly connected to the speed reducer. V-belt drives will not be acceptable.

M. Drive Base

1. Each drive unit shall be supported by a 304 stainless-steel drive base. The drive base shall be designed to support the complete drive unit including forces encountered at the design torque overload protection setting.

N. Drive Sprocket and Torque Overload Protection

1. The drive sprocket shall consist of a polymeric plate section mounted to a Type 316 stainless steel driving hub. The sprocket plate section shall be molded of polyurethane. The sprocket shall be not less than 9.26-inch pitch diameter and have 11 teeth.
2. The drive sprocket shall be provided with a shear pin device to provide for protection of the drive equipment in the event of excessive loading. Aluminum shear pins shall be provided to transmit torque from the driving hub to the sprocket shear plate.
3. The driver sprocket hub shall be provided with an actuating pin that, upon torque overload, shall contact the actuator arm of the double throw limit switch which, in turn, shall shut-off the motor and energize the alarm circuit. The limit switch shall be a

combination NEMA 4X /7 enclosure and shall be provided with a stainless-steel support bracket for positioning adjacent to the overload device. Electrical controls for alarms shall be furnished by Chain and Scraper Supplier and coordinated with the Electrical Contractor as detailed in Division 26.

O. Driven Sprocket

1. The driven sprocket body shall be molded of high performance polyurethane. The body shall be molded concentric and perpendicular to the bore with the rim mounting holes accurately located to insure concentricity of the sprocket assembly. The body halves shall be assembled on the Head shaft with four (4) stainless steel studs with hex nut, flat washer and lock washers to exert compressive force at the hub, thereby securing the sprocket assembly to the shaft. Six (6) stainless steel studs shall be located along the split line so designed to draw the sprocket halves together in alignment. The body shall have a machined keyway designed to restrict the lateral movement of the key. The sprocket hub shall be of the offset design.
2. The tooth segments shall allow replacement without removal of the sprocket hub or having to replace the entire sprocket assembly. Driven sprockets containing non-replaceable integral tooth segments will not be allowed. The toothed rim shall be molded in four (4) segments and each segment shall be bolted to the body with four (4) diameter bolts. The sprocket rim shall be not less than 33.25-inch pitch diameter and have 40 teeth. All sprocket hardware shall be Type 316 stainless steel.

P. Drive Chain

1. The collector drive chain shall be unfilled acetal links, 304 stainless steel pin, minimum working load of 1,750 lb. and maximum 4,000 lb. Chain weight per foot shall be 1.4 lb/ft.

Q. Drive Chain Tightener

1. The drive chain arrangement shall include a chain tightener to take-up excessive slack in the drive chain. The tightener assembly shall include a non-metallic or 304 stainless-steel slide base with self-centering polyurethane idler sprocket.

R. Chain Guard

1. The drive chain and sprockets located above the operating platform shall be covered with a removable metal guard of No. 14 gauge Type 304 stainless steel.

S. Shop Painting and Finish Field Painting

1. All iron and steel surfaces shall be blast-cleaned in accordance to SSPC-SP10 and shop primed in accordance with Division 09 Section "High-Performance Coatings".
2. Finish field painting shall be in accordance with Division 09 Section "High-Performance Coatings".
3. All pre-painted purchased equipment such as motors, reducers shall be furnished with original factory finish.
4. Shafting, machined and or polished surfaces shall be provided with a temporary protective coating of a nondrying oily-type rust preventative compound.
5. Fiberglass, plastic, aluminum, stainless steel and galvanized surfaces need not be coated.

T. Anchors and Fasteners

1. All anchor bolts shall be Type 304 stainless steel furnished by the Manufacturer, of ample size and strength for the purpose intended. All anchor bolts shall be set by the Contractor in accordance with the Manufacturer's instructions.

2. All fasteners shall be Type 316 stainless steel, unless otherwise specified.
  3. All field installed stainless steel fastener connections shall be made with an anti-seize lubricant, designed to further reduce the possibility of galling.
- U. Electrical Controls
1. Except for shear pin limit switch, no electrical controls are included in this section. Refer to Division 26 of these specifications.
- V. Screed Board
1. For existing tanks, a radius screed board shall not be furnished.

### PART 3 - WARRANTY

#### 3.1 WARRANTY

- A. Equipment Manufacturer shall furnish its standard warranty against defects in material and workmanship for all Equipment provided by Equipment Manufacturer under this Section. The Equipment Manufacturer shall warrant the Equipment, or any components thereof, through the earlier of eighteen (18) months from delivery of the Equipment or twelve (12) months from initial operation of the Equipment.

### PART 4 - EXECUTION

#### 4.1 INSTALLATION

- A. The collector mechanism shall be erected and installed in strict conformance with the approved shop drawings and Manufacturer's installation instructions.

#### 4.2 MANUFACTURER ON-SITE SERVICES

- A. Provide Manufacturer service technician for start-up, field testing, verification of any final adjustments necessary for the contractor to complete and operator training.
- B. Minimum service requirements:
1. Field testing, start-up, and operator training: two (2) trips totaling six (6) full days on-site.
  2. A written report covering the technician's findings and installation approval shall be submitted to the Engineer covering all inspections and outlining in detail any deficiencies noted.

**END OF SECTION 467010**

## SECTION 467020 – SCREW CONVEYOR CROSS COLLECTOR

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Provide all labor, material and equipment for installing sludge collecting cross screw conveyors in two (2) existing settling tanks.
- B. Each settling tank screw conveyor shall consist of one (1) 18-inch diameter section for an overall channel length of 18'-0".
- C. Work and Components Included
  1. The Manufacturer shall furnish the items listed below:
    - a. Screw conveyor
    - b. Wall bearings
    - c. Intermediate hanger bearing
    - d. Drive unit complete with reducer, motor, overload device and appropriate guards
    - e. Vertical torque tube
    - f. Right angle gear box
    - g. Oil fill lines if required right angle gear box manufacturer
    - h. Grease fittings
    - i. Grease lines
    - j. Associated attachment bolts and anchor bolts
  2. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts and Manufacturer's service.
- D. System Responsibility – The chain and scraper sludge collector equipment (Division 46 Section "Chain and Scraper Sludge Collector") and the screw conveyor cross collector equipment (Division 46 Section "Screw Conveyor Cross Collector") are to be supplied by a single system supplier that is responsible for the proper operation of the entire sludge receiving, thickening and transfer system.
  - a. System supplier to design and furnish a complete, integrated and functionally operating system warranted to perform the intended functions herein specified.
  - b. The equipment supplier is responsible to the Contractor for the complete and satisfactory operation of the entire system.
  - c. Provide all devices specified herein or required and provide all required and specified collateral services in connection with the system such as testing, calibration, start-up, operation and maintenance manuals.
  - d. The equipment supplier is responsible for coordinating all I/O databases with the system integrator to ensure proper operation of the SCADA system.
  - e. All submittals from the System Supplier must be sealed by a Professional Engineer who is registered in the State of North Carolina. This is required to prove the depth and design capabilities of the system supplier.

## 1.2 QUALITY ASSURANCE

- A. The following standards apply to the work and products specified herein.
  - 1. American Society for Testing and Materials (ASTM)
    - a. ASTM A36 – Standard Specification for Carbon Structural Steel
    - b. ASTM A48 – Standard Specification for Gray Iron Castings
    - c. ASTM A351 – Standard Specification for Stainless Steel Castings
  - 2. American National Standards Institute (ANSI)
    - a. ANSI B15 – Ball Bearing, Load Ratings and Fatigue Life
    - b. ANSI B29.21M-1996 – 700 Class Welded Steel and Cast Chains, Attachments and Sprockets for Water and Sewage Treatment Plants
  - 3. The Society of Protective Coatings (SSPC)
    - a. SSPC-SP-10 – Surface Preparation Specification No. 10 Near White Blast Cleaning
  - 4. National Electrical Manufacturers Association (NEMA)
  - 5. American Welding Society (AWS)
  - 6. American Gear Manufacturers Association (AGMA)
  - 7. American Society of Mechanical Engineers (ASME)
  - 8. American Bearing Manufacturers Association (ABMA)
  - 9. National Sanitary Foundation (NSF)
  - 10. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Evoqua Water Technologies, LLC of Waukesha, Wisconsin or approved equal.

### 2.2 DESIGN CRITERIA

- A. The Manufacturer shall select the conveyor components based up design calculations incorporating the following criteria:
  - 1. Shaft deflection – not to exceed 0.25-inch per shaft length
  - 2. Sludge loading – 55 lb/ft<sup>3</sup> at 45% loading
  - 3. Conveyor speed – 5 RPM
  - 4. Conveyor Bronze Bearing Friction Factor – 1.7
- B. In no event shall the conveyor components be less than specified herein. Alternate manufactures shall submit complete design calculations in accordance with the Substitute Equipment Section of this specification.

### 2.3 EQUIPMENT

- A. Screw Conveyor
  - 1. The screw conveyor shall be an 18-inch diameter helical screw, full pitch, 3/8-inch thick steel sectional flights welded to schedule 40 steel pipe. The screw shall have one (1)

quick removal coupling to allow for disassembly of the screw without removing the bearings.

B. Wall Bearings

1. End wall bearings shall be of cast iron construction, bronze sleeved and of the water lubricated, ball and socket, self-aligning type, especially designed to prevent the accumulation of settled solids on their surfaces. These bearings shall be bolted directly to the tank walls. The housing shall have provisions for greasing when the tank is drained.

C. Intermediate Hanger Bearing

1. The screw conveyor shall be supported by one (1) bronze lined, water lubricated hanger bearings.

D. Drive Unit

1. The motor shall be rated at a minimum of 2 HP and 1.15 Service Factor, totally enclosed, fan cooled, ball bearing, constant speed of ample power for starting and continuously operating the mechanism under normal operating conditions without overloading. The motor shall conform to NEMA or IEC standards and be suitable for operation on 460 volts, 3 phase, 60 Hertz.
2. The speed reducer shall be of the helical gear type, fully housed, running in oil, with anti-friction bearings throughout. The speed reducer shall be designed and manufactured based on calculated average sludge load, stated under Design Criteria of this Specification, and have a 1.25 Service Factor. The minimum torque rating shall be 55 lb-in.
3. The drive unit, including drive sprocket and drive base plate, shall be assembled by the Manufacturer and shipped as a complete assembly to ensure proper assembly of all components. The motor shall be directly connected to the speed reducer. V-belt drives will not be acceptable.

E. Drive Hub

1. The connection between the drive unit and the torque tube shall consist of two (2) fabricated steel shear pin hubs. One (1) hub shall be keyed to the drive unit output shaft and one (1) hub shall be keyed to the torque tube shaft. The torque tube shall be supported at the drive base by a flange mounted, self-aligning ball bearing.

F. Overload Protection

1. The drive unit shall be provided with a shear pin device to provide for full protection of the equipment in the event of excessive loading. Shear pins shall be provided to transmit torque from the driving hub to the torque tube hub.
2. The drive hub shall be provided with a trip lug that, upon torque overload, shall contact the actuator arm of the double throw limit switch which, in turn, shall shut-off the motor and energize the alarm circuit. The limit switch shall be a combination NEMA 4X/7 (IP67) enclosure and shall be provided with a stainless steel support bracket for positioning adjacent to the overload device. Electrical controls for alarms shall be furnished by the Electrical Contractor as detailed in Division 26.

G. Torque Tube

1. The speed reducer and right angle gear box shall be connected with a torque tube made from minimum 2½-inch diameter extra heavy steel pipe. The gear box end of the torque tube shall have a ball and socket, self-aligning type coupling.

H. Right Angle Gearbox

1. The driven end of the screw conveyor shall be supported by and connected to a right angle miter gear box. The gears shall be spiral bevel type and the ratio shall be 1:1. The gear box shall have sealed tapered roller bearings for radial and thrust load capabilities and chrome plated steel shafts. The gear box shall contain lubrication that will not require replacement over its lifetime. Lubricant shall be food grade quality.

I. Shop Painting and Finish Field Painting

1. All iron and steel surfaces shall be blast-cleaned in accordance to SSPC-SP10 and shop primed in accordance with Division 09 Section "High-Performance Coatings".
2. Finish field painting shall be in accordance with Division 09 Section "High-Performance Coatings".
3. All pre-painted purchased equipment such as motors, reducers shall be furnished with original factory finish.
4. Shafting, machined and or polished surfaces shall be provided with a temporary protective coating of a nondrying oily-type rust preventative compound.
5. Fiberglass, plastic, aluminum, stainless steel and galvanized surfaces need not be coated.

J. Anchors and Fasteners

1. All anchor bolts shall be Type 304 stainless steel furnished by the Manufacturer, of ample size and strength for the purpose intended. All anchor bolts shall be set by the Contractor in accordance with the Manufacturer's instructions.
2. All fasteners shall be Type 316 stainless steel, unless otherwise specified.
3. All field installed stainless steel fastener connections shall be made with an anti-seize lubricant, designed to further reduce the possibility of galling.

K. Electrical Controls

1. Shear pin limit switch and electrical controls are included in this section. Refer to Division 26 of these specifications to coordinate installation.

### PART 3 - WARRANTY

- 3.1 Equipment Manufacturer shall furnish its standard warranty against defects in material and workmanship for all Equipment provided by Equipment Manufacturer under this Section. The Equipment Manufacturer shall warrant the Equipment, or any components thereof, through the earlier of eighteen (18) months from delivery of the Equipment or twelve (12) months from initial operation of the Equipment.

### PART 4 - EXECUTION

#### 4.1 INSTALLATION

- A. The collector mechanism shall be erected and installed in strict conformance with the approved shop drawings and Manufacturer's installation instructions.

#### 4.2 MANUFACTURER ON-SITE SERVICES

- A. Provide Manufacturer service technician for start-up, field testing, verification of any final adjustments necessary for the contractor to complete and operator training.
- B. Minimum service requirements:
  - 1. Field testing, start-up, and operator training quantity of trips and days is included with the Division 46 Section “Chain and Scraper Sludge Collector” of this specification.
- C. A written report covering the technician’s findings and installation approval shall be submitted to the Engineer covering all inspections and outlining in detail any deficiencies noted.

**END OF SECTION 467020**



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## SECTION 467633 – CENTRIFUGE

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required. Manufacture, assemble, shop test, deliver and install complete centrifuge for processing of water treatment alum sludge.
- B. The centrifuge shall be a complete unit.
- C. All equipment specified herein shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings and specifications, engineering data, instructions and recommendations of the equipment manufacturer. The centrifuge unit shall be the product of suppliers regularly engaged in the design and manufacture of centrifuges and shall be specifically designed for the intended conditions of service. Appurtenant equipment shall be new and shall be designed, fabricated and assembled in accordance with the best engineering and shop practices. Individual parts shall be manufactured to standard sizes and gauges. Components of the centrifuge shall be designed for the stresses that may occur during fabrication, shipping, erection, or maintenance. Materials shall be suitable for service conditions and as described herein.
- D. The centrifuge supplier will be responsible for providing a complete centrifuge system, as described herein, and for delivering the equipment to the job site. See Section 1.2.B below.
  - 1. The equipment shall be installed by an installing contractor, who will be responsible for off-loading the equipment, providing any temporary storage in accordance with the manufacturer's recommendation for storage and installing the equipment in place. Installation will include mounting the unit, piping the unit, and providing power to the panels and all interconnected wiring and piping required between various components.
  - 2. The centrifuge and the controls shall each be tested prior to shipment.
  - 3. The equipment will be shipped in a minimum number of components; and they will typically be comprised of the centrifuge skid assembly with drive and backdrive, control panels, and other parts.

#### 1.2 SYSTEM DESCRIPTION

- A. General
  - 1. All system components and equipment utilized in the centrifuge system, including those described in Part 1 shall be furnished as a complete integrated system by one manufacturer. Prequalified manufacturers and products include:
    - a. Alfa Laval, Inc.
    - b. Andritz, Group
  - 2. The centrifuge specified herein is of the counter-current design, horizontal, solid bowl type. The bowl of the centrifuge must be removed vertically from the frame and casing.
  - 3. The centrifuge shall be continuously fed alum sludge conditioned with polymer by individual progressive cavity type feed pumps. The sludge shall be fed into the center of the equipment where the solids are thrown against the wall of the bowl, which is rotating

at high speeds thus generating high centrifugal forces. An internal screw conveyor shall continuously move the solids deposited against the bowl wall to one end of the machine where they are plowed up a beach and discharged out a solids discharge chute. The cake shall discharge onto cake conveying equipment. The clarified liquid shall continuously flow over adjustable weirs at the other end of the machine where it discharges into a centrate chute that connects to plant piping. The centrifuges shall be provided with back drives to infinitely vary the speed of the conveyor to optimize sludge processing.

**B. System Responsibility**

1. The centrifuge and related equipment specified in this section, plus the auxiliary equipment specified in Division 41 Section “Shafted Screw Conveyor”, in Division 43 Section “Sludge Feed Pump”, and Division 46 Sections “Polymer Feed System”, “Sludge Tank Mixer”, and “Inline Electric Grinder” shall be an integrated system provided by a single system supplier that is responsible for the proper operation of the entire dewatering system.
  - a. System supplier to design and furnish a complete, integrated and functionally operating system warranted to perform the intended functions herein specified.
  - b. The equipment supplier is responsible to the Contractor for the complete and satisfactory operation of the entire system.
  - c. Provide all devices specified herein or required and provide all required and specified collateral services in connection with the system such as testing, calibration, start-up, operation and maintenance manuals.
  - d. The equipment supplier is responsible for coordinating all I/O databases with the system integrator to ensure proper operation of the SCADA system.
  - e. The centrifuge control system will synchronize and control the operation of the auxiliary equipment to optimize the process. In addition, contacts with four spares will be provided in the centrifuge control panel to monitor each auxiliary equipment status at the SRU operations center located in the main Water Treatment Plant.

**C. Design Requirements**

1. The centrifuge shall be capable of processing typical water treatment sludge.
2. The sludge shall be as described herein:
  - a. Feed type: Alum Waste Sludge from filter backwash and Actiflo system.
  - b. Sludge Type/Blend (Ratio w:w): 25% backwash and 75% Actiflo
  - c. Feed Concentration (% T.S.): 2.0% to 6.0%
  - d. pH: 7.3
  - e. Temperature (oF): Ambient
3. The centrifuge shall be manufactured to meet or exceed each of the following physical parameters:
  - a. Nominal inside bowl diameter: 17-inches
  - b. Minimum bowl length: 69-inches
  - c. Operating centrifugal force (at inside bowl wall diameter): 3,500 G
4. The water supply available at each unit shall be as follows:
  - a. Bowl Flushing: 50 GPM at 22-45 psi.
  - b. CIP Flushing: 22 GPM at 22-45 psi
  - c. Temperature: Up to 140 degrees F.
  - d. Cake capacity during a power loss condition: 6.4 cubic feet./0.24 cubic yards

**D. Performance Requirements**

1. When processing sludge with characteristics as specified above, the centrifuge shall be capable of exhibiting the following process parameters:
  - a. Sludge Feed Rate (gpm) exclusive of polymer: 50 to 150
  - b. Solids Rate (d-lbs/hr): 630
  - c. Percent Cake Solids (%T.S.): 20 to 25
  - d. Percent Recovery (%T.S.S.): 93-96
  - e. Polymer Dosage (active lb/dry ton): 28.0

E. Sequence of Operation

Centrifuge and Auxiliary Equipment - When centrifuge equipment is called for start-up operation the sequences shall be as follows:

1. Step 1: The following events shall occur to prepare for operating the solids handling system:
  - a. Acknowledge level within new sludge mixing tank. If level is at or below low level shut-off, the system controls will not activate sludge pumps and alarm will be sent to control panel.
  - b. If level in new mixing tank is above the low level preset condition, the following equipment will be activated in sequence accordance with manufacturer recommendations.
    - 1) Conveyor
    - 2) Conveyor solenoid flushing valve
    - 3) Polymer pumps shall be paced by the sludge flow from the centrifuge sludge pumps.
    - 4) Centrifuge sludge pumps
    - 5) Grinder
2. Step 2: Centrifuge Operation - During the operation performed in Step 1 the control system will:
  - 1) Control system will monitor and adjust the operation of equipment to perform at optimum efficiency.
  - 2) All equipment shall be connected to the PLC and monitored in the local control cabinet provided by the centrifuge manufacturer. Contacts shall be provided in the control cabinet to connect the PLC and RTU provided by the contractor. Information shall be displayed on HMI Screen located in the door of the local control cabinet. SRU will connect the existing fiber system.
  - 3) All information will be transmitted to the existing water treatment plant control room.
3. Step 3: After the start up sequence is complete and the new sludge mixing tank reaches the low level shutoff, the centrifuge will automatically begin a shutdown process. This process will be in accordance with manufacturer's recommendations.
  - 1) Conveyor
  - 2) Conveyor solenoid flushing valve
  - 3) Polymer pumps
  - 4) Centrifuge sludge pumps
  - 5) Grinder

### 1.3 WARRANTY

- A. The unit shall be warranted to be free from defects in materials and workmanship for a period of 12-months after successful completion of Acceptance Testing, beneficial use, or for a period not to exceed 18-months from shipment, whichever occurs first. The warranty shall cover all repairs for all systems furnished by the manufacturer. Manufacturer shall repair or replace, at its option, any such equipment found to be defective, provided written notice of the alleged defect is received within 12-months after successful completion of Acceptance Testing, beneficial use, or for a period not to exceed 18-months from shipment.

### 1.4 SUBMITALS

- A. Submit the following:
  - 1. Installation and dimensional drawings certified correct for the specific application, showing details of construction, dimensions and anchor bolts.
  - 2. List centrifuge installations of comparable size in the U.S. from water treatment plants with:
    - a. A brief description of each installation.
    - b. Name of owner of installation, telephone number, and contact person.
    - c. Date of installation.
    - d. Description of sludge
  - 3. General Information:
    - a. Typical system description of operations. List component identification on schematic diagrams. Identify all input/outputs to PLC.
    - b. Operating and maintenance manuals shall be written in US standards. Operating and maintenance manuals will be specific to equipment purchased.
    - c. All drawings and data marked to show only items applicable to work. Show all data, bill of materials, rated capacities, material of construction, layouts of all components, and all feed and discharge piping arrangements. Show details of construction dimensions, and anchor bolt locations.
    - d. Recommend cleaning instruction, procedures and safety precautions for equipment. Provide detailed cleaning instructions for particular cleaning system as specified.
    - e. Control Panel shop drawings to include:
      - 1) Outline
      - 2) AC schematics
      - 3) Equipment interconnect drawings
      - 4) Bill of materials
      - 5) Clarifications and exceptions
      - 6) Sequence of operations including list of functions monitored, controlled and alarmed.
    - f. Setting plans with tolerances for anchor bolts.
    - g. Supplied tools and spares.
    - h. List of Recommended spare parts not supplied.
    - i. Typical installation inspection reports.
    - j. Test reports that certify that most severe service abrasion resistant materials supplied are in accordance with ASTM G65, Procedure A abrasion test. FMC Corporation, Colorado School Of Mines, Kennametal, Inc., and the Falex Corporation have laboratories qualified to perform this test. At a minimum the report should include the following:

- 1) Typical material analysis
- 2) ASTM standards
- 3) Manufacturer's name
- k. Recommendations for both short and long term storage of each major component.
- l. Weights and lifting points of all equipment and subassemblies. Identify any special handling requirements.
- m. Shop and field-testing procedures.
- n. Training lesson plan.

## 1.5 SUBSTITUTIONS

- A. Manufacturers and products other than those listed herein or added by Addendum during the bidding process must meet EVERY provision of this specification Section except those expressly attributed herein to a particular manufacturer or product. Such Substitutions not meeting EVERY provision will be rejected without further consideration, and Contractor shall thereafter promptly submit one of the named products.
- B. Engineer will consider other Substitutions ONLY if a complete PRE-QUALIFICATION PACKAGE is received at the office of the Engineer at least twenty (20) days prior to the bid. Any such package must contain as a minimum:
  - 1. Detailed layout drawings
  - 2. Welder certifications
  - 3. Evidence of a recognized ongoing quality assurance program.
  - 4. Detailed component specifications and catalog cuts as required.
  - 5. Detailed list of ALL VARIATIONS required from the original design, referencing appropriate sections of the specifications and locations on the drawings.
    - a. Copy of Contract Drawings, illustrating all such variations
    - b. Copy of this Specification Section, highlighting and detailing all such variations
  - 6. Full installation list of proposed equipment including six (6) user references.
  - 7. Bidder's certification that Bidder shall bear all costs associated with any redesign required for use of the Substitution.
- C. Qualifying Substitutions will be recognized by Addendum a minimum of (7) days prior to the bid.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. The centrifuge shall be a solid bowl, horizontal, scroll type unit and shall be specifically designed to handle the sludge specified above. The centrifuge shall be capable of continuous (or intermittent) operations with minimum of maintenance.
- B. The centrifuge shall be equipped with:
  - 1. Vibration isolators
  - 2. Drive motor
  - 3. Belt guards
  - 4. Operating controls

5. Backdrive assembly
6. Planetary Gear reducer
7. Vibration Switches
8. Main Bearing Temperature Monitor
9. Power Tubes

## 2.2 MATERIALS

- A. All wetted parts of the centrifuge rotating assembly shall be 316, or duplex stainless steel, except for the “O” rings, seals, and abrasion-resistant material. “O” rings shall be Nitrile rubber; lip-type seals shall be Nitrile rubber.
- B. The feed tube will be constructed of stainless steel or a fiberglass and stainless steel combination.
- C. The frame will be fabricated from structural tubular steel and shall contain no weighted aggregate.
- D. The upper casing will be 316 stainless steel with 316 stainless protecting the wetted parts of the lower casing.
- E. The belt guards will be constructed of painted steel and/or fiberglass; or be an integral part of the upper casing.

## 2.3 CENTRIFUGE

- A. Bowl
  1. The bowl shall be manufactured from centrifugal castings of type duplex stainless steel, and designed to operate at a maximum of 3,500 x G at the inside bowl wall diameter based on 3,800 rpm for maximum process flexibility and reliability and to withstand all centrifugal forces encountered at design operating speeds with adequate safety factors. Rolled and welded or static cast bowls shall not be allowed. The bowl shall be inspected for cracks, shrinkage, porosity, or other defects.
  2. The centrifuge bowl shall be supported by roller bearings mounted in pillow blocks and fitted for convenient external lubrication. Main bearings shall have a calculated life of at least 100,000 hours at standard operating speeds in accordance with DIN ISO 281 requirements.
  3. Flow through the centrifuge shall be counter current such that there are no centrate tubes to maintain. Pond depth shall be readily adjustable via power plate weirs located at the large diameter end of the bowl and shall not require removing the rotating assembly from the frame. Solids shall be discharged at the small diameter end of the bowl.
  4. Power tubes that adjust the pond depth shall be utilized for maximum energy efficiency. The power tube will direct the centrate in the opposite direction of the bowl rotation to provide additional power for bowl rotation. The pond depth shall be adjusted by simply rotating the power tube.
- B. Scroll Conveyor
  1. The centrifuge shall include a duplex stainless steel hub for the horizontal conical-cylindrical scroll conveyor. The conveyor shall be equipped with duplex stainless steel

flights on the conical section and 316 stainless steel helical flights on the horizontal section, independently mounted concentrically within the bowl. The scroll shall utilize a differential speed to convey solids from the cylindrical section to the conical section and out of the bowl with a minimum disturbance to the pool, and to the maximum advantage of the variable speed back drive described in this section. The scroll conveyor shall be supported on grease lubricated anti-friction ball or roller bearings sealed from process contamination.

2. The edge and the face of the conveyor flights shall be protected by a series of welded on sintered tungsten carbide tiles, as described in the abrasion protection section. The tiles shall extend from the feed zone area to the point of solids discharge.
3. The scroll conveyor shall be designed such that the feed leaving the feed tube is accelerated in a feed zone. The feed material leaving the conveyor hub will pass through conveyor feed ports, that will be protected from abrasion by field replaceable solids sintered tungsten carbide wear lines. The feed shall be evenly discharged into the bowl. The flights on the conveyor shall be designed with flow equalization windows to allow axial flow of centrate for minimum disturbance to the pool and maximum settling of fine particles.

C. Gear Box

1. The centrifuge shall be equipped with a direct drive multistage planetary gearbox to provide control of the differential speed between the centrifuge bowl and conveyor. The gear unit shall have a torque capacity of 8 kNm.
2. Lubricating oil is self-contained and shall be high performance gear oil.
3. The gear box shall be independently balanced from the centrifuge, and interchangeable. Each gear unit should be protected from damage due to high torque overload.
4. A thermal overload protection device shall not be considered as providing for sufficient protection for the gear unit.
5. Hydraulic drive units or externally cooled gearboxes will not be acceptable.

D. Frame and Casings

1. The rotating assembly and bearings of the centrifuge will rest on a steel frame.
2. The frame and casing shall be supplied on a modular frame and shall be fabricated from structural tubular steel. The modular frame shall support both the drive motor and backdrive and shall provide a minimum clearance of 23-inches from floor to the casing solids and liquid discharge openings. The casing assembly will be provided with a stainless steel upper casing, specifically designed for rigidity and noise reduction. Fiberglass upper casing shall not be allowed to maintain safety. The case shall be designed to act as a protective guard and to provide a complete enclosure for odor containment. The casing top shall be gasketed.
3. The bottom of the casing shall be fitted with a flexible splashguard for cake discharge. The liquid discharge shall be fitted with a flexible connection fitted with a flanged connection for the centrate. The lower casing shall be fabricated from carbon steel with stainless steel cladding on the wetted parts.
4. The case top shall be removable bolted in place, and be equipped with a cover switch so the centrifuge cannot be started when the cover is open.
5. Vibration isolators for the drive motor and back drive shall be supplied as required. Conduit boxes for all centrifuge mounted switches, except those specifically related to the main drive motor, shall be mounted on the base.



E. Feed Tube

1. Sludge shall be fed to the centrifuge by means of a progressive cavity pump, supplied by others, suitable to minimize turbulence and pulsation. The minimum inlet pressure to the centrifuge shall be 15 psig at 75 gpm (when used on water with viscosity of 1 Centipoise).
2. The feed connection to the centrifuge shall be a 2½-inch hose connection. The feed tube shall also include a ¾-inch connection for polymer.
3. The feed flow to the centrifuge shall be monitored by a magnetic flow meter provided by others.

F. Drive System

1. The bowl drive system shall consist of an electric motor and a belt drive system. The belt drive system shall consist of multiple belts as required to provide full capacity and also to withstand the full starting torque of the system.
2. The drive system shall use one motor for the bowl drive and a separate motor for the back drive system for differential adjustment.

G. Back Drive System

1. Each centrifuge shall be furnished with a complete direct drive back drive system to control differential speed between the conveyor and the bowl. The backdrive shall provide an infinitely adjustable differential speed variation over its range of operation.
2. Each back drive system shall be furnished with all the required instrumentation and electrical controls to meet the operating requirements of this specification.
3. Back drives utilizing hydraulic drive, or water cooled units will not be acceptable.

H. Abrasion Protection

1. In order to minimize wear due to abrasive materials in the feed, replaceable hard surfacing shall be provided at all points where the abrasive action of the sludge will cause wear on the metal parts of the centrifuge. The following shall be considered a minimum degree of hard surfacing required.
  - a. Bowl Wall: The bowl wall and conical extensions shall be protected with minimum of eight (8) welded ribs designed to trap a protective layer of solids between the bowl wall and the conveyor.
  - b. Conveyor Feed Ports: Integral part of scroll conveyor in 316 SS.
  - c. Accelerator Target: Field replaceable solid tungsten carbide that is held in place by field replaceable solid tungsten plates.
  - d. Solids Discharge Ports: The solids discharge ports shall be protected from abrasion by field replaceable tungsten carbide wear saddles.
  - e. Solids Discharge Casing: A replaceable stainless steel or urethane insert shall protect the solids discharge casing.
  - f. Scroll Conveyor Flights: The edge and face of the conveyor flights shall be protected against abrasion from the solids by a series of welded-on sintered tungsten carbide tile assemblies from two wraps beyond the feed zone through the solids discharge end. Each tile assembly shall be weight correct, and consist of a solid sintered tungsten carbide wear part braised to a stainless steel back-up holder. Spray hardsurfacing applied to a back-up plate will not be allowed. Each assembly shall be individually replaceable and shall include the ability to monitor wear by means of visual inspection. The tile assemblies must extend ½-inch beyond the radial edge of the conveyor flight. The remaining scroll conveyor edge and face shall be protected from abrasion by flame sprayed hardsurfacing containing a

minimum 40% tungsten carbide particle. Stellite or ceramic hardsurfaced tiles are not acceptable.

## 2.4 NOISE AND VIBRATION

- A. The centrifuge shall be equipped with noise suppression devices of an energy efficient design, such that the average noise level measured at 3-feet around the periphery of the complete centrifuge assembly shall not exceed the 88 dBA when tested at the manufacturing facility without feed and with the inlet and discharge closed.
- B. The centrifuge shall be equipped with an accelerometer type vibration monitors located on each pillow block to protect against excessive vibration. The monitor shall be interlocked with the controls to shut down the centrifuge if excessive vibration is sensed. The monitors shall provide an analog output signal proportional to the vibration magnitude for display and monitoring at the HMI operator interface.
- C. The centrifuge, when running without feed, shall be measured for vibration at the manufacturing facility. The vibration shall be less than or equal to 8.0 mm/s RMS when measured at the pillow blocks under dry shop conditions.

## 2.5 LUBRICATION

- A. All bearings on the centrifuge shall be grease lubricated through suitably located fittings.
- B. Bearing temperature monitors will be provided on each main bearing pillow block, with an analog output signal sent to the Decanter Management System for display and monitoring at the HMI operator interface.
- C. The gearbox lubrication shall be self-contained and consist of high performance gear oil.

## 2.6 VIBRATION ISOLATORS

- A. The centrifuge shall be mounted on rubber-type vibration isolators. The number and vibration constant of the isolator shall be as recommended by the manufacturer for the load and impact resulting from the operation of the centrifuge provided
- B. There shall be no rigid connections to the centrifuge.

## 2.7 ANCHOR BOLTS

- A. Anchor bolts shall be sized by the centrifuge manufacturer, and shall be supplied by the installing contractor. Anchor bolts shall be 304 minimum stainless steel.

## 2.8 FLEXIBLE CONNECTORS

- A. To insure a quiet installation, flexible connectors shall be provided to isolate the centrifuge from the building structure. Flexible connectors include the solids discharge splashguard, flexible

feed connections, flexible centrate connection, and flexible polymer connection for the feed tube. These items are to be supplied by the centrifuge manufacturer:

1. The flexible solids splashguard shall be constructed of 1/8-inch black neoprene. All hardware shall be constructed of type 304 stainless steel.
2. The flexible feed connection shall be constructed of black neoprene hose with a hose clamp fitting mounted on a 150 lb. flange connection.
3. The flexible centrate connection shall be 8-inches long and constructed of black neoprene with a flanged connection.
4. The flexible polymer connection shall be constructed of hose with a custom connector on the centrifuge feed tube side and a 1½-inch polymer connection to process piping.

## 2.9 STANDARD TOOLS

- A. One (1) set of the following standard tools to be provided to assemble and disassemble the centrifuge as required by the owner. The following tools shall be supplied as a minimum:
  1. One (1) set of special tools including bowl lifter, conveyor lifter, and bowl truck
  2. One (1) set of lubricants for start-up
  3. One (1) set of spare O-rings and seals
  4. One (1) set spare drive belts

## 2.10 PAINT SYSTEM

- A. Paint system shall be manufactures standard system consisting of a catalyzed epoxy primer and a top coating of aliphatic acrylic urethane. All carbon steel and cast iron shall be properly prepared and cleaned in accordance with standard practice. A total of seven mils for primer and finish coat shall be applied.

## 2.11 CONTROLS & MOTORS

- A. General
  1. The Decanter Management System (DMS) shall be complete with a NEMA 4X centrifuge operator control (COP) panel mounted on a stand, back drive controller, and a NEMA 12 free standing starter/back drive panel (CPP).
- B. Centrifuge Control Panel (COP)
  1. The centrifuge operator control panel shall contain a minimum 10.4-inch graphic color operator interface. Indication for running, off, and fault indication of all major components, elapsed time meter, and alarm acknowledge/lamp reset push-button shall be included in the screen. An emergency stop push-button and an alarm horn shall also be provided. The control screen shall receive and transmit information to the Decanter Management System (DMS).
    - a. All components in the control panel shall be completely factory wired. All external control connection points shall terminate on terminal blocks with ferrules on wire ends to prevent fraying of wires during connection and servicing. There shall be a minimum of 10% spare terminal connection points supplied.
    - b. The enclosure shall be 304 stainless steel.
    - c. The centrifuge is monitored and the back drive is controlled by the Back Drive Controller (B.C.), which controls delta rpm in the speed control mode, and scroll

torque in the automatic control mode. The unit also provides digital display of bowl speed, pinion speed, delta rpm, vibration, bearing temperature, and torque. Applicable set point values are entered via the DMS. This unit is mounted on the centrifuge and connects via Ethernet to the DMS.

- d. Control logic is by the DMS and the associated operator interface unit. The operator interface unit consists of a color display. All operator functions described below will be provided through menus and keys on the HMI operator interface unit. The DMS shall be supplied with battery back-up capability so all programs and settings are retained if a power supply failure occurs. Digital and analogue I/O units shall be supplied.
- e. The operator interface unit shall be capable of automatic or manual start/stop operations, as well as provide display readings of the following: Centrifuge drive motor amps, sludge and polymer actual flow rates, sludge and polymer desired flow rates, bearing temperature, vibration, fault monitoring, and pre-set and actual timing operations, local/remote control status, and auto/manual control status, back drive torque, back drive speed, differential speed, and bowl speed.
- f. The HMI shall be supplied with selector keys to allow the operator to toggle between feed pump 1 or feed pump 2 and polymer pump 1 or polymer pump 2 which are supplied by others.
- g. Control wire shall be #16 AWG minimum, shall conform to UL standards, and shall be type THHN, THW or MTW.
- h. Nameplates shall agree with the wiring diagram, and shall be made of 1/16-inch thick laminated acrylic. Letters shall be black on a white background to prevent obscuring text with dirt build-up, and shall be 1/8-inch in height
- i. The centrifuge shall be equipped with accelerometer type vibration monitors located on each pillow block to protect against excessive vibration. The monitors shall be interlocked with the controls to shut down the centrifuge if excessive vibration is sensed. The monitors shall provide an analog output signal proportional to the vibration magnitude for display and monitoring at the HMI operator interface. Bearing temperature monitors will be provided on each pillow block, an analog output signal will be sent to the HMI operator interface.
- j. The centrifuge shall be equipped with a cover switch so the centrifuge cannot be started when the cover is open.
- k. Field mounting of the control panel and interconnecting wiring between the centrifuge, operator panel, and starter panel shall be provided by the installing contractor.

C. Centrifuge Starter/Back Drive Panel (CPP)

1. The centrifuge starter/back drive panel shall be a free standing ventilated enclosure, containing a main circuit breaker with a through the door handle, a common buss variable frequency drive (VFD) system for the centrifuge back drive and drive motor, sludge cake conveyor starter and a back drive motor blower starter. The VFD system shall be sized in accordance with the centrifuge manufacturer's design requirements and shall be as specified in the variable Frequency Drive section of this specification. The drive system shall be capable of a flying restart after any shutdown including power outage. The main circuit breaker shall be a 22,000 symmetrical amp thermal magnetic breaker sized in accordance with centrifuge system requirements. A duplex 120 VAC receptacle for customer use up to 3 amps, non-inductive loads shall be mounted internal to the enclosure.
2. The enclosure is to be painted with enclosure manufacturers stand paint system.

3. A 24 V D.C. power supply and U.P.S. for the DMS and associated operator interface unit shall be provided. All +24 VDC power supplies must provide short circuit fold back protection.
4. The DMS shall have the capability to be hardwired to any control system for remote operation and monitoring through analog I/O's and digital I/O's of the centrifuge and ancillary equipment supplied by others such as conveyors, feed pumps, diverter gates, etc.
5. The DMS shall have the capability to be hardwired to any control system for remote operation and monitoring through analog I/O's and digital I/O's of the centrifuge and ancillary equipment supplied by others such as conveyors, feed pumps, diverter gates, etc.
6. In the event of a power loss the DMS shall have the ability to provide Powerless blow clean out Protection that will allow the centrifuge to run through a short duration power blip, generally defined as 3-5 seconds. If the power outage extends past the 3-5 seconds the system will down the feed pump and polymer pump and put the centrifuge into the production standby mode for a programmed set time. If power is restored during this time the feed pump and polymer pump will automatically restart and production will resume. Should the power not be restored, the control system must allow the centrifuge to be brought to a stop in a normal shutdown mode (as if it had power); including a normal flush cycle along with maintaining the differential speed during the coast down period. This system will allow the centrifuge to scroll the solids out and be available for an immediate restart, once power is restored.
7. Control wire shall be #16 AWG minimum, shall conform to UL standards, and shall be type THHN, THW or MTW.
8. A ground lug shall be supplied on the panel. All customer interface contacts are provided through isolated 10 amp interposing relays. Contacts shall be suitable for 24 VDC or 120 VAC control. DMS shall provide 24 V DC control voltage for all external inputs.
9. Each wire segment shall be numbered at each end using tubular heat shrinkable markers with permanent mechanically stamped. The wire numbers shall correspond to those on the wiring diagram. Wrap around or clip type numbers are not acceptable.
10. Nameplates shall agree with the wiring diagram, and shall be made of 1/16-inch thick laminated acrylic. Letters shall be black on a white background to prevent obscuring text with dirt build-up, and shall be 1/8-inch in height.

#### D. Drive Motor

1. The motor shall be a squirrel cage induction motor suitable for VFD starting, 50 HP, 1800 rpm, TEFC, continuous duty, with a non-hydroscopic class F insulation system limited to a B temperature rise, 1.0 service factor on sine wave, NEMA design B or IEC equivalent design, standard long shaft for v-belt drive, and terminal box rotatable in 180 degree increments. The motor shall be provided with thermal protection using a bi-metal thermal switch. The motor shall have copper windings and be of high thermal capacity design for operation on 460/3/60 power. Fluid coupling/clutch starting systems shall not be allowed due to maintenance concerns.
2. With the motor at ambient temperature, it shall be capable of making two (2) complete starts in succession with coasting to rest between starts. The motor shall be capable of one (1) immediate restart after of any shutdown except motor overload. The motor shall not take longer than 5-minutes (each start) to accelerate to full rated rpm on at 90% nameplate voltage while maintaining operation below name plated full load amps. The motor shall be rated by the motor manufacturer as having a noise level not exceeding 88 dBa (sound pressure) when measured at 3-feet from the motor in any direction. The motor bearings shall be grease lubricated, ball or roller anti-friction type of standard

manufacture. The bearings shall be conservatively designed to withstand all stresses of the service specified. Motor bearings shall have a minimum life rating of 40,000 hours of operation.

3. Motor shall be Baldor or approved equal.

E. Main Drive & Back Drive – Variable Frequency Drive

1. The Main Drive VFD and Back Drive VFD shall be housed in the Centrifuge Starter/Back Drive Panel, containing both AC VFD controllers and a BD motor blower starter. The main drive and back drive AC motor VFD controller shall be a flux vector controlled, sine coded, PWM drive.
2. Output contactors must be provided for each VFD to ensure positive power disconnect on over speed, emergency stop fault, and at reset conditions. A positive speed measurement device must be provided for over speed protection.
3. The drive shall include the following minimum features:
  - a. IGBT (Insulated Gate Bipolar Transistor) power module.
  - b. On-board alphanumeric digital display for programming and indication of set-up operating, circuit analysis, and diagnostic data.
  - c. Set-up parameters shall be stored in EPROM memory that does not require battery backup.
  - d. UL, Canadian UL, or CSA Labels.
  - e. Product of ISO 9001 certified production facility.
  - f. Designed to provide 100,000 hours mean time between failures with specified preventative maintenance.
  - g. Inner loop torque control strategy with mathematical torque and flux calculation updates every 25 microseconds (40,000 times per second).
  - h. Operation from 3-phase power rated 380 to 690 VAC  $\pm 10\%$  and 48 to 63 Hz.
  - i. The drive shall employ a Full Wave rectifier to prevent input line notching and operate at fundamental power factor of 0.98 at all speeds and loads.
  - j. Drive efficiency shall be 97% or higher at full speed and load.
  - k. An internally mounted line reactor shall be provided to reduce input current harmonic content, provide protection from power line transients such as utility power factor correction capacitor switching transients and reduce RFI emission.
  - l. An automatic motor parameter ID function shall define the motor equivalent circuit in the VFD.
  - m. Flux optimization to limit the audible noise produced by the motor and to maximize the efficiency by providing the optimum magnetic flux for any given speed/torque operating point.
  - n. VFD Manufacturer's 2-year onsite warranty.
  - o. VFD drives shall be equipped with Profibus communication module or fiber optics to allow communication with DMS.
    - 1) As a minimum the drive will include the following adjustable parameters of indication.
      - a) Adjustable Parameters
      - b) Torque Limit Level
      - c) Minimum/Maximum RPM
      - d) Output signal selection and scaling
      - e) Input signal scaling
      - f) Preset speeds
      - g) Motor full load current
      - h) Motor Base RPM
    - 2) Indication

- a) Motor torque
- b) Motor Current
- c) Motor Speed
- d) Motor Speed Set-point
- e) Motor Power
- f) External Torque Reference
- g) DC Buss Voltage
- h) Motor Temperature
- 3) Main Drive System Performance
  - a) Speed regulation of 0.4% or better
  - b) 100% Torque output in all Four Quadrant Control when required
  - c) Torque signal accuracy of  $\pm 5\%$
  - d) Torque limiting of motor torque, 0 - 200%
- 4) VFD drives shall be Allen Bradley or approved equal.
- 5) Centrifuge VFD requirements are unique to centrifugation equipment. Centrifuge VFD requirements in this section shall take precedent over general VFD requirements for other equipment listed in the general equipment requirements or general electrical requirements.

F. Back Drive Motor

1. The motor shall be a minimum 10 HP premium efficiency squirrel cage induction motor for VFD duty, TEFC, or TEBC blower cooled, continuous duty, 1.0 service factor, NEMA design B, with class F insulation and class B rise, and a pinion pickup sensor for pinion speed feedback control. The motor shall have copper windings and be designed for operation on 460/3/60 power and balanced for centrifuge operation. Thermal protection in the motor shall be bi-metallic thermostat. The VFD system shall be sized in accordance with the centrifuge manufacturer's design requirements and shall be as specified in the Variable Frequency Drive section of this specification. The motor shall be capable of delivering full load torque across a 20:1 turn down ratio. The drive system shall be capable of a flying restart. Hydraulic back drive systems shall not be allowed.
2. Motor shall be Baldor or approved equal.

G. Control System Operation

1. The centrifuge shall be able to be started automatically or manually. To automatically start the centrifuge, press "Auto Start" key on the operator interface unit.
2. The DMS will issue a "run" command to the centrifuge main drive motor and the bowl will begin to accelerate. The polymer and feed systems (by others) shall be interlocked with the centrifuge controls to prevent their operation at this time. During acceleration of the centrifuge, the DMS shall issue a "run" command to the back drive and a "start-up speed" command to the back drive controller (B.C.). This will make the back drive run at a pre-programmed start-up speed as set in the B.C. to provide the maximum scrolling of residual solids from the bowl. After a pre-set, timed interval, during which the bowl has reached full operating speed, the feed and polymer pumps will then start automatically. As process requirements vary, the back drive speed shall be infinitely adjustable via the B.C., which shall maintain the set speed utilizing a closed loop, feedback.
3. Automatic torque mode may also be selected at any time. In this mode the back drive torque shall be maintained while the speed is allowed to vary, within pre-set limits, in order to maximize residence time. If torque begins to rise above the set point, the differential speed shall be increased to scroll solids out of the bowl at a faster rate, thereby lowering the torque back to the set point. The DMS shall be equipped with a feature that will allow for manual adjustment of the PID Proportional, Integral and

Derivative values from the operator interface. Separate software, computers, and communication cables shall not be required to activate this feature.

4. The centrifuge shall be able to be started manually as well, by pressing the appropriate keys as prompted by the manual operation screen of the operator interface unit.
5. Upon stopping the centrifuge by pressing the “Auto Stop” key on the operator interface unit, or via a fault condition, the feed and polymer system interlock contact shall open thereby insuring feed to the centrifuge is stopped. An auto flush valve will also be opened for a pre-determined time during shutdown.
6. A Clean-In-Place (CIP) System should also be provided. This system is used for optimal cleaning of the centrifuge. The CIP run cycle can be started anytime the main drive motor is at rest as determined by the shutdown timer. Before initiation of the CIP start sequence, all faults must be cleared. A “CIP Start” key is pressed to begin the CIP cycle. The back drive will be energized and begin to rotate in the normal direction at a low speed for a predetermined time. At the same time, the main drive will accelerate the bowl to a low speed in the forward direction. At the end of the set time, the main drive and drive will then toggle direction, causing a water “sloshing” effect within the centrifuge bowl and conveyor. The process will continue until the predetermined overall time ends, a “CIP Stop” key is depressed, or a fault occurs. Any shutdown fault will terminate the CIP cycle.

#### H. Control System Fault Detection

1. In the event that a fault condition occurs, the sounding of an alarm horn will take place, and an alarm text fault message will be displayed on the operator interface unit to facilitate trouble shooting. An alarm acknowledge push-button, on the HMI interface, will flash when a fault condition occurs. When pressed, the horn will be silenced and the flashing will turn solid. When the alarm fault is corrected and reset, the solid light will turn off.
2. The following faults shall be provided as alert conditions and shall shut off the feed pump, polymer system, and grinder as required:
  - a. Feed pump fault
  - b. Polymer system fault
  - c. Grinder fault
  - d. Cake conveyor fault
  - e. Torque alert
  - f. Low differential
  - g. High vibration
  - h. Main or back drive motor shutdown
3. The following faults shall be provided as alarms and will cause shutdown of the main drive and backdrive motors:
  - a. Main motor overheat
  - b. Main drive malfunction
  - c. Excessive vibration
  - d. Back drive motor overheated
  - e. Back drive malfunction
  - f. Centrifuge cover open
  - g. Torque alarm
  - h. Centrifuge bowl over speed
  - i. High bearing temperature



## 2.12 CONTROL – AUXILIARY EQUIPMENT INTERFACES

- A. The following auxiliary control must be provided within the centrifuge control panel for use with related auxiliary centrifuge equipment and future installed options. These features must be able to be enabled or disabled as required from the Operator Interface Unit. Centrifuge supplier to enable actual configuration at start-up.
- B. Installing contractor is required to coordinate and ensure proper interface between the centrifuge control panel and auxiliary equipment supplied in other sections.
  - 1. Positive Displacement Sludge Feed Pump Interface: The sludge feed pump specified in Division 43 Section “Sludge Feed Pump” shall be provided with a VFD for speed control and a hand-off-auto switch. In hand, the pump speed shall be controlled locally from the VFD, but still interlocked with the centrifuge permissive signal. In the auto position, the pump shall accept a run command and a 4-20 mA speed control signal from the centrifuge DMS. In the off position, the pump shall be locked out of operation. The pump shall also be provided with on/off status contacts.
  - 2. Packaged Polymer System Control Interface:
    - a. The packaged polymer system as specified in Division 46 Section “Polymer Feed System” provided with a self-contained local control panel with a hand-off-auto switch, a dilution water flow control valve, dilution water flow meter, and logic system to maintain constant dilute polymer concentration.
    - b. In the off position, the polymer system shall be locked out of operation. In hand, the polymer system shall be controlled locally from the polymer system local control panel. The system shall accept a run command from the centrifuge. In the auto position, the dilution water control valve shall accept a 4-20 mA control signal from the centrifuge DMS. The flow meter shall send a 4-20 mA output signal to the DMS for indication and display of the actual polymer flow rate.
  - 3. The sludge cake screw conveyor shall be controlled from the COP. The conveyor starter shall be in the centrifuge power panel (CPP).
  - 4. The grinder on the centrifuge sludge feed line shall be controlled by the Decanter Management System when the H-O-A switch on the GR-1 control panel is in the “auto” position.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. The installing contractor shall conduct a field inspection to verify the foundations and other preparations are complete and that the site is ready for installation of the centrifuges.
- B. All equipment shall be properly crated to protect any and all components from damage during shipment.
- C. The contractor shall ensure that all parts are properly protected so that no damage or deterioration will occur during a prolonged delay from the time of delivery until installation is complete and the units and equipment are ready.
- D. Unfinished iron or unpainted steel surfaces shall be properly protected to prevent rust and corrosion.

- E. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment and proper care shall be taken to protect parts from the entrance of water during shipment, storage, and handling.
- F. A supply of the manufacturer's recommended oil, grease and hydraulic fluids required for the equipment startup, shall be furnished with the centrifuges.

### 3.2 INSTALLATION

- A. Installation shall be in accordance with the recommendation of the centrifuge manufacturer to ensure that systems are properly installed.
- B. Representatives of the centrifuge manufacturer, who have complete knowledge and experience in the proper installation, start up and operation of the equipment shall inspect the final installation and supervise the field acceptance tests of the equipment.
- C. Functional Testing
  - 1. After installation of the units and after all systems have run in steady state, the contractor shall perform a functionality test under the supervision of the manufacturer in the presence of engineer.
  - 2. Each centrifuge shall run for 4-hours without failure. At the beginning, middle, and at the end of this test, the operator will record all temperature indicators, pressure gauges, and flow indicators. All safety devices shall be checked for satisfactory operation. The no-load amperage of the main drive motor shall be recorded. The start timer and acceleration time to running speed shall be adjusted, if necessary. The belt tension shall be, checked and readjusted if necessary, at the end of the test.
  - 3. Any malfunctions that appear during the tests shall be corrected and additional testing performed, to assure that the problem has been corrected.

### 3.3 FIELD SERVICE

- A. A field service technician shall be provided for ten (10) days in two (2) trips. Additional days may be purchased at the current rate.

**END OF SECTION 467633**

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# **GEOTECHNICAL ENGINEERING REPORT**

**Salisbury Water Treatment Plant Improvements  
1 Water Street  
Salisbury, Rowan County, North Carolina**

**CVET Project No. 19-523**

**July 12, 2019**

**PREPARED FOR:**

**Salisbury-Rowan Utilities  
Rowan County, North Carolina 28144**

**PREPARED BY:**



**CATAWBA VALLEY  
ENGINEERING & TESTING**





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July 12, 2019

Mr. Jason H. Wilson, P.E.  
Engineering Manager  
Salisbury-Rowan Utilities  
Salisbury, North Carolina  
jason.wilson@salisburync.gov

Re: Geotechnical Engineering Report  
Salisbury Water Treatment Plant Improvements Phase I  
1 Water Street  
Salisbury, Rowan County, North Carolina  
CVET Project No.: 19-523

Dear Mr. Wilson:

Catawba Valley Engineering and Testing (CVET) is pleased to submit to you our Geotechnical Engineering Report for the proposed Salisbury Water Treatment Plant Improvements Phase I located at 1 Water Street in Salisbury, North Carolina. This study was authorized by yourself on May 10, 2019. This report presents the findings of our subsurface exploration and provides geotechnical recommendations for design and construction of the project.

CVET appreciates the opportunity to provide our geotechnical engineering services for this project. If you have any questions regarding the contents of this report, or if we can provide additional services for the project such as construction materials testing, please do not hesitate to contact us.

Sincerely,

**CATAWBA VALLEY ENGINEERING AND TESTING, P.C.**

Cody B. Dobbins, E.I.  
Project Manager



7/12/19

David M. LeGrand, Jr., P.E.  
Principal Engineer  
NC 041419

Geotechnical Engineering

Environmental Services

CMT/Special Inspections



Project Name: Salisbury Water Treatment Plant  
Location: Salisbury, Rowan County, North Carolina  
Date: July 12, 2019  
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## 1.0 EXECUTIVE SUMMARY

The following items represent a short summary of (1) the findings of our subsurface exploration, (2) our conclusions, and (3) our recommendations for design and construction of proposed Salisbury Water Treatment Plant Improvements Phase I located at 1 Water Street in Salisbury, North Carolina.

1. The area being evaluated generally consists of surficial fill soils overlying residual soils. Initial Exploration (B-1 through B-6) - Surficial undocumented fill soils were encountered in all six (6) soil test borings and mainly consist of silty sand (SM), sandy silt (ML), and sandy clay (SC). Various amounts of organic material and rock fragments were encountered in the fill soils. The fill soils were encountered to depths ranging from approximately 4.0 to at least 15.0 feet below existing site grades. SPT N-values within the cohesionless fill soils ranges from 6 to 30 blows per foot (bpf), indicating loose to medium dense soil consistencies. SPT N-values within the cohesive fill soils ranges from 2 to 13 bpf, indicating very soft to stiff soil consistencies. Note the undocumented fill soils were not penetrated in boring B-5. Alluvial soils were encountered in borings B-1, B-3, and B-4 underlying the undocumented fill soils to depths ranging from approximately 12.0 to 25.0 feet below existing site grades. The alluvial soils consist of sandy lean clay (CL), silty sand (SM), and sandy fat clay (CH) and contains trace amounts of organics. The SPT N-value within the cohesionless alluvial soil was measured to be 12 bpf, indicating medium dense soil consistencies. SPT N-values within the cohesive alluvial soils ranges from Weight of Hammer (WOH) or 0 to 32 bpf, indicating very soft to hard soil consistencies. Residual soils were encountered underlying the undocumented fill soil and/or alluvium in borings B-1 through B-4 and consist of dry to moist, silty sand (SM) with sporadic rock fragments. SPT N-values from the residual soils ranges from 10 to 59 bpf indicating medium dense to very dense soil consistencies. Secondary Exploration (B-8 through B-13A) - Surficial undocumented fill soils were encountered in all six (6) soil test borings and mainly consist of silty sand (SM), sandy silt (ML), and sandy elastic silt (MH). Various amounts of organic material and rock fragments were encountered in the fill soils. The fill soils were encountered to depths ranging from approximately 5.5 to 12.0 feet below existing site grades. SPT N-values within the cohesionless fill soils ranges from 2 to 9 bpf, indicating very loose to loose soil consistencies. SPT N-values within the cohesive fill soils ranges from 3 to 10 bpf, indicating soft to stiff soil consistencies. Alluvial soils were encountered underlying the undocumented fill soils, in all test borings, to depths ranging from approximately 5.5 to 17.0 feet below existing site grades. The alluvial soils consist of sandy elastic silt (MH). Trace amounts of organics were encountered and select SPT samples are being subjected to organic content testing to evaluate the percentage of organic content by weight. SPT N-values within the cohesive alluvium ranges from Weight of

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Hammer (WOH) or 2 to 13 bpf, indicating very soft to stiff soil consistencies. Residual soils were encountered underlying the alluvium in borings B-8 through B-13A and consist of moist, silty sand (SM) and/or sandy silt (ML) with sporadic rock fragments. SPT N-values from the residual soils ranges from 6 to 77 bpf indicating loose to very dense soil consistencies. Partially weathered rock was encountered in soil test borings B-1, B-2, B-6 and B-10 at depths of 38.5, 19.0, 4.5 and 65.0 feet below existing site grades, respectively. Auger refusal conditions were encountered in the same three borings at 48.5, 19.3, 9.9 and 83.5 feet below existing site grades, respectively. Groundwater was encountered in soil test borings B-1, B-8, B-10 and B-12C at the time of drilling (ATD) at a depths ranging from approximately 15.0 to 25.0 feet below existing site grades. Groundwater was encountered in B-1, B-10 and B-12C at the end of drilling (EOD) at depths ranging from approximately 3.0 to 14.5 feet below existing site grades.

1. We offer the following design and construction recommendations for the proposed Salisbury Water Treatment Plant Improvements Phase I located at 1 Water Street in Salisbury, North Carolina:

- The soil test borings extended for this subsurface exploration encountered undocumented fill soils to depths ranging from 4.0 to at least 15.0 feet below existing site grades. Alluvial soils were encountered to depths ranging from approximately 5.5 to 25.0 feet below existing site grades. Various amounts of organics and rock fragments were encountered within the fill and alluvium.
- Regardless of how the undocumented fill soils are addressed, site preparation should consist of removing the existing topsoil layer, the relocation or proper abandonment of any existing utilities that may be affected by the proposed construction, along with all other soft or unsuitable material from the proposed building envelope and associated pavement areas. Site preparation operations should extend a minimum of 10 feet beyond the planned limits of the facilities and a minimum of 5 feet beyond the planned limits of the pavement areas. These limits should also extend beyond the perimeter of the structural fill slopes laterally equal the depth of necessary structural fill to achieve finished grades.
- We anticipate that the majority of the undocumented fill soils will be suitable for re-use as structural fill. The existing alluvial soils should not be re-used as structural fill. Some localized areas of unsuitable soils may be encountered during earthwork and foundation construction.
- Any required fill soils should be compacted to at least 98 percent of the maximum dry density obtained in accordance with ASTM Specification D-698, Standard Proctor Method, with a moisture content within +/- 3% of the optimum moisture

content (OMC). Acceptable fill soils should be soil that has less than 5 percent organic content and a liquid limit and plasticity index less than 50 and 20, respectively. Soils with USCS group symbols of SP, SW, SM, SC, and ML are recommended for use as controlled fill, although it is important to note that silty soils are very moisture sensitive and not as strong as sandy soils. Elastic silts (MH) and plastic clays (CH) should not be utilized as structural fill at this site unless approved by CVET prior to placement and compaction operations.

- Pending the finished floor elevation of the proposed facility and the finished floor of the proposed concrete water retaining tank, groundwater control will likely be anticipated. If excavations in proximity to boring B-12A exceed approximately 3.0 feet, groundwater mitigation should be anticipated.
- Based upon the encountered subsurface conditions across the site we have developed three recommendations for foundation support. The options are presented in section 6.3 FOUNDATIONS.
- We recommend that grade slabs for the pre-engineered building be supported on newly compacted, non-elastic, structural fill soils and the grade slabs for the concrete tank be supported on ground improved site soils (aggregate piers).
- Based on our soil test boring data at the proposed site, it is our opinion that a Site Seismic Classification of D is appropriate for this site.

This executive summary should be used in conjunction with the entire contents of the report, in order to gain a complete understanding of all conclusions and recommendations contained within the report. If conditions revealed during construction vary from those described in this report, the on-site geotechnical engineer shall contact the engineer of said report to discuss potential options to address the varying site conditions.

## **2.0 PURPOSE AND SCOPE OF WORK**

The purpose of the subsurface exploration and geotechnical engineering evaluation was to explore the subsurface conditions at the site, collect representative samples of soil for examination in our laboratory, and provide conclusions and recommendations for design and construction of the proposed Salisbury Water Treatment Plant Improvements Phase I located at 1 Water Street in Salisbury, North Carolina.

CVET's scope of work included the following:

- Drilling of sixteen (16) soil test borings at the site (Borings B-1 through B-6 and B-8 through B-13A);

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- Collection of representative samples of soil from the soil test borings;
- Classification of collected soil samples and laboratory testing as necessary;
- Preparation of boring logs, boring location plan, and general subsurface profile;
- Evaluation of the encountered subsurface conditions at the site; and
- Preparation of this geotechnical report.

### **3.0 PROJECT INFORMATION**

This project will consist of the evaluation of subsurface soil conditions to aid in the design and construction of a 1½ story industrial type pre-engineered building with a partial height concrete perimeter wall and slab on grade and a second structure consisting of a reinforced concrete water retaining tank. Maximum wall loads are expected to be less than 3 klf and the maximum column loads to be less than 80 kips. The property is currently owned by the City of Salisbury and operates as a water treatment plant.

Borings B-1 through B-6 were based upon the original Boring Location Sketch in the Geotech RFP dated May 2, 2019 by LaBella Associates. Existing site grades within the initial area range from approximately 726 to 740 feet above mean sea level (amsl). Borings B-8 through B-13A were completed at a later date in the proximity to the revised building layout provided by Mr. Dan Hill, PE through email correspondence on June 18, 2019. Final building layout subsequently provided by Mr. Hill on July 9, 2019. Existing site grades in proximity to the revised and final building layout range from approximately 732 to 727 feet amsl and slopes down gradient from south to north.

### **4.0 EXPLORATION PROCEDURES**

Exploration procedures for this project included drilling test borings at the site and laboratory testing of representative soil samples at our laboratory in Hickory, North Carolina.

#### **4.1 Field Exploration**

The subsurface conditions at the existing Water Treatment Plant were explored by drilling a total of fourteen (14) soil test borings (denoted B-1 through B-6 and B-8 through B-13A) at the locations indicated on Figure 2 – Boring Location Plan in Appendix A. Borings B-1 through B-6 were performed between May 13 and May 14, 2019 and borings B-8 through B-13A were performed between June 17 through June 21, 2019. Boring depths ranged from approximately 5.0 to 83.5 feet below existing site grades. The initial boring locations were selected by LaBella Associates and located in the field by CVET using existing site features as a reference, while the follow up boring locations were selected by CVET. Ground elevations at the boring locations were estimated from the provided Boring Location Sketch (May 2, 2019), the revised building layout (June 18, 2019) and

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the Rowan County GIS website. Therefore, the boring locations and elevations shown on Figure 2 and 3; plus the boring logs should be considered approximate. Please note that borings B-12, B-12A, B-12B, and B-13 were extended auger only and terminated at the request of Salisbury-Rowan Utilities personnel due to possible below ground obstructions.

Drilling was performed with a Geoprobe 7822DT atv-mounted drill rig using continuous-flight hollow stem augers (HSA). Soil samples were obtained by means of the split-barrel sampling procedures, performed in general accordance with ASTM D1586. A 2-inch O.D., split-barrel sampler was driven into the soil a distance of 18 inches by means of an automatic hammer. The number of blows required to drive the sampler through the final 12-inch interval is termed the Standard Penetration Test (SPT) "N" value and is indicated for each sample on the boring logs. This value can be used to provide an indication of the in-place relative density of cohesionless soils, but is a less reliable indicator of the consistency of cohesive soils. For cohesive soils, the measurement of unconfined compressive strength  $Q_u$  is a better indicator of consistency; this value is also listed on the boring logs.

Representative portions of each SPT sample were sealed in airtight containers and returned to our laboratory for classification and storage. See the individual soil test boring logs in Appendix B for more details. Note that the soil samples will be discarded after 60 dates from this report date, unless otherwise directed by Salisbury-Rowan Utilities.

## **4.2 Laboratory Testing**

Representative samples of soil obtained during the field exploration were transported to CVET's laboratory in Hickory, North Carolina, where they were examined and classified by a geotechnical engineer. The soil samples were visually classified in general accordance with the Unified Soil Classification System (USCS), per ASTM D2487. Laboratory testing for this portion of the study consisted of Soil Moisture Content (ASTM D2216), Grain Size Distribution (ASTM D422), and Atterberg Limits for plasticity (ASTM D4318). The soil laboratory results from borings B-1 through B-6 are included in Appendix C. The soil laboratory results from borings B-8 through B-13A are in process and will be submitted, upon completion, under separate cover.

## **5.0 SUBSURFACE CONDITIONS**

The subsurface conditions at the site are described in the following paragraphs.

### **5.1 Site Geology**

The site is located in the Piedmont Physiographic Province of North Carolina. The name "piedmont" means "foot-of-the-mountains" which reflect remnants of an ancient

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mountain range that has since been extensively weathered, decomposed and eroded to form rolling terrain and hillsides. The bedrock is metamorphic in nature (igneous or sedimentary rocks that have been changed by heat and/or pressure) and typically consists of schist, gneiss and/or granite. Extensive weathering over time has reduced the bedrock in-place to form overburden residual soils that range from clay topsoil to sandy silts and silty sandy that grade with depth back to saprolite and partially-weathered-bedrock. The degree of weathering varies both laterally and vertically. Based on the 1985 North Carolina Geologic map, the site appears to be underlain by Metavolcanic Rock.

## **5.2 Soils**

A generalized subsurface profile has been prepared for the site – see figure 3 in Appendix A. Soil boring logs are included in appendix B. The area being evaluated generally consists of surficial fill soils overlying residual soils.

### Initial Exploration (B-1 through B-6)

Surficial undocumented fill soils were encountered in all six (6) soil test borings and mainly consist of silty sand (SM), sandy silt (ML), and sandy clay (SC). Various amounts of organic material and rock fragments were encountered in the fill soils. The fill soils were encountered to depths ranging from approximately 4.0 to at least 15.0 feet below existing site grades. SPT N-values within the cohesionless fill soils ranges from 6 to 30 blows per foot (bpf), indicating loose to medium dense soil consistencies. SPT N-values within the cohesive fill soils ranges from 2 to 13 bpf, indicating very soft to stiff soil consistencies. Note the undocumented fill soils were not penetrated in boring B-5.

Alluvial soils were encountered in borings B-1, B-3, and B-4 underlying the undocumented fill soils to depths ranging from approximately 12.0 to 25.0 feet below existing site grades. The alluvial soils consist of sandy lean clay (CL), silty sand (SM), and sandy fat clay (CH) and contains trace amounts of organics. The SPT N-value within the cohesionless alluvial soil was measured to be 12 bpf, indicating medium dense soil consistencies. SPT N-values within the cohesive alluvial soils ranges from Weight of Hammer (WOH) or 0 to 32 bpf, indicating very soft to hard soil consistencies.

Residual soils were encountered underlying the undocumented fill soil and/or alluvium in borings B-1 through B-4 and consist of dry to moist, silty sand (SM) with sporadic rock fragments. SPT N-values from the residual soils ranges from 10 to 59 bpf indicating medium dense to very dense soil consistencies.

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### Secondary Exploration (B-8 through B-13A)

Surficial undocumented fill soils were encountered in all six (6) soil test borings and mainly consist of silty sand (SM), sandy silt (ML), and sandy elastic silt (MH). Various amounts of organic material and rock fragments were encountered in the fill soils. The fill soils were encountered to depths ranging from approximately 5.5 to 12.0 feet below existing site grades. SPT N-values within the cohesionless fill soils ranges from 2 to 9 bpf, indicating very loose to loose soil consistencies. SPT N-values within the cohesive fill soils ranges from 3 to 10 bpf, indicating soft to stiff soil consistencies.

Alluvial soils were encountered underlying the undocumented fill soils, in all test borings, to depths ranging from approximately 5.5 to 17.0 feet below existing site grades. The alluvial soils consist of sandy elastic silt (MH). Trace amounts of organics were encountered and select SPT samples are being subjected to organic content testing to evaluate the percentage of organic content by weight. SPT N-values within the cohesive alluvium ranges from Weight of Hammer (WOH) or 2 to 13 bpf, indicating very soft to stiff soil consistencies.

Residual soils were encountered underlying the alluvium in borings B-8 through B-13A and consist of moist, silty sand (SM) and/or sandy silt (ML) with sporadic rock fragments. SPT N-values from the residual soils ranges from 6 to 77 bpf indicating loose to very dense soil consistencies.

### **5.3 Bedrock**

Partially weathered rock was encountered in soil test borings B-1, B-2, B-6 and B-10 at depths of 38.5, 19.0, 4.5 and 65.0 feet below existing site grades, respectively. Auger refusal conditions were encountered in the same three borings at 48.5, 19.3, 9.9 and 83.5 feet below existing site grades, respectively.

### **5.4 Groundwater**

Groundwater was encountered in soil test borings B-1, B-8, B-10 and B-12C at the time of drilling (ATD) at a depths ranging from approximately 15.0 to 25.0 feet below existing site grades. Groundwater was encountered in B-1, B-10 and B-12C at the end of drilling (EOD) at depths ranging from approximately 3.0 to 14.5 feet below existing site grades. Note that boreholes are left open for only a short period of time during the drilling operation, so the detection of groundwater during this brief period is difficult. Also note that soil moisture and groundwater conditions vary depending on conditions such as temperature, precipitation and season. Therefore, soil moisture and groundwater location at other times of the year may vary from those observed at the time of this subsurface exploration and as described in this report.



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The borehole cave-in depths ranged from 6.0 to 29.0 feet below existing site grade. The borehole cave-in depths are listed on the boring logs. In this geology, the cave-in depth of a boring is sometimes an indication of the stabilized water level, although the water level may be a few feet below the cave-in depth and therefore cannot be directly observed.

## **6.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION**

The following recommendations are provided for the proposed Salisbury Water Treatment Plant Improvements Phase I located at 1 Water Street in Salisbury, North Carolina. The recommendations stated herein shall not be applied to any other project, or used in conjunction with any other recommendation, and shall be used explicitly for this project.

### **6.1 Undocumented Fill/Alluvial Soils and Associated Risks**

The soil test borings extended for this subsurface exploration encountered undocumented fill soils to depths ranging from 4.0 to at least 15.0 feet below existing site grades. Alluvial soils were encountered to depths ranging from approximately 5.5 to 25.0 feet below existing site grades. Various amounts of organics and rock fragments were encountered within the fill and alluvium.

Undocumented fill/alluvial soils encountered during a geotechnical engineering exploration or during construction present unique challenges unlike issues associated with residual soil deposits. Soft clay, peat, loose sand, and hard highly plastic clay can all be characterized reasonably well by proper exploration and testing techniques, knowledge of geologic conditions, and local experience. However, by definition, uncontrolled fills can range from compacted engineered fills where no construction records exist, to a heterogeneous mix of soil types, organics, cobbles, boulders, construction debris, building rubble, trash, industrial waste, and contaminants. Alluvial soils can also be a heterogeneous mix of soil types and having been deposited by means of water and are not consolidated in nature. In some limited cases, properly engineered fills can be sampled and tested and their shear strength and compressibility determined for design purposes. However, no practical amount of exploration and testing can be attempted to try to characterize the shear strength and compressibility for the wide range of deleterious materials found in most alluvial soils. As a result, in order to mitigate the risk of a bearing failure or excess settlement, geotechnical engineers have typically recommended that these undocumented fill/alluvial soils be excavated completely and replaced with engineered materials or addressed through remedial foundation support.

The magnitude of settlement or subsidence of undocumented fill/alluvial soil with the inclusions organic materials cannot be accurately predicted and is a function of time rate of decomposition of the organic material. Undocumented fill/alluvial soil poses an

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unquantifiable degree of risk associated with potential for settlement related distress of structures and pavement areas. Settlement will occur as a result of the extra load or pressure resulting from the new facility, the self-weight consolidation of any necessary grade raised fill, and the consolidation of the existing fill and alluvial soils. The only way to totally eliminate the risks associated with alluvial soil is to completely remove it and backfill with approved, structural fill or through remedial foundation support. Moving forward with the planned construction indicates that the elevated risks associated with site development have been accepted by the owner/developer or will be addressed during construction of the proposed facility.

## **6.2 Site Preparation**

Regardless of how the undocumented fill soils are addressed, site preparation should consist of removing the existing topsoil layer, the relocation or proper abandonment of any existing utilities that may be affected by the proposed construction, along with all other soft or unsuitable material from the proposed building envelope and associated pavement areas. Site preparation operations should extend a minimum of 10 feet beyond the planned limits of the facilities and a minimum of 5 feet beyond the planned limits of the pavement areas. These limits should also extend beyond the perimeter of the structural fill slopes laterally equal the depth of necessary structural fill to achieve finished grades.

Once stripping and rough excavation has been accomplished, the exposed subgrade should be evaluated by proofrolling. Proofrolling consists of driving the appropriate equipment, typically a dump truck with axle weights of 10 or 20 tons for single and double axles respectively, over the subgrade at a walking pace. The proofrolling equipment should first make overlapping passes across the subgrade in one direction, followed by passes in a perpendicular direction. We recommend that the proofrolling be observed by a qualified engineer or engineering technician.

As a result of the existing undocumented fill soils, we anticipate instability within areas to receive structural fill will be observed. Instability during proofrolling of exposed subgrade soils should also be anticipated if elevated in-place moisture content of the encountered site soils is observed. Unstable areas that exhibit excessive rutting, pumping and/or similar distress should be undercut to an approved materials and backfilled with structural fill soil, or stabilized with geosynthetics, as recommended by a qualified geotechnical engineer.

If conditions revealed during site preparation operations vary from those described in this report, the on-site geotechnical engineer shall contact the engineer of said report to discuss potential options to address the varying site conditions.

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### **6.3 Earthwork**

We anticipate that the majority of the undocumented fill soils will be suitable for re-use as structural fill. The existing alluvial soils should not be re-used as structural fill. Some localized areas of unsuitable soils may be encountered during earthwork and foundation construction.

Any required fill soils should be compacted to at least 98 percent of the maximum dry density obtained in accordance with ASTM Specification D-698, Standard Proctor Method, with a moisture content within +/- 3% of the optimum moisture content (OMC). Acceptable fill soils should be soil that has less than 5 percent organic content and a liquid limit and plasticity index less than 50 and 20, respectively. Soils with USCS group symbols of SP, SW, SM, SC, and ML are recommended for use as controlled fill, although it is important to note that silty soils are very moisture sensitive and not as strong as sandy soils. Elastic silts (MH) and plastic clays (CH) should not be utilized as structural fill at this site unless approved by CVET prior to placement and compaction operations. All fill soils should be placed in horizontal loose lifts and compacted with adequately-sized equipment. Loose lift thicknesses will vary depending on the size of the compaction equipment: we recommend a maximum of 8 inches for large self-propelled compactors, 6 inches for small self-propelled compactors, and 4 inches for remote-controlled compactors and hand-operated equipment (plate tampers, wacker-packers, or jumping jacks). Vibratory smooth-drum rollers are appropriate for cohesionless/coarse-grained soils while sheepsfoot rollers are appropriate for cohesive/fine-grained soils. Localized undercut and replacement should be anticipated in areas to receive structural fill due to the elevated in-situ moisture content and varying existing fill soils.

We recommend that positive site drainage is maintained during earthwork operations to prevent the ponding of water on exposed subgrades. Soil subgrades should be protected from inclement weather (rain especially) by 'sealing' the subgrades prior to forecasted inclement weather. 'Sealing' can be performed by rolling with a smooth steel-drum roller without vibration. Ruts should not be created during the 'sealing' operation. Prior to the placement of additional fill, the 'sealed' subgrade should be scarified.

If earthwork is performed during winter months or after inclement weather, the subgrade soil conditions could potentially be more unstable due to wet soil conditions, which could potentially require stabilization or undercutting.

### **6.4 Groundwater Control**

Pending the finished floor elevation of the proposed facility and the finished floor of the proposed concrete water retaining tank, groundwater control will likely be anticipated. If excavations in proximity to boring B-12A exceed approximately 3.0 feet, groundwater

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mitigation should be anticipated. Groundwater control is the purposeful drawdown of the groundwater levels to facilitate necessary construction. Temporary dewatering operations consist of well points and sump pumps, while permanent dewatering operations typically consist of French underdrains which discharge by means of gravity flow into the site storm drainage system.

Note that soil moisture and groundwater conditions vary depending on conditions such as temperature, precipitation and season. Therefore soil moisture and groundwater location at other times of the year may vary from those observed at the time of this subsurface exploration and as described in this report.

## **6.5 Foundations**

Based upon the encountered subsurface conditions across the site we have developed the following recommendations for foundation support. The options are presented below along with their associated risk:

### Option 1 – Shallow Foundation System Supported by Improved Site Soils – Lowest Risk

The lowest risk option to address the encountered site conditions would be to support the pre-engineered metal building and concrete tank on shallow foundation system bearing in improved site soils. We recommend that the top 3 feet of soils within the building and tank be re-compacted to create a stable bearing surface to allow for the installation of an aggregate pier ground improvement system. We recommend any utility connections to the proposed storage tanks be flexible to accommodate for the allowable settlement. Additionally, we recommend that the proposed building foundations be supported on ground improvement elements and the entire concrete tank be supported on ground improvement elements.

The Geopier foundation system has been in use since 1988 for soil reinforcement applications to improve shear strength, decrease compressibility, and control existing fill variability allowing settlement control of building foundations and other structures. Replacement aggregate piers (RAP) can provide a solution to the unknown natural and potential hazards associated with design and construction over uncontrolled fills, low consistency soils and the use of the system eliminates the issues associated with mass excavation and disposal of unacceptable and potentially hazardous soil and materials (often times at or below the ground water level).

Geopier elements consist of highly-densified well-graded aggregate that is placed in controlled lifts in predrilled shafts. The aggregate is densified using a special high-energy impact hammer with a 45-degree beveled tamper. The beveled tamper transfers the impact energy down and to the sides of the shaft as it compacts the aggregate. This

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tamping action prestresses the soils adjacent to the Geopier element, which provides significant lateral confinement to the Geopier element. By reinforcing and stiffening the foundation soils with Geopier elements the composite soil will be capable of supporting a significantly higher allowable bearing pressure, while controlling total and differential settlement.

Footings supported by Geopier elements can be designed using an allowable bearing pressure of 5,000 pounds per square foot (psf) which will limit post construction settlement to approximately 1 inch. Conventional spread footings can be sized and designed using this value. The improvement will be accomplished through the use of conventional crushed stone elements.

Footings should be based upon optimizing Geopier layouts; i.e.-rectangular footings should be used where only two Geopiers are required. Geopier design should consider influence/stresses from adjacent structures. This would be applicable for foundations within the same structure and from adjacent structures (i.e. apartments and parking garage). We also recommend that the Geopier elements penetrate any existing undocumented fill. Use of Rigid inclusions or cement treated aggregate pier sections may be required to mitigate effects of overlapping stresses. Rigid inclusions are stiffer Geopier elements constructed through the inclusion of cement, grout, or concrete. Where organic contents exceed 10%, cement treatment of the piers should be planned in order to prevent long term bulging.

We recommend that a qualified Geopier installer be contacted and allowed to review and analyze the subsurface data in this report, as well as the proposed structural loads for the project, and provide you with a cost estimate for Geopier installation. The estimate should include the cost to perform modulus tests on Geopier elements at the project site. The modulus tests should be performed to confirm the amount of compression that an individual Geopier element will experience at the maximum theoretical Geopier element stress. Tests should be monitored full time by the Owner's geotechnical consultant. At least one test should be performed on a conventional element and one test performed on a CTA Geopier element located in an area of the site exhibiting the softest and/or loosest subsurface conditions. Loading of the test piers should be conducted up to approximately 150 percent of the maximum theoretical stress to which the Geopier elements will be subjected.

We recommend that the Geopier installer's QC program be monitored full time by the Owner's geotechnical consultant. The QC program includes conducting dynamic cone penetration (DCP) testing on conventional crushed stone aggregate, verification of bottom stabilization, measurement of drill depths, and aggregate lift thickness. These items should be documented for each Geopier element installed to provide a complete record of Geopier foundation quality.

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### Option 2 – Shallow Foundation System Supported by Partial Undercut and Replacement – Moderate Risk

The moderate risk option for addressing the encountered site soils for the pre-engineered metal building only would be to perform a partial undercut and replacement of the existing fill soils. If this option is elected we recommend that the undercut extend a minimum of 5 feet below the bottom of footing elevation. The undercut excavation shall also extend a minimum of 10 feet beyond the perimeter of the building in all directions. The base and sidewalls of the approved excavation shall be lined with a heavy, woven geotextile fabric (Mirafi HP370 or approved equivalent) prior to backfilling with approved structural fill soils performed in accordance with *Section 6.3 Earthwork* of this report. Shallow foundations can then be designed for a net allowable bearing pressure of up to 2,500 psf with minimum width and embedment of 16-inches, respectively.

As previously discussed the amount of settlement cannot be accurately predicted; however, the undercut and replacement mass will result in a total settlement scenario for the facility. The risks associated with the possible settlements shall be accepted by the owner.

### Option 3 – Shallow Foundation System Supported Existing Site Soils – High Risk

The highest risk option for addressing the encountered site soils for the pre-engineered metal building only would be to perform localized undercut and replacement of the existing fill soils within the foundation systems only. If this option is elected we recommend that the shallow foundations should be designed for an allowable net bearing pressure of up to 500 pounds per square foot. We recommend minimum foundation widths and embedment depths of 16 and 16 inches, respectively, for building foundations. Subgrade soils exposed at the excavated foundation should be evaluated utilizing a Dynamic Cone Penetrometer (ASTM STP-399) to confirm adequate bearing conditions are present.

We do not recommend bearing any foundations directly on elastic/plastic fill soils, especially perimeter foundations which have a greater chance of being subjected to surface water. Plastic/elastic soils should be undercut to depths of at least 24 inches from where encountered at the foundation bearing elevation and replaced with approved fill materials or ABC stone. Plastic/elastic soils are moisture sensitive and prone to shrink/swell with moisture changes. If fill soils will be placed to reach final grades, we recommend a 24-inch buffer of non-plastic fill soils between the foundation subgrade and elastic/plastic soils.

As previously discussed the amount of settlement cannot be accurately predicted. The risks associated with the possible settlements shall be accepted by the owner.

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## **6.6 Floor Slabs**

We recommend that grade slabs for the pre-engineered building be supported on newly compacted, non-elastic, structural fill soils and the grade slabs for the concrete tank be supported on ground improved site soils (aggregate piers).

If grade slabs are supported on newly compacted, structural fill soils we recommend a modulus of subgrade reaction ( $k$ ) of up to 100 pounds per cubic inch for structural design of the floor slab. If the undocumented fill soils are left in place and the floor slab is built over them, we recommend a modulus of subgrade reaction ( $k$ ) of up to 70 pounds per cubic inch for structural design of the floor slab. Additional reinforcement and closer joint spacing are recommended to help handle the expected settlement of the existing fill and weak upper alluvial soil layers.

This value is representative of a 1-ft square loaded area and may need to be adjusted depending the size and shape of the loaded area and the method of structural analysis. The floor slab should be isolated from building foundations unless the connection is designed to accommodate anticipated differential settlement between the slab and foundation systems.

We consider properly prepared soil subgrade to consist of approved residuum or approved structural fill soils within the top two feet of finished grades compacted to 100% of the standard Proctor method (ASTM D698). Compacted soils should be placed within  $\pm 3\%$  of the optimum moisture content (OMC) as determined by the standard Proctor method. Subgrades for floor slab areas should be proofrolled to ensure that the subgrade is competent, and to locate any soft or incompetent areas that require undercutting and replacement with controlled fill soils.

We recommend the use of 4 to 6 inches of free-draining granular material (NCDOT No. 57 stone or recycled concrete) as both aggregate base course under the slab and capillary break. Prior to placing the granular material, the subgrade for the entire floor slab area should be proofrolled. Plastic/elastic soils are moisture sensitive and prone to shrink/swell with moisture changes. If plastic/elastic soil is exposed at the floor slab elevation, we recommend an undercut of at least 18 inches of the elastic/plastic soil, and replacement with quality non-plastic fill materials. If fill soils are placed to reach final grades, we recommend an 18-inch buffer of non-plastic fill soils between the bottom of foundations and the elastic/plastic soils. Stabilization can also include the installation of a biaxial geogrid (Mirafi BX1200 or approved equivalent) or a heavy woven geotextile fabric (Mirafi HP 370 or approved equivalent) depending on the exposed subgrade soil conditions. If conditions revealed during slab on grade preparation operations vary from those described in this report, the on-site geotechnical engineer shall contact the engineer of said report to discuss potential options to address the varying site conditions.

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The use of a vapor retarder should be considered beneath concrete slabs on grade which will be covered with wood, tile, carpet or other moisture-sensitive or impervious coverings, per ACI 302 and/or ACI 360. Construction joints, contraction joints, and isolation joints should be provided in the slab to reduce the impacts of cracking and shrinkage. See ACI 302 for additional details regarding slab joint design.

## **6.7 Lateral Earth Pressure and Site Retaining Walls**

Chapter 18, Section 1806 of the North Carolina Building Code requires that retaining systems providing a cumulative vertical relief greater than 5 feet in height within a horizontal distance of 50 feet or less, including retaining walls or mechanically stabilized earth walls shall be designed under the responsible charge of a registered design professional. Please note that the retaining walls should be designed to carry the proposed overlying loading conditions.

If a site retaining wall is required, CVET should be contacted prior to design to develop equivalent fluid pressure parameters for use in determining lateral earth pressures against below grade retaining walls retaining structural fill soils or undisturbed residual soils.

Please note that the following parameters are typical values for design purposes. Prior to construction of the retaining system, the proposed backfill should be subject to adequate laboratory testing to confirm design parameters, to confirm that they meet or exceed the parameters listed below. CVET does not recommend the use of elastic site soils (MH and/or CH) for use within the reinforced zone of the proposed site walls.

We recommend the following parameters for design of retaining systems:

- **Controlled Fill**
  - Moist Unit Weight ( $\gamma_m$ ) = 120 pcf
  - Active Earth Pressure Coefficient ( $K_a$ ) = 0.36
  - At-Rest Earth Pressure Coefficient ( $K_o$ ) = 0.53
  - Passive Earth Pressure Coefficient ( $K_p$ ) = 2.77
  - Internal Friction Angle ( $\phi$ ) = 28°
  - Friction Factor ( $\delta$ ) = 0.30

The parameters stated above are for retaining systems that do not have significant backslopes. If it is necessary to have sloping backfill at the top of the system, an increase in lateral earth pressure applied to the wall shall be addressed during design phase.

Retaining systems shall be designed to ensure stability against overturning and sliding with a minimum factor of safety = 1.5. A global stability analysis shall also be performed



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to ensure the overall stability of the retaining system against failure of weak underlying soils. The retaining system design should also address the vertical pressures developed at the base of the wall against the ultimate bearing capacity of the soil. The allowable settlement and tilt of the retaining system shall also be addressed during design.

Implementation of a drainage feature within the retaining system is a critical feature that shall be addressed during design. The buildup of hydrostatic water pressure behind the wall can lead to excessive lateral pressures, not accounted for in the design, thus leading to potential wall failure. Weep holes should be installed at regular intervals to discharge any accumulated water from the backfill. In order to guard against the possibility of backfill material washing into the weep holes or drainage features, ultimately clogging them, the drainage features should be encased in a geotextile filter fabric.

Heavy earthwork equipment should maintain a minimum horizontal distance of 3 to 4 feet from wall face, while within this area lighter, hand held compaction equipment should be used to compact wall backfill. Heavy equipment or material should not be parked or placed behind the retaining wall during construction, within 10 feet.

All design and construction considerations for retaining systems are site dependent. CVET would be pleased to provide design services for these systems or construction materials testing/ special inspection observations as an additional scope of services.

## **6.8 Seismic Site Classification**

Based on our soil test boring data at the proposed site, it is our opinion that a Site Seismic Classification of D is appropriate for this site. This opinion is based on calculations that use SPT and unconfined compressive strength data from the boring logs, in accordance with the 2012 North Carolina State Building Code. Note that a site seismic classification of D correlates with an average N value between 15 and 50 and "stiff soil profile" for the upper 100 feet of overburden.

## **7.0 LIMITATIONS**

This report has been prepared for the exclusive use of Salisbury-Rowan and their agents for specific application to the referenced property, in accordance with generally accepted soils and foundation engineering practices. No warranties, express or implied, are intended or made. The conclusions and recommendations presented in this report are based on the specific test borings and laboratory testing performed as part of our scope of work, and do not reflect variations in subsurface conditions that may exist between test boring locations or in unexplored portions of the site. Note that the soil data presented in this report is for the specific time of this subsurface exploration. While the type of material encountered in the test borings will not likely change significantly over

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time, the properties of the materials can and will change over time, including soil moisture content, density, consistency, SPT "N" values, etc. Fluctuations in the groundwater level can have a significant impact on the material properties, as can seasonal changes. Site safety, excavation support related to OSHA requirements, and construction dewatering requirements are the responsibility of others, not CVET. In the event changes are made to the proposed construction plans, design or location of the project as described within this report, the conclusions and recommendations provided in this report shall not be considered valid unless CVET is given the opportunity to review the changes, and either verifies or modifies the conclusions and recommendations contained in this report in writing.

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**APPENDIX A – PROJECT FIGURES**

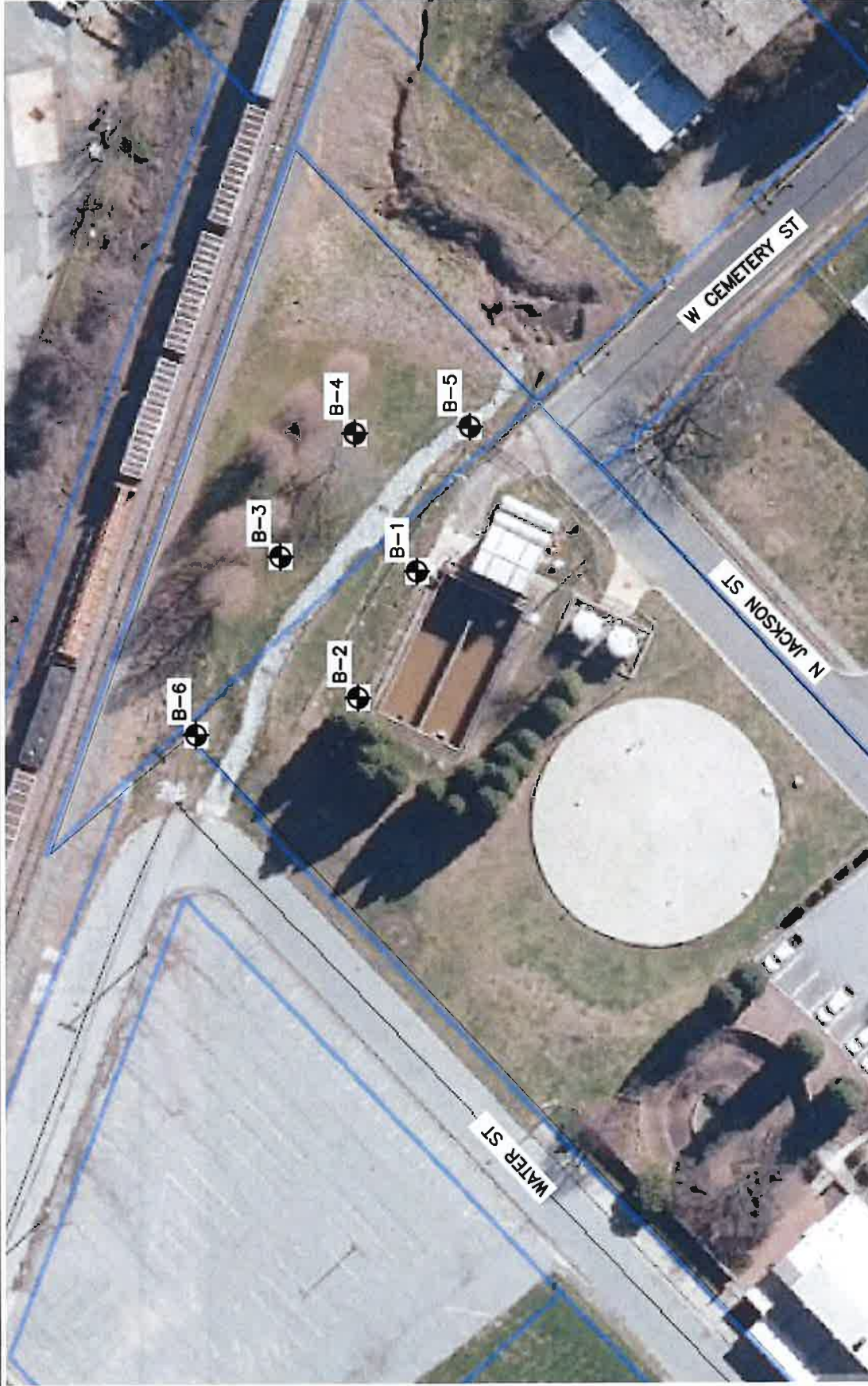




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**SALISBURY WATER TREATMENT PLANT**  
1 WATER STREET  
SALISBURY, ROWAN COUNTY, NORTH CAROLINA

<b>DRAWN BY</b> EMG	<b>PROJECT NO.</b> 19-523
<b>DATE</b> 05-30-19	<b>SHEET NO.</b> FIG. 1



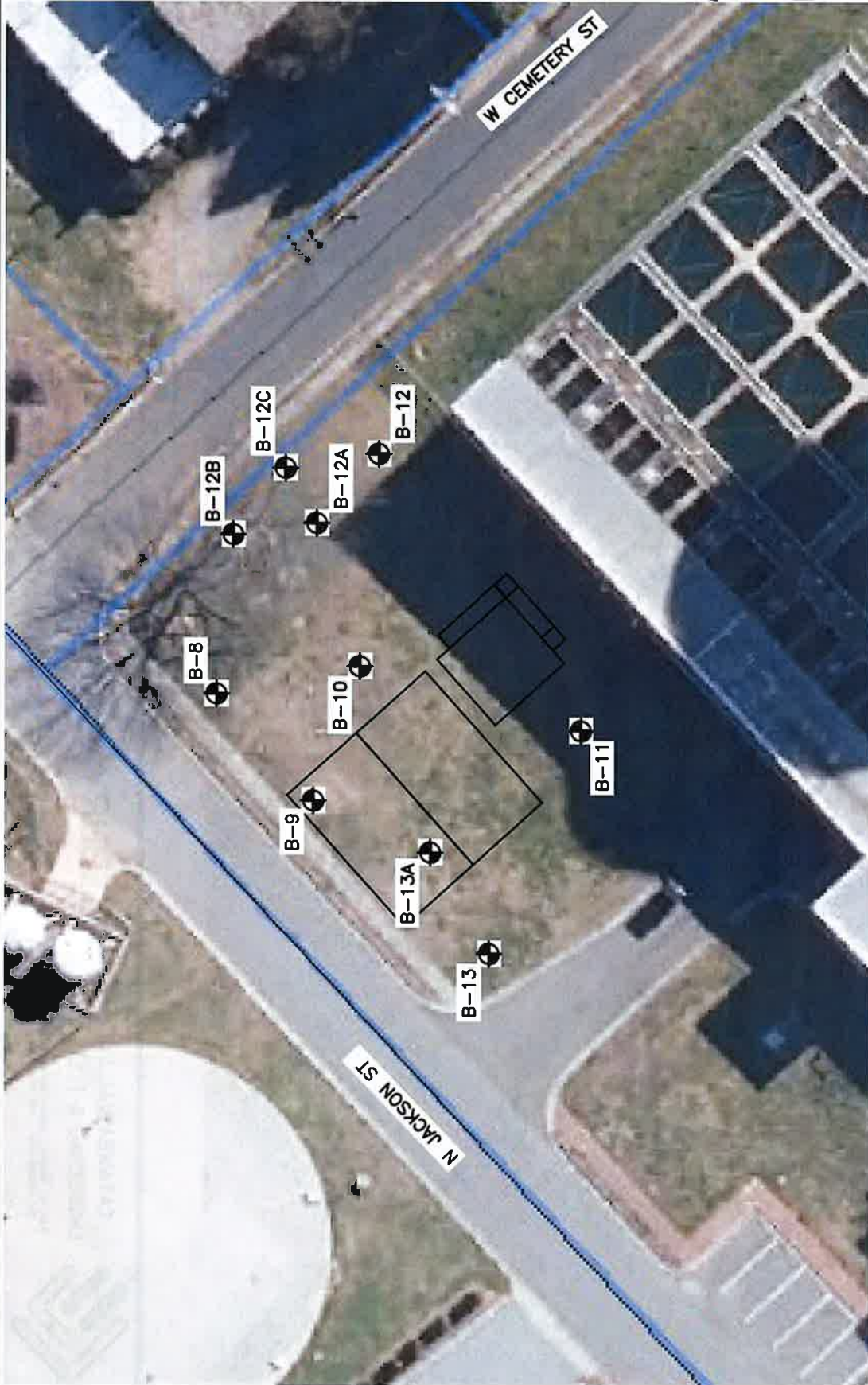
**BORING LOCATIONS**  
SCHEMATIC

PROJECT NO. 19-523	DRAWN BY EMB
SHEET NO. FIG. 2	DATE 05-30-19

**SALISBURY WATER TREATMENT PLANT**  
1 WATER STREET  
SALISBURY, ROWAN COUNTY, NORTH CAROLINA

CATAWBA VALLEY  
ENGINEERING & TESTING  
P.O. BOX 747 HICKORY, NORTH CAROLINA 28603  
TELE: 828-578-5972 FAX: 828-322-8001





**BORING LOCATIONS**

SCHEMATIC

PROJECT NO.	19-523
DRAWN BY	EMB
DATE	07-11-19
SHEET NO.	FIG. 3

**SALISBURY WATER TREATMENT PLANT**

1 WATER STREET  
SALISBURY, ROWAN COUNTY, NORTH CAROLINA



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P.O. BOX 717, WICKERY, NORTH CAROLINA 28693  
TELE: 828-538-5972 FAX: 828-372-8601

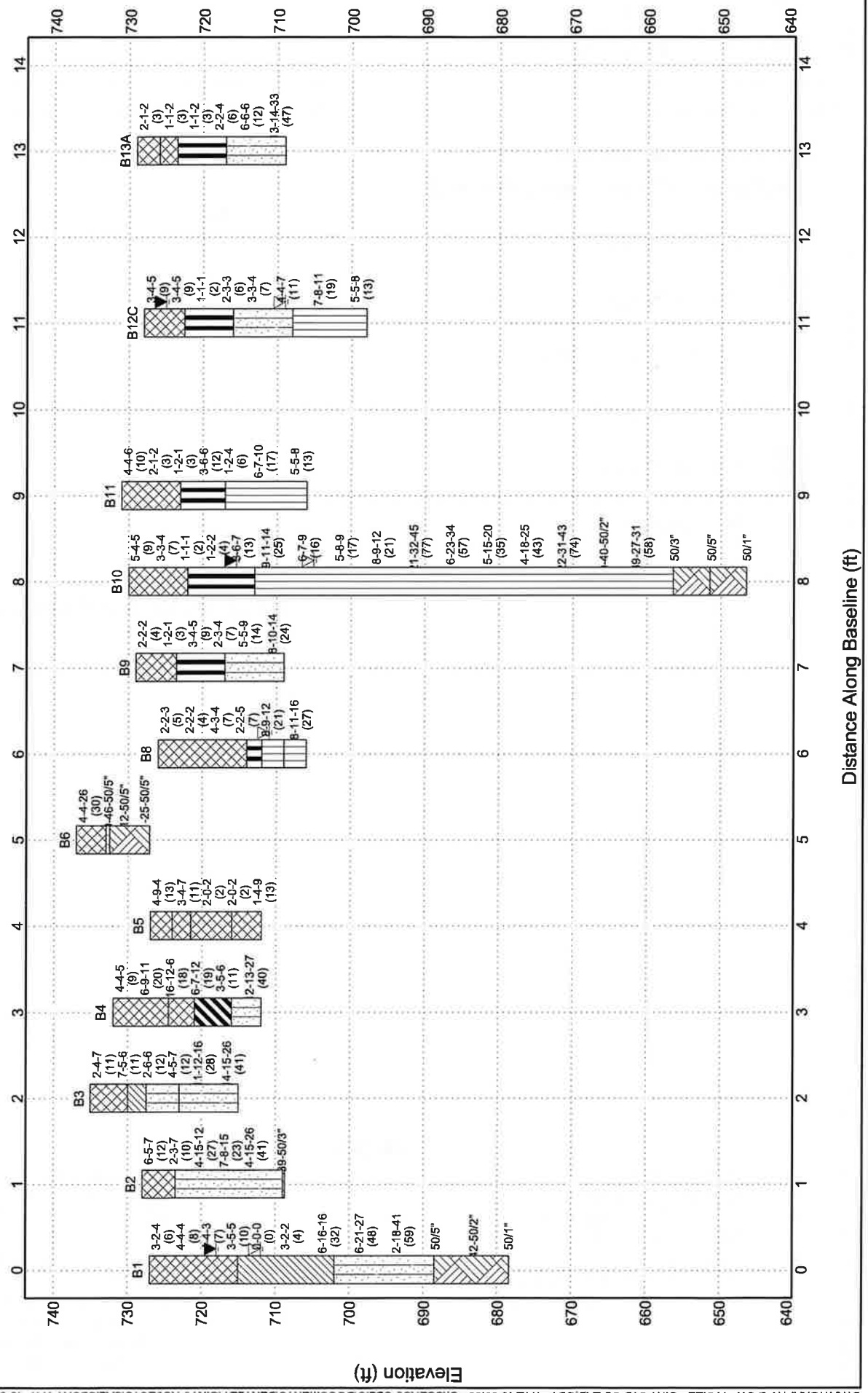


CVET  
308 15th St SE  
Hickory, NC 28702  
ENGINEERING & TESTING Telephone: 828 578 9972

# SUBSURFACE DIAGRAM

PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I  
PROJECT LOCATION 1 Water Street, Salisbury, North Carolina

CLIENT LaBella Associates  
PROJECT NUMBER 19-523







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Telephone: 828 578 9972

# KEY TO SYMBOLS








CLIENT LaBella Associates

PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I

PROJECT NUMBER 19-523

PROJECT LOCATION 1 Water Street, Salisbury, North Carolina

## LITHOLOGIC SYMBOLS (Unified Soil Classification System)

-  BEDROCK: Bedrock
-  CH: USCS High Plasticity Clay
-  CL: USCS Low Plasticity Clay
-  FILL: Fill (made ground)
-  MH: USCS Elastic Silt
-  ML: USCS Silt
-  SM: USCS Silty Sand




## SAMPLER SYMBOLS

-  Split Spoon

## WELL CONSTRUCTION SYMBOLS

## ABBREVIATIONS

- LL - LIQUID LIMIT (%)
- PI - PLASTIC INDEX (%)
- W - MOISTURE CONTENT (%)
- DD - DRY DENSITY (PCF)
- NP - NON PLASTIC
- 200 - PERCENT PASSING NO. 200 SIEVE
- PP - POCKET PENETROMETER (TSF)

- TV - TORVANE
- PID - PHOTOIONIZATION DETECTOR
- UC - UNCONFINED COMPRESSION
- ppm - PARTS PER MILLION
-  Water Level at Time Drilling, or as Shown
-  Water Level at End of Drilling, or as Shown
-  Water Level After 24 Hours, or as Shown



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## **APPENDIX B – BORING LOGS**



## REFERENCE NOTES FOR BORING LOGS

### I. Drilling Sampling Symbols

SS	Split Spoon Sampler	ST	Shelby Tube Sampler
RC	Rock Core, NX, BX, AX	PM	Pressure meter
DC	Dutch Cone Penetrometer	RD	Rock Bit Drilling
BS	Bulk Sample of Cuttings	PA	Power Auger (no sample)
HSA	Hollow Stem Auger	WS	Wash Sample
REC	Rock Sample Recovery %	RQD	Rock Quality Designation %

### II. Correlation of Penetration Resistance to Soil Properties

Standard penetration (blows/ft) refers to the blows per foot of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler, as specified in ASTM D 1586. The blow count is commonly referred to as the N-value.

#### A. Non-Cohesive Soils (Silt, Sand, Gravel and Combinations)

<i>Density</i>	<i>Adjective Form</i>
Under 4 blows/ft	Very Loose
5 to 10 blows/ft	Loose
11 to 30 blows/ft	Medium Dense
31 to 50 blows/ft	Dense
Over 51 blows/ft	Very Dense

<i>Particle Size Identification</i>		
Boulders		8 inches and larger
Cobbles		3 to 8 inches
Gravel	Coarse	1 to 3 inches
	Medium	½ to 1 inch
	Fine	¼ to ½ inch
Sand	Coarse	2.00 mm to ¼ inch
	Medium	0.42 to 2.0 mm
	Fine	0.074 to 0.42 mm
Silt and Clay		0.0 to 0.074 mm

#### B. Cohesive Soils (Clay, Silt, and Combinations)

<i>Blows/ft</i>	<i>Consistency</i>	<i>Unconfined Comp. Strength Q<sub>p</sub> (tsf)</i>	<i>Degree of Plasticity</i>	<i>Plasticity Index</i>
Under 2	Very Soft	Under 0.25	None to Slight	0-4
3 to 4	Soft	0.25-0.49	Slight	5-7
5 to 8	Medium Stiff	0.50-0.99	Medium	8-22
9 to 15	Stiff	1.00-1.99	High to Very High	Over 22
16 to 30	Very Stiff	2.00-3.00		
31 to 50	Hard	4.00-8.00		
Over 51	Very Hard	Over 8.00		

### III. Water Level Measurement Symbols

WL Water Level	BCR Before Casing Removal	DCI Dry Cave-in
WS While Sampling	ACR After Casing Removal	WCI Wet Cave-in
WD While Drilling	▽ Est. Groundwater Level	▼ Est. Seasonal High GWT

The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in a granular soil. In clay and plastic silts, the accurate determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally applied.





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# BORING NUMBER B1

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CLIENT LaBella Associates  
PROJECT NUMBER 19-523  
DATE STARTED 5/14/19 COMPLETED 5/14/19  
DRILLING CONTRACTOR CVET  
DRILLING METHOD 2.25 Hollow Stem Auger  
LOGGED BY TV CHECKED BY CBD  
NOTES \_\_\_\_\_

PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I  
PROJECT LOCATION 1 Water Street, Salisbury, North Carolina  
GROUND ELEVATION 727 ft MSL HOLE SIZE 2.25 inches  
GROUND WATER LEVELS:  
▽ AT TIME OF DRILLING 15.00 ft / Elev 712.00 ft Cave at 29.0 ft.  
▼ AT END OF DRILLING 9.00 ft / Elev 718.00 ft  
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲			
								PL	MC	LL	
								□ FINES CONTENT (%) □			
								20	40	60	80
0		(SM) FILL: Silty SAND with intervals of Clayey SAND and Rock Fragments, Brown to Grey, Moist, Loose	SS 1	100	3-2-4 (6)						
			SS 2	100	4-4-4 (8)						
			SS 3	100	4-4-3 (7)						
			SS 4	100	3-5-5 (10)						
10		(CL) ALLUVIAL: Sandy CLAY with intervals of Silty SAND, Brown to Grey, Wet, Very Soft to Hard	SS 5	100	0-0-0 (0)						
			SS 6	44	3-2-2 (4)						
			SS 7	67	16-16-16 (32)						
		(SM) RESIDUAL: Silty SAND with Small Rock Fragments, Brown, Grey, Black, Orange Brown, Tan, Moist, Dense to Very Dense	SS 8	100	16-21-27 (48)						
			SS 9	100	12-18-41 (59)						
30		(SM) PARTIALLY WEATHERED BEDROCK: Silty Fine SAND, Brown, Grey, Yellow, Black Inclusions, Moist	SS 10	100	50/5"						>>
			SS 11	100	42-50/2"						>>
40		Refusal at 48.5 feet. Bottom of borehole at 48.5 feet.	SS 12	100	50/1"						>>

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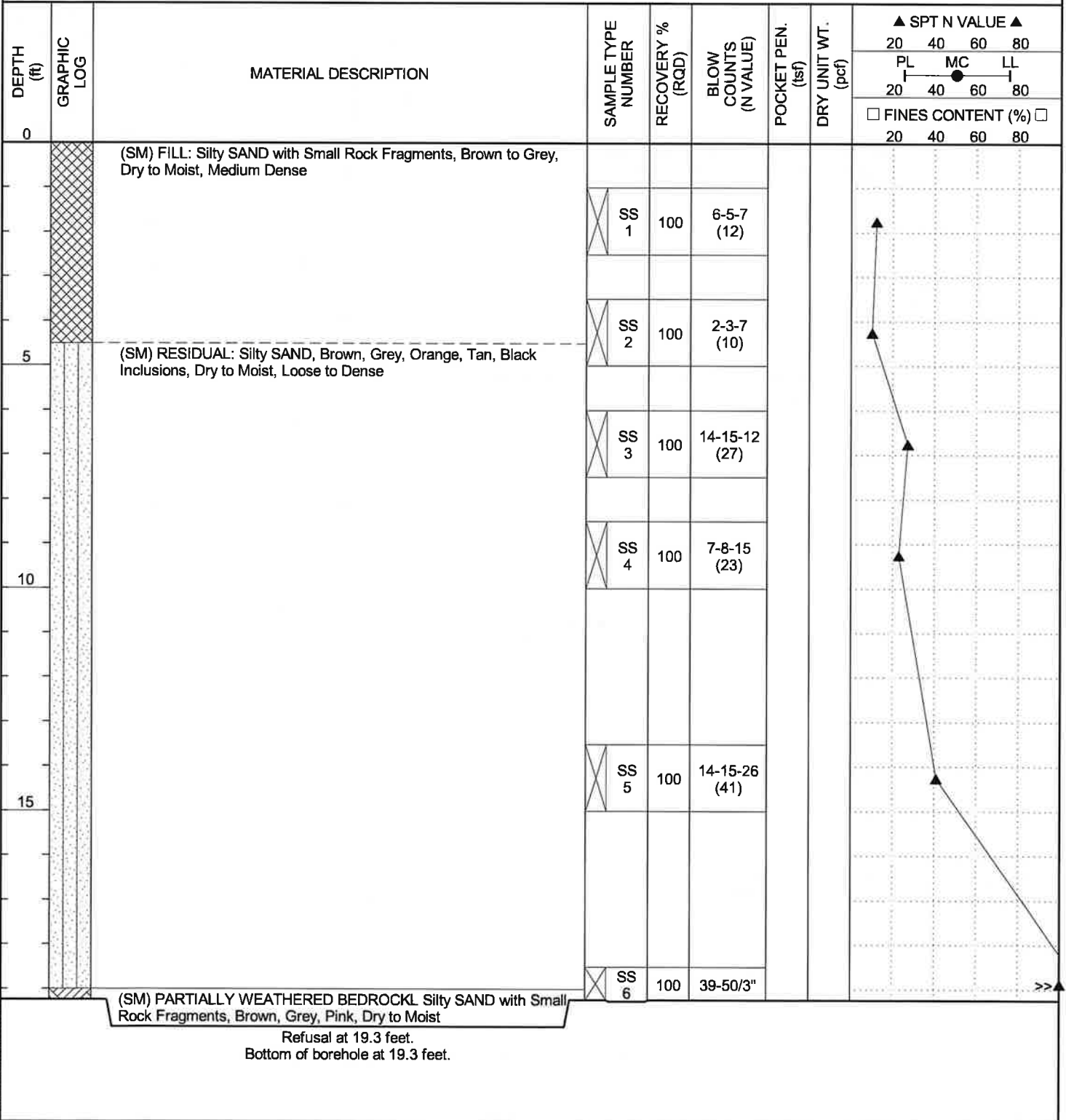
# BORING NUMBER B2

PAGE 1 OF 1

CLIENT LaBella Associates  
PROJECT NUMBER 19-523  
DATE STARTED 5/14/19 COMPLETED 5/14/19  
DRILLING CONTRACTOR CVET  
DRILLING METHOD 2.25 Hollow Stem Auger  
LOGGED BY TV CHECKED BY CBD  
NOTES \_\_\_\_\_

PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I  
PROJECT LOCATION 1 Water Street, Salisbury, North Carolina  
GROUND ELEVATION 728 ft MSL HOLE SIZE 2.25 inches  
GROUND WATER LEVELS:  
AT TIME OF DRILLING --- Cave at 14.5 ft.  
AT END OF DRILLING ---  
AFTER DRILLING ---

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PROJECT NUMBER 19-523  
DATE STARTED 5/13/19 COMPLETED 5/13/19  
DRILLING CONTRACTOR CVET  
DRILLING METHOD 2.25 Hollow Stem Auger  
LOGGED BY TV CHECKED BY CBD  
NOTES \_\_\_\_\_

PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I  
PROJECT LOCATION 1 Water Street, Salisbury, North Carolina  
GROUND ELEVATION 735 ft MSL HOLE SIZE 2.25 inches  
GROUND WATER LEVELS:  
AT TIME OF DRILLING --- Cave at 13.5 ft.  
AT END OF DRILLING ---  
AFTER DRILLING ---

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DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲			
								20	40	60	80
0		(SM) FILL: Silty SAND with Inclusions of Clay, Brown, Grey, Dry to Moist, Medium Dense									
1			SS 1	100	2-4-7 (11)						
2			SS 2	100	7-5-6 (11)						
3		(CL) ALLUVIAL: Sandy CLAY with Rock Fragments and Organic Material, Dark Brown to Dark Grey, Black, Moist, Stiff									
4			SS 3	100	2-6-6 (12)						
5		(SM) ALLUVIAL: Silty SAND with Small Rock Fragments, Brown, Grey, Yellow, Dry to Moist, Medium Dense									
6			SS 4	100	4-5-7 (12)						
7		(SM) RESIDUAL: Silty SAND with Trace Mica, Brown, Grey, Yellow-Orange, Dry to Moist, Medium Dense to Dense									
8			SS 5	100	11-12-16 (28)						
9			SS 6	100	14-15-26 (41)						

Bottom of borehole at 20.0 feet.



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# BORING NUMBER B4

PAGE 1 OF 1

CLIENT LaBella Associates  
PROJECT NUMBER 19-523  
DATE STARTED 5/13/19 COMPLETED 5/13/19  
DRILLING CONTRACTOR CVET  
DRILLING METHOD 2.25 Hollow Stem Auger  
LOGGED BY TV CHECKED BY CBD  
NOTES \_\_\_\_\_

PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I  
PROJECT LOCATION 1 Water Street, Salisbury, North Carolina  
GROUND ELEVATION 732 ft MSL HOLE SIZE 2.25 inches  
GROUND WATER LEVELS:  
AT TIME OF DRILLING --- Cave at 12.0 ft.  
AT END OF DRILLING ---  
AFTER DRILLING ---

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DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲						
								20	40	60	80			
0		(SM) FILL: Silty SAND with Rock Fragments, Brown, Grey, Yellow, Tan, Dry to Moist, Loose to Medium Dense												
			SS 1	100	4-4-5 (9)									
5			SS 2	100	6-9-11 (20)									
		(SM) FILL: Silty SAND with Rock Fragments and Organic Material, Dark Brown, Dark Grey, Black, Dry to Moist, Medium Dense												
			SS 3	100	16-12-6 (18)									
10			SS 4	100	6-7-12 (19)									
		(CH) ALLUVIAL: Sandy Fat CLAY, Grey-Green, Moist, Stiff												
			SS 5	100	3-5-6 (11)									
15														
		(SM) RESIDUAL: Silty SAND, Brown, Grey, Yellow, Black, Dry to Moist, Dense												
			SS 6	100	12-13-27 (40)									
20														

Bottom of borehole at 20.0 feet.



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# BORING NUMBER B5

CLIENT LaBella Associates  
 PROJECT NUMBER 19-523  
 DATE STARTED 5/13/19 COMPLETED 5/13/19  
 DRILLING CONTRACTOR CVET  
 DRILLING METHOD 2.25 Hollow Stem Auger  
 LOGGED BY TV CHECKED BY CBD  
 NOTES Petroleum odor in soil from 8.5' to 14.0'

PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I  
 PROJECT LOCATION 1 Water Street, Salisbury, North Carolina  
 GROUND ELEVATION 727 ft MSL HOLE SIZE 2.25 inches  
 GROUND WATER LEVELS:  
 AT TIME OF DRILLING --- Cave at 10.0 ft.  
 AT END OF DRILLING ---  
 AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲					
								20	40	60	80		
								PL	MC	LL			
								20	40	60	80	□ FINES CONTENT (%) □	
								20	40	60	80		
0.0		(SC) FILL: Clayey SAND with Rock Fragments, Grey, Brown, Red, Dry to Moist, Medium Dense	SS 1	100	4-9-4 (13)								
2.5		(SM) FILL: Silty SAND with Rock Fragments (Possibly Coal), Brown, Grey, Yellow, Black, Dry to Moist, Medium Dense	SS 2	100	3-4-7 (11)								
5.0		(ML) FILL: Sandy SILT with Root Fragments and a Petroleum Odor, Brown, Dark Grey, Black, Moist, Very Soft	SS 3	100	2-0-2 (2)								
7.5				SS 4	61	2-0-2 (2)							
10.0			(SC) FILL: Clayey SAND, Dark Brown to Dark Grey, Moist, Medium Dense	SS 5	100	1-4-9 (13)							
12.5													
15.0													

Bottom of borehole at 15.0 feet.

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# BORING NUMBER B6

PAGE 1 OF 1

CLIENT LaBella Associates PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I  
 PROJECT NUMBER 19-523 PROJECT LOCATION 1 Water Street, Salisbury, North Carolina  
 DATE STARTED 5/13/19 COMPLETED 5/13/19 GROUND ELEVATION 737 ft MSL HOLE SIZE 2.25 inches  
 DRILLING CONTRACTOR CVET GROUND WATER LEVELS:  
 DRILLING METHOD 2.25 Hollow Stem Auger AT TIME OF DRILLING --- Cave at 6.0 ft.  
 LOGGED BY TV CHECKED BY CBD AT END OF DRILLING ---  
 NOTES \_\_\_\_\_ AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲						
								20	40	60	80			
0		(SM) FILL: Silty SAND with Inclusions of Clay, Rock Fragments and Root Material, Brown, Orange, Black, Dry to Moist, Medium Dense												
			SS 1	83	4-4-26 (30)									
5		(SM) RESIDUAL: Silty SAND with Rock Fragments, Light Brown, Dry (SM) PARTIALLY WEATHERED BEDROCK: Silty SAND with Rock Fragments, Light Brown, Dry	SS 2	100	29-46-50/5"									
			SS 3	100	12-50/5"									
			SS 4	100	21-25-50/5"									

Refusal at 9.9 feet.  
Bottom of borehole at 9.9 feet.

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# BORING NUMBER B8

PAGE 1 OF 1

CLIENT LaBella Associates  
PROJECT NUMBER 19-523  
DATE STARTED 6/17/19 COMPLETED 6/17/19  
DRILLING CONTRACTOR CVET  
DRILLING METHOD 2.25 Hollow Stem Auger  
LOGGED BY TV CHECKED BY CBD  
NOTES \_\_\_\_\_

PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I  
PROJECT LOCATION 1 Water Street, Salisbury, North Carolina  
GROUND ELEVATION 726 ft MSL HOLE SIZE 2.25 inches  
GROUND WATER LEVELS:  
▽ AT TIME OF DRILLING 15.00 ft / Elev 711.00 ft Cave at 4.9 ft.  
AT END OF DRILLING ---  
AFTER DRILLING ---

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DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲					
								20	40	60	80		
0		(SM) FILL: Silty SAND with Rock Fragments, Brown to Grey, Dry to Moist, Very Loose to Loose											
1			SS 1	100	2-2-3 (5)								
2			SS 2	61	2-2-2 (4)								
3			SS 3	100	4-3-4 (7)								
4			SS 4	33	2-2-5 (7)								
13			(MH) ALLUVIAL: Sandy Elastic SILT, Brown, Wet										
14			(ML) RESIDUAL: Sandy SILT, Grey, Moist, Medium Dense	SS 5	78	8-9-12 (21)							
15		(ML) RESIDUAL: Sandy SILT, Grey-Brown, Moist, Medium Dense											
19			SS 6	100	8-11-16 (27)								

Bottom of borehole at 20.0 feet.



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# BORING NUMBER B9

PAGE 1 OF 1

CLIENT LaBella Associates  
PROJECT NUMBER 19-523  
DATE STARTED 6/17/19 COMPLETED 6/17/19  
DRILLING CONTRACTOR CVET  
DRILLING METHOD 2.25 Hollow Stem Auger  
LOGGED BY TV CHECKED BY CBD  
NOTES \_\_\_\_\_

PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I  
PROJECT LOCATION 1 Water Street, Salisbury, North Carolina  
GROUND ELEVATION 729 ft MSL HOLE SIZE 2.25 inches  
GROUND WATER LEVELS:  
AT TIME OF DRILLING --- Cave at 8.8 ft.  
AT END OF DRILLING ---  
AFTER DRILLING ---

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DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲						
								20	40	60	80			
0		(SM) FILL: Silty SAND with Rock Fragments, Brown to Grey, Dry to Moist, Very Loose												
			SS 1	61	2-2-2 (4)									
5		(MH) ALLUVIAL: Sandy Elastic SILT with Trace Organic Material, Brown to Grey, Black, Wet, Medium Stiff to Stiff												
			SS 2	100	1-2-1 (3)									
			SS 3	89	3-4-5 (9)									
10		(SM) RESIDUAL: Silty Fine SAND, Brown, Grey, Black, Orange, Tan, Dry to Moist, Medium Dense												
			SS 4	100	2-3-4 (7)									
			SS 5	100	5-5-9 (14)									
15			SS 6	100	8-10-14 (24)									
20														

Bottom of borehole at 20.0 feet.



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# BORING NUMBER B10

PAGE 1 OF 2

CLIENT LaBella Associates  
PROJECT NUMBER 19-523  
DATE STARTED 6/18/19 COMPLETED 6/18/19  
DRILLING CONTRACTOR CVET  
DRILLING METHOD 2.25 Hollow Stem Auger  
LOGGED BY TV CHECKED BY CBD  
NOTES \_\_\_\_\_

PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I  
PROJECT LOCATION 1 Water Street, Salisbury, North Carolina  
GROUND ELEVATION 730 ft MSL HOLE SIZE 2.25 inches  
GROUND WATER LEVELS:  
▽ AT TIME OF DRILLING 25.00 ft / Elev 705.00 ft Cave at 27.8 ft.  
▽ AT END OF DRILLING 14.50 ft / Elev 715.50 ft  
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (FGD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲		
								20	40	60
0		(ML) FILL: Sandy SILT with Rock Fragments, Brown, Dark Brown to Grey, Grey, Black, Dry to Moist, Very Loose to Loose	SS 1	100	5-4-5 (9)					
5			SS 2	100	3-3-4 (7)					
10		(MH) ALLUVIAL: Sandy Elastic SILT with Organic Content, Brown, Grey, Black, Moist to Wet, Soft to Stiff	SS 3	100	1-1-1 (2)					
15			SS 4	100	1-2-2 (4)					
20		(ML) RESIDUAL: Sandy SILT, Yellow-Brown, Brown, Tan, Grey, Green-Grey, Dark Grey, Dry to Moist, Medium Dense to Very Dense	SS 5	100	3-6-7 (13)					
25			SS 6	100	9-11-14 (25)					
30			SS 7	100	6-7-9 (16)					
35			SS 8	56	5-8-9 (17)					
40			SS 9	100	8-9-12 (21)					
45			SS 10	100	21-32-45 (77)					
			SS 11	100	16-23-34 (57)					

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# BORING NUMBER B10

PAGE 2 OF 2

CLIENT LaBella Associates

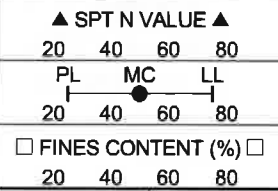
PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I

PROJECT NUMBER 19-523

PROJECT LOCATION 1 Water Street, Salisbury, North Carolina

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DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲						
								20	40	60	80			
45		(ML) RESIDUAL: Sandy SILT, Yellow-Brown, Brown, Tan, Grey, Green-Grey, Dark Grey, Dry to Moist, Medium Dense to Very Dense (continued)												
50			SS 12	100	15-15-20 (35)									
55			SS 13	100	14-18-25 (43)									
60			SS 14	100	22-31-43 (74)									
65			SS 15	100	30-40-50/2"									
70			SS 16	100	39-27-31 (58)									
75		(ML) PARTIALLY WEATHERED BEDROCK: Sandy SILT, Dark Green, Grey, Moist to Wet	SS 17	100	50/3"									
80		(GM) PARTIALLY WEATHERED BEDROCK: Rock Fragments	SS 18	100	50/5"									
		Refusal at 83.5 feet. Bottom of borehole at 83.5 feet.	SS 19	100	50/1"									







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# BORING NUMBER B11

PAGE 1 OF 1

CLIENT LaBella Associates  
PROJECT NUMBER 19-523  
DATE STARTED 6/20/19 COMPLETED 6/20/19  
DRILLING CONTRACTOR CVET  
DRILLING METHOD 2.25 Hollow Stem Auger  
LOGGED BY TV CHECKED BY CBD  
NOTES \_\_\_\_\_

PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I  
PROJECT LOCATION 1 Water Street, Salisbury, North Carolina  
GROUND ELEVATION 731 ft MSL HOLE SIZE 2.25 inches  
GROUND WATER LEVELS:  
AT TIME OF DRILLING --- Cave at 6.9 ft.  
AT END OF DRILLING ---  
AFTER DRILLING ---

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DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲				
								20	40	60	80	
0												
0 - 10		(MH) FILL: Sandy Elastic SILT with Root Material and Rock Fragments, Red-Brown, Grey, Black, Dry to Moist, Soft to Stiff	SS 1	100	4-4-6 (10)							
10 - 14		(MH) ALLUVIAL: Sandy Elastic SILT with Organic Material, Grey to Black, Wet, Stiff	SS 2	100	2-1-2 (3)							
14 - 25		(ML) RESIDUAL: Sandy SILT, Grey, Tan, Orange, Moist to Wet, Loose to Medium Dense	SS 3	100	1-2-1 (3)							
			SS 4	100	3-6-6 (12)							
			SS 5	100	1-2-4 (6)							
			SS 6	100	6-7-10 (17)							
			SS 7	100	5-5-8 (13)							

Bottom of borehole at 25.0 feet.



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# BORING NUMBER B12C

PAGE 1 OF 1

CLIENT LaBella Associates  
PROJECT NUMBER 19-523  
DATE STARTED 6/20/19 COMPLETED 6/20/19  
DRILLING CONTRACTOR CVET  
DRILLING METHOD 2.25 Hollow Stem Auger  
LOGGED BY TV CHECKED BY CBD  
NOTES \_\_\_\_\_

PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I  
PROJECT LOCATION 1 Water Street, Salisbury, North Carolina  
GROUND ELEVATION 728 ft MSL HOLE SIZE 2.25 inches  
GROUND WATER LEVELS:  
▽ AT TIME OF DRILLING 19.00 ft / Elev 709.00 ft Cave at 15.5 ft.  
▽ AT END OF DRILLING 3.00 ft / Elev 725.00 ft  
AFTER DRILLING ---

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DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲							
								PL	MC	LL					
								20	40	60	80				
								□ FINES CONTENT (%) □							
								20	40	60	80				
0		(ML) FILL: Sandy SILT with Traces of Root and Rock Fragments, Brown, Orange, Grey, Tan, Dry to Moist, Loose	SS 1	100	3-4-5 (9)										
5		(MH) ALLUVIAL: Sandy Elastic SILT, Brown, Grey, Black, Moist to Wet, Soft to Medium Stiff	SS 2	100	3-4-5 (9)										
10		(SM) RESIDUAL: Silty SAND, Brown, Grey, Black, Moist, Loose to Medium Dense	SS 3	100	1-1-1 (2)										
15		(SM) RESIDUAL: Silty SAND, Brown, Grey, Black, Moist, Loose to Medium Dense	SS 4	100	2-3-3 (6)										
20		(ML) RESIDUAL: Sandy SILT, Brown to Grey, Moist, Medium Dense	SS 5	100	3-3-4 (7)										
25		(ML) RESIDUAL: Sandy SILT, Brown to Grey, Moist, Medium Dense	SS 6	100	4-4-7 (11)										
30		(ML) RESIDUAL: Sandy SILT, Brown to Grey, Moist, Medium Dense	SS 7	100	7-8-11 (19)										
		(ML) RESIDUAL: Sandy SILT, Brown to Grey, Moist, Medium Dense	SS 8	100	5-5-8 (13)										

Bottom of borehole at 30.0 feet.



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# BORING NUMBER B13A

CLIENT LaBella Associates  
 PROJECT NUMBER 19-523  
 DATE STARTED 6/21/19 COMPLETED 6/21/19  
 DRILLING CONTRACTOR CVET  
 DRILLING METHOD 2.25 Hollow Stem Auger  
 LOGGED BY TV CHECKED BY CBD  
 NOTES \_\_\_\_\_

PROJECT NAME Salisbury Water Treatment Plant Improvements Phase I  
 PROJECT LOCATION 1 Water Street, Salisbury, North Carolina  
 GROUND ELEVATION 729 ft MSL HOLE SIZE 2.25 inches  
 GROUND WATER LEVELS:  
 AT TIME OF DRILLING --- Cave at 12.2 ft.  
 AT END OF DRILLING ---  
 AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲			
								20	40	60	80
0		(ML) FILL: Sandy SILT, Brown, Moist, Soft	SS 1	100	2-1-2 (3)						
5		(SM) FILL: Silty SAND, Brown, Grey, Moist, Very Loose	SS 2	100	1-1-2 (3)						
10		(MH) ALLUVIAL: Sandy Elastic SILT, Red-Brown, Grey, Black, Moist, Soft to Medium Stiff	SS 3	100	1-1-2 (3)						
10			SS 4	100	2-2-4 (6)						
15		(SM) RESIDUAL: Silty SAND with Rock Fragments, Orange, Brown, Grey, Black, Dry to Moist, Medium Dense to Dense	SS 5	100	6-6-6 (12)						
20			SS 6	100	13-14-33 (47)						

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Bottom of borehole at 20.0 feet.

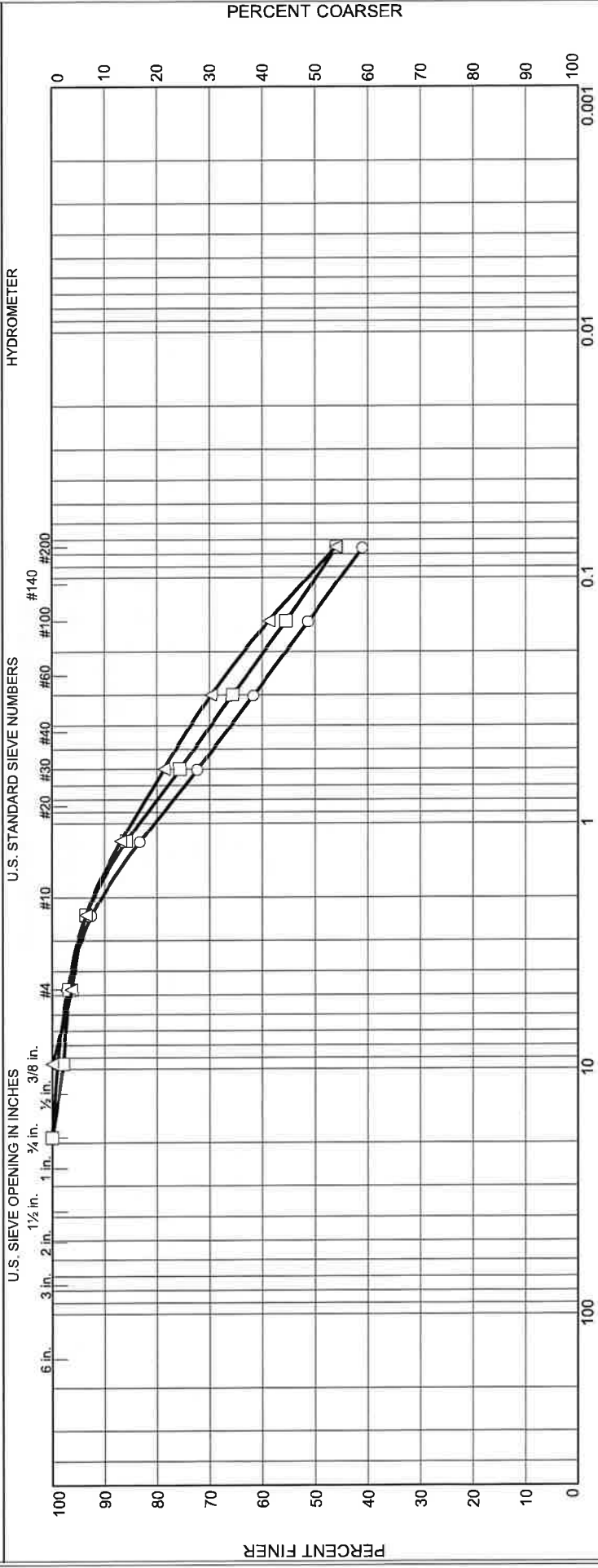


Project Name: Salisbury Water Treatment Plant  
Location: Salisbury, Rowan County, North Carolina  
Date: July 12, 2019  
Project No. 19-523

## **APPENDIX C – LABORATORY TEST DATA**



# Particle Size Distribution Report



Symbol	% +3"		% Gravel		% Sand		% Fines	
	Coarse	Fine	Coarse	Fine	Silt	Clay	Silt	Clay
○	0	10	23	26	41			
□	0	8	21	25	46			
△	0	8	18	28	46			

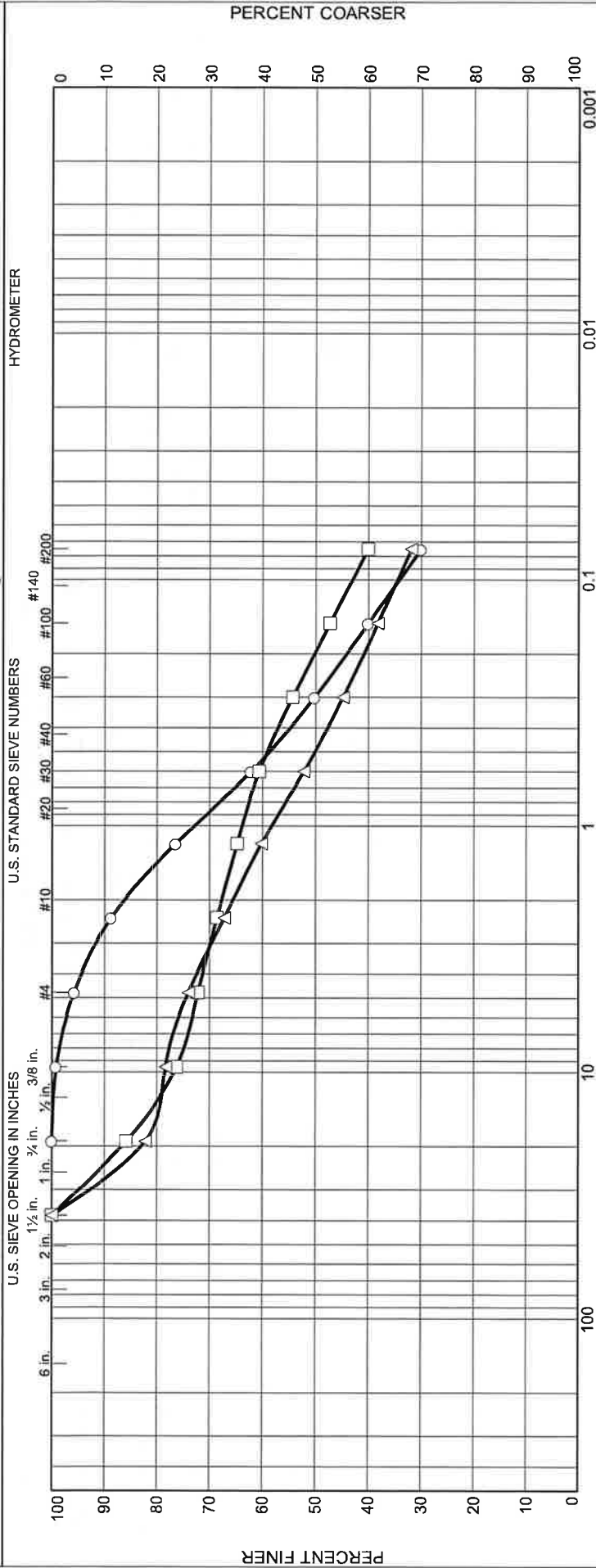
  

Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	3702	B1 1-2.5'	5/20/19	SM	Light Brown Silty SAND	15.9	NV	NP
□	3703	B1 6-7.5'	5/20/19	SC	Gray/Light Brown Clayey SAND	15.3	33	21
△	3704	B1 23.5-25'	5/20/19	SM	Gray/Brown Silty SAND	20.9	NV	NP

Client Labella Associates  
 Project Salisbury Rowan Utilities  
 Project No. 19523 Figure

**Catawba Valley  
 Engineering & Testing, P.C.  
 Hickory, North Carolina**

# Particle Size Distribution Report



	% +3"			GRAIN SIZE - mm.			% Fines		
	% Gravel	% Sand	% Clay	Coarse	Fine	Silt	Clay		
○	0	30	30	30	26	30	30		
□	0	10	40	10	18	40	40		
△	0	18	32	18	16	32	32		

Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	3705	B1 28.5-30'	5/20/19	SM	Brown/Gray Silty SAND	14.8	NV	NP
□	3706	B3 6-7.5'	5/20/19	SC	Light Brown Clayey SAND with Gravel	14.0	39	17
△	3707	B4 8.5-10'	5/20/19	SM	Black/Dark Brown Silty SAND with Gravel	12.1	NV	NP

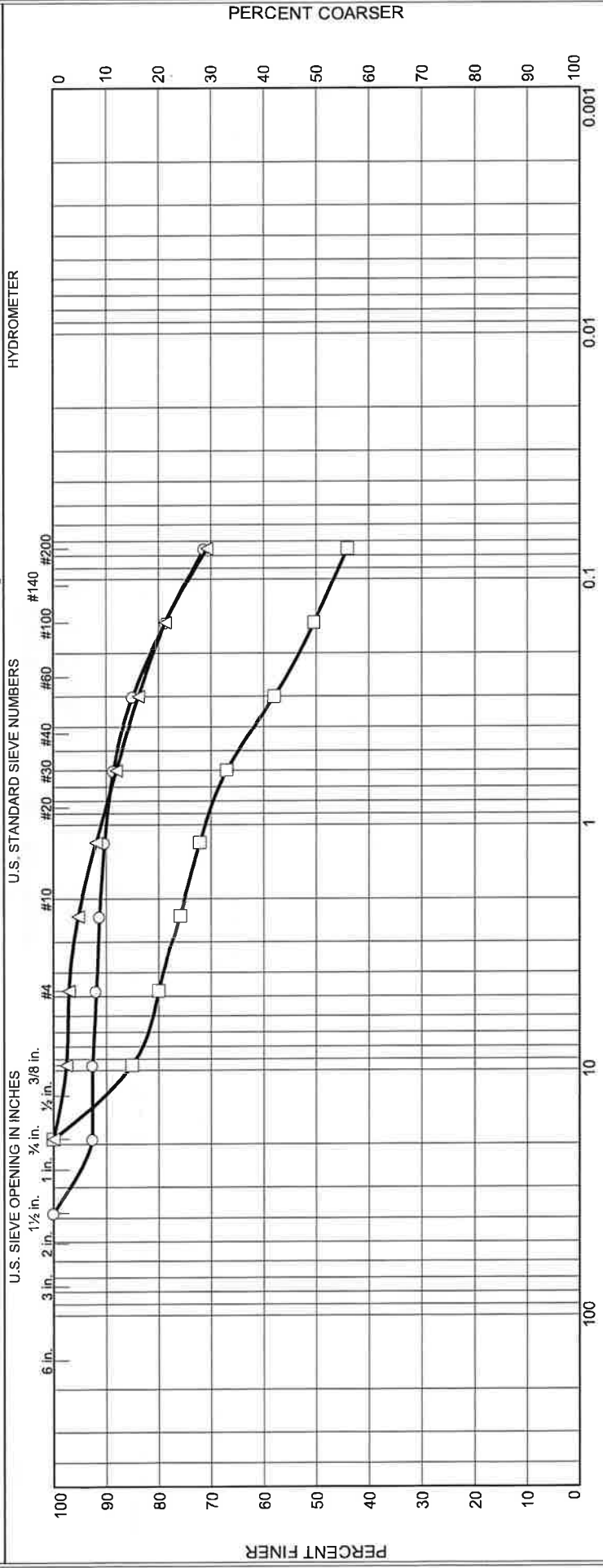
Client: Labella Associates  
 Project: Salisbury Rowan Utilities  
**Catawba Valley Engineering & Testing, P.C.**  
**Hickory, North Carolina**

Project No. 19523 Figure

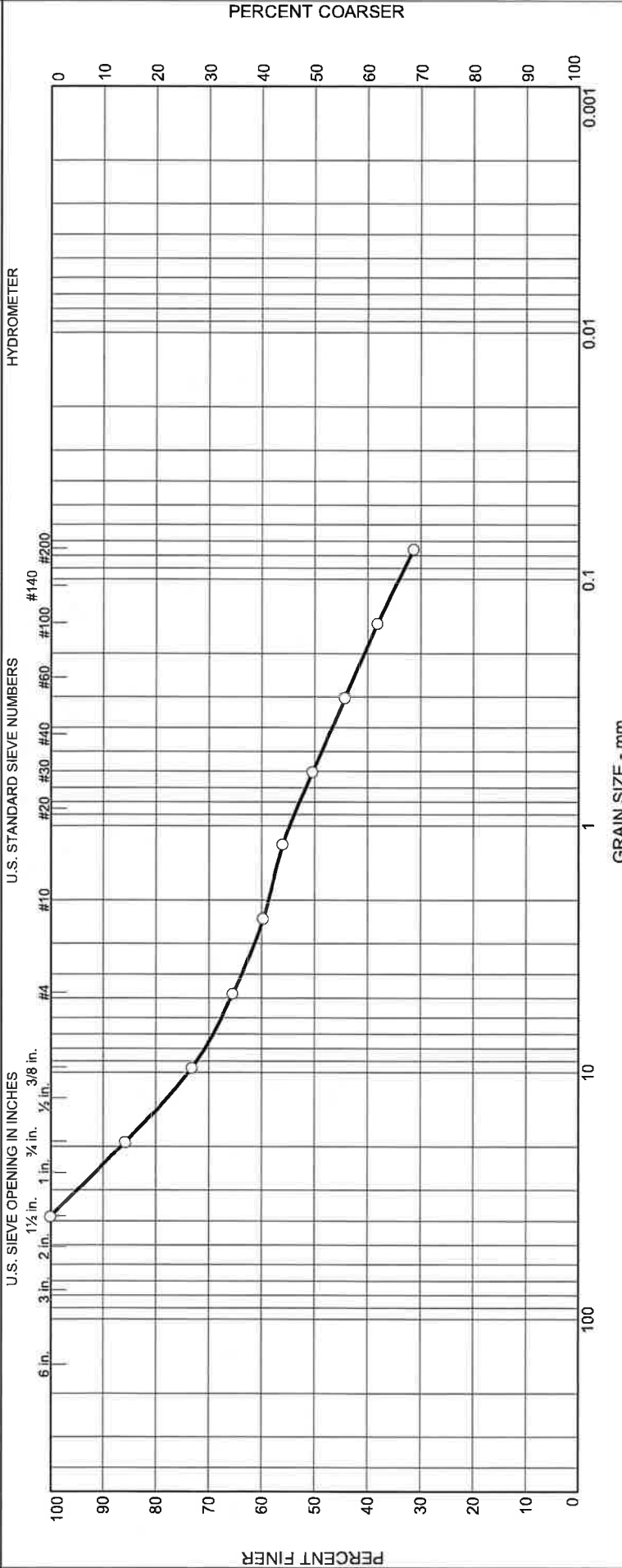
Tested By: CLP Checked By: CR



# Particle Size Distribution Report



# Particle Size Distribution Report



		GRAIN SIZE - mm.			% Fines	
		% Gravel	% Sand		Silt	Clay
	% +3"	41				
		12	16	31		

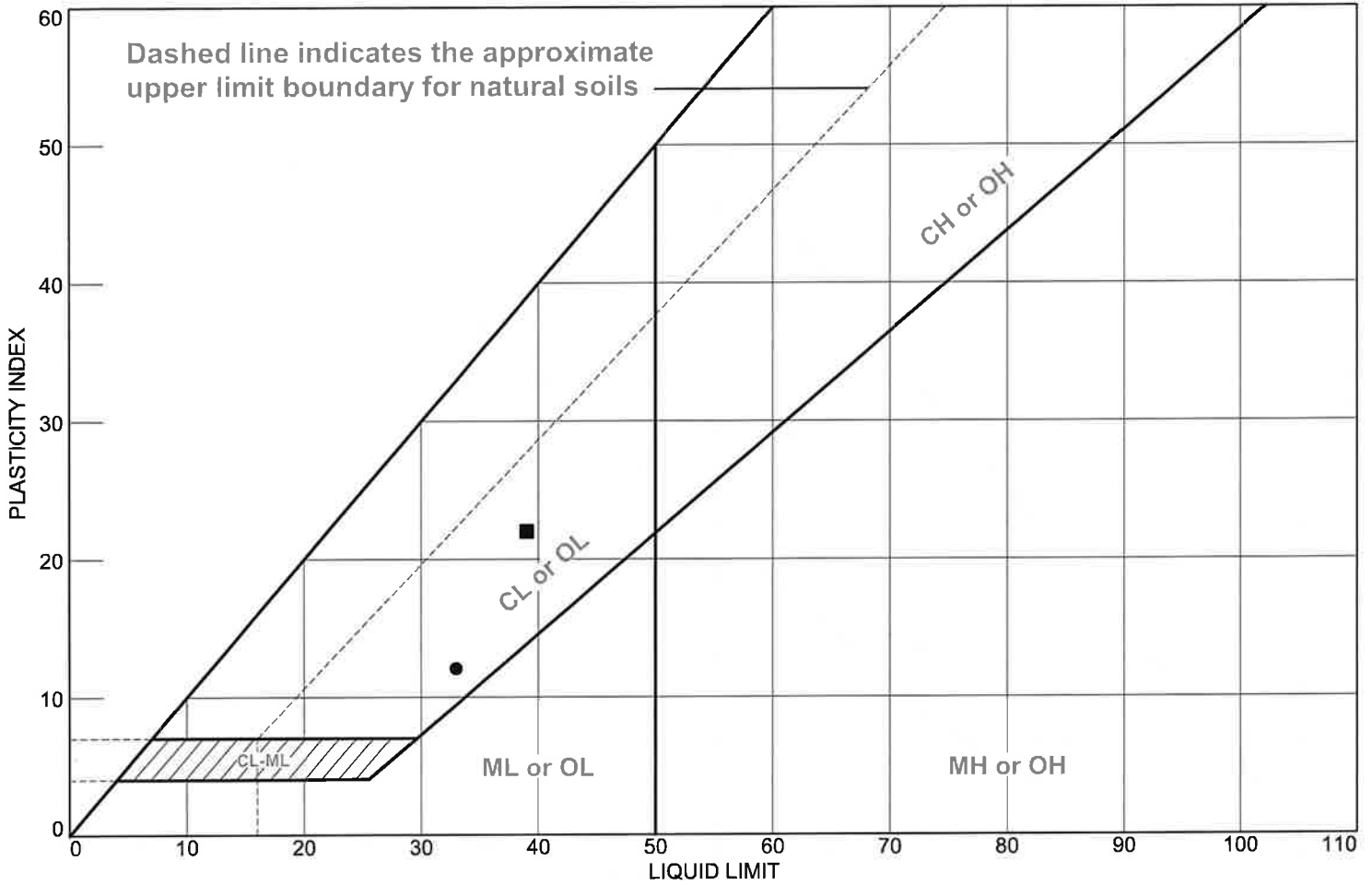
  

Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
Test Borings	3711	B6 1-2.5'	5/20/19	GM	Brown Silty GRAVEL with Sand	11.0	NV	NP

Client <b>Labella Associates</b> Project <b>Salisbury Rowan Utilities</b>	<b>Catawba Valley Engineering &amp; Testing, P.C. Hickory, North Carolina</b>
Project No. <b>19523</b>	Figure

**Tested By:** CLP      **Checked By:** CR

# LIQUID AND PLASTIC LIMITS TEST REPORT



## SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Test Borings	3703	B1 6-7.5	15.3	21	33	12	SC
■	Test Borings	3706	B3 6-7.5'	14.0	17	39	22	SC

**Catawba Valley  
Engineering & Testing, P.C.  
Hickory, North Carolina**

Client: Labella Associates  
Project: Salisbury Rowan Utilities  
Project No.: 19523

Figure

Tested By: JLT Checked By: CR

