

July 2, 2026

Subject: Invitation to Bid 26150-B: FCWS – Crosstown WTP Chemical System Upgrades

Gentlemen/Ladies:

Fayette County, Georgia invites you to submit a bid for upgrades to the existing Crosstown Water Treatment Plant (WTP) chemical systems. You are invited to submit a bid in accordance with the information contained herein.

A **mandatory** pre-bid conference will be held at **10:00 a.m., Friday, July 24, 2026, at Crosstown WTP 3500 Tdk Blvd, Peachtree City, GA 30269**. We will meet at Crosstown WTP, to provide an opportunity for you to become more familiar with the project, and to ask questions. Companies that attend will be invited to submit bids. Questions concerning this invitation to bid should be addressed to Colette Cobb in writing via email to ccobb@fayettecountyga.gov or fax to (770) 719-5534. Questions will be accepted until **4:30 p.m., Wednesday, July 29, 2026**. Purchasing Department office hours are Monday through Friday 8:00 a.m. to 5:00 p.m. The office telephone number is (770) 305-5420. Please return your response to the following address:

Fayette County Purchasing Department
140 Stonewall Avenue West, Suite 204
Fayetteville, Georgia 30214

Bid Number: **ITB 26150-B**

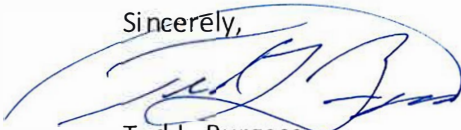
Bid Name: **FCWS – Crosstown WTP Chemical System Upgrades**

Your envelope ***must*** be sealed and should show your company's name and address. Bids will be received at the above address until **3:00 p.m., Wednesday, August 12, 2026** in the Purchasing Department, Suite 204. Bids will be opened at that time. Bids must be signed to be considered. Late bids cannot be considered. Faxed bids or emailed bids cannot be considered.

If you download this invitation to bid from the County's web site, it will be your responsibility to check the web site for any addenda that might be issued for this solicitation. The County cannot be responsible for a vendor not receiving information provided in any addendum.

Thank you for participating in the solicitation process.

Sincerely,



Ted L. Burgess
Chief Procurement Officer

**CONTRACT DOCUMENTS
FOR CONSTRUCTION OF
ITB 26150-B
FCWS – CROSSTOWN WTP
CHEMICAL SYSTEM
UPGRADES**

The logo for Fayette County Water features the word "FAYETTE" in a bold, blue, sans-serif font. Below it, "County" is written in a light blue, cursive script. At the bottom, "Water" is in a bold, dark blue, sans-serif font, with a single blue water droplet positioned directly beneath the letter 'a'.

**Issued for Bid
JULY 2026**



Prepared For:

Fayette County Water System
245 McDonough Rd., Fayetteville, GA 30214
(770) 461-1146



Prepared By:

Arcadis U.S., Inc.
2839 Paces Ferry Road Suite 1000
Atlanta, GA 30339
(770) 431-8666

00 01 07 DESIGN PROFESSIONAL SEALS

 6/25/2026 Michael Diaz, PE Arcadis U.S. Inc.	Specification Sections Sealed
	Division 00 Bidding and Contracting Requirements

 6/19/2026 Travis Thomas, PE Arcadis U.S. Inc.	Specification Sections Sealed
	Division 01 General Requirements Division 02 Existing Conditions Division 33 Utilities Division 40 Process Integration 40 05 05 Exposed Piping Installation 40 05 06 Couplings, Adapters and Specials for Process Piping 40 05 07 Pipe Hangers and Supports 40 05 08 Wall Pipes, Floor Pipes and Pipe Sleeves 40 05 31 Thermoplastic Process Pipe 40 05 53 Process Valves and Appurtenances 40 23 26 Piping Valves and Appurtenances for Chemical Feed Systems Division 43 Process Gas and Liquid Handling, Purification and Storage Equipment Division 46 Water and Wastewater Equipment

DESIGN PROFESSIONAL SEALS

 Donnell Duncan, PE, SE Arcadis U.S. Inc.	Specification Sections Sealed Division 03 Concrete Division 05 Metals Division 06 Wood, Plastics and Composites Division 13 Special Construction
 Errol Dawkins, RA Arcadis U.S. Inc.	Specification Sections Sealed Division 07 Thermal and Moisture Protection Division 08 Openings Division 09 Finishes Division 10 Specialties
 Sunilsen Peramanu, PE Arcadis U.S. Inc.	Specification Sections Sealed Division 22 Plumbing Division 23 Heating, Ventilating and Air conditioning

DESIGN PROFESSIONAL SEALS

 Thomas Powell, PE Arcadis U.S. Inc.	Specification Sections Sealed
	Division 26 Electrical Division 40 Process Integration 40 05 93 Common Motor Requirements for Process Equipment 40 05 96 Vibration, Seismic and Wind Controls 40 41 13 Heat Trace 40 42 00 Insulation of Process Piping and Equipment 40 60 05 Instrumentation and Controls for Process Systems

END OF SECTION 00 01 07

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END OF SECTION

Checklist of Required Documents

*(Be Sure to Return This Checklist and
the Required Documents in the order listed below)*

ITB 26150-B: FCWS – Crosstown WTP Chemical System Upgrades

Contractor Affidavit under O.C.G.A. § 13-10-91(b)(1) _____

Exceptions to Specifications _____

Bid Form (Section 00 41 13)* _____

Bid Bond (Section 00 43 13)* _____

Qualifications Statement (Section 00 45 13) _____

***FAILURE TO INCLUDE THIS ITEM WILL RESULT IN DISQUALIFICATION**

COMPANY NAME: _____

Contractor Affidavit under O.C.G.A. § 13-10-91(b)(I)

The undersigned contractor ("Contractor") executes this Affidavit to comply with O.C.G.A § 13-10-91 related to any contract to which Contractor is a party that is subject to O.C.G.A. § 13-10-91 and hereby verifies its compliance with O.C.G.A. § 13-10-91, attesting as follows:

- a) The Contractor has registered with, is authorized to use and uses the federal work authorization program commonly known as E-Verify, or any subsequent replacement program;
- b) The Contractor will continue to use the federal work authorization program throughout the contract period, including any renewal or extension thereof;
- c) The Contractor will notify the public employer in the event the Contractor ceases to utilize the federal work authorization program during the contract period, including renewals or extensions thereof;
- d) The Contractor understands that ceasing to utilize the federal work authorization program constitutes a material breach of Contract;
- e) The Contractor will contract for the performance of services in satisfaction of such contract only with subcontractors who present an affidavit to the Contractor with the information required by O.C.G.A. § 13-10-91(a), (b), and (c);
- f) The Contractor acknowledges and agrees that this Affidavit shall be incorporated into any contract(s) subject to the provisions of O.C.G.A. § 13-10-91 for the project listed below to which Contractor is a party after the date hereof without further action or consent by Contractor; and
- g) Contractor acknowledges its responsibility to submit copies of any affidavits, drivers' licenses, and identification cards required pursuant to O.C.G.A. § 13-10-91 to the public employer within five business days of receipt.

Federal Work Authorization User Identification Number

Date of Authorization

Name of Contractor

ITB 26150-B: FCWS – Crosstown
WTP Chemical System Upgrades

Name of Project

Fayette County, Georgia

Name of Public Employer

I hereby declare under penalty of perjury that the foregoing is true and correct.

Executed on _____, _____, 2026 in _____ (city), _____ (state).

Signature of Authorized Officer or Agent

Printed Name and Title of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME
ON THIS THE _____ DAY OF _____, 2026.

NOTARY PUBLIC

My Commission Expires: _____

Please list below any exceptions or clarifications to the specifications of this bid. Explain any exceptions in full.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

COMPANY NAME_____

INSTRUCTIONS TO BIDDERS

Fayette County, Georgia
Fayetteville, Georgia
FCWS – Crosstown WTP Chemical Upgrades

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ARTICLE 1—DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in 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—BIDDING DOCUMENTS

- 2.01 Bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is Bidder's responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.
- 2.02 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use. Authorization to download documents, or other distribution, includes the right for Bidders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the Bidder pays all costs associated with printing or reproduction. Printed documents may not be re-sold under any circumstances.
- 2.03 Owner has established a Bidding Documents Website as indicated in the Invitation to Bid. Owner recommends that Bidder obtain a complete set of the Bidding Documents from such website. Bidders may rely that sets of Bidding Documents obtained from the Bidding Documents Website are complete, unless an omission is blatant. Addenda issued by Owner will be posted in the Website.
- 2.04 *Electronic Documents*
- A. After the Contract is awarded, the Owner will provide or direct the Engineer to provide for the use of the Contractor documents that were developed by Engineer as part of the Project design process, as Electronic Documents in native file formats.
1. Electronic Documents that are available in native file format include:
 - a. **Specifications and Drawings**
 2. Release of such documents will be solely for the convenience of the Contractor. No such document is a Contract Document.
 3. Unless the Contract Documents explicitly identify that such information will be available to the Successful Bidder (Contractor), nothing herein will create an obligation on the part of the Owner or Engineer to provide or create such information, and the Contractor is not entitled to rely on the availability of such information in the preparation of its Bid or pricing of the Work. In all cases, the Contractor shall take appropriate measures to verify that any electronic/digital information provided in Electronic Documents is appropriate and adequate for the Contractor's specific purposes.

4. In no case will the Contractor be entitled to additional compensation or time for completion due to any differences between the actual Contract Documents and any related document in native file format.

ARTICLE 3—QUALIFICATIONS OF BIDDERS

- 3.01 Bidder is to submit the following information with its Bid to demonstrate Bidder's qualifications to perform the Work: (Complete the Qualifications Statement included in the Bidding Documents.)
 - A. Written evidence establishing its qualifications such as financial data, previous experience, and present commitments.
 - B. A written statement that Bidder is authorized to do business in the state where the Project is located, or a written certification that Bidder will obtain such authority prior to the Effective Date of the Contract.
 - C. Bidder's state or other contractor license number, if applicable.
 - D. Subcontractor and Supplier qualification information.
 - E. Other required information regarding qualifications.
- 3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
- 3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

ARTICLE 4—PRE-BID CONFERENCE

- 4.01 A mandatory pre-bid conference will be held at the time and location indicated in the Advertisement or invitation to bid. Representatives of Owner and Engineer will be present to discuss the Project. Proposals will not be accepted from Bidders who do not attend the conference. It is each Bidder's responsibility to sign in at the pre-bid conference to verify its participation. Bidders must sign in using the name of the organization that will be submitting a Bid. Sign-in sheet at the Pre-Bid Conference will be posted online.
- 4.02 Information presented at the pre-Bid conference does not alter the Contract Documents. Owner will issue Addenda to make any changes to the Contract Documents that result from discussions at the pre-Bid conference. Information presented, and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

ARTICLE 5—SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

- 5.01 *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.

5.02 *Existing Site Conditions*

A. *Subsurface and Physical Conditions; Hazardous Environmental Conditions*

1. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:
 - a. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.
 - b. Those drawings known to Owner of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data.
 - 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 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:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05 of the General Conditions, and not in the drawings referred to in Paragraph 5.02.A of these Instructions to Bidders. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

5.03 *Site Visit and by Bidders*

- A. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.

5.04 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner safety program. If an Owner safety program exists, it will be noted in the Supplementary Conditions.

5.05 *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 6—BIDDER’S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Express Representations and Certifications in Bid Form, Agreement*

- A. The Bid Form that each Bidder will submit contains express representations regarding the Bidder’s examination of Project documentation, Site visit, and preparation of the Bid, and certifications regarding lack of collusion or fraud in connection with the Bid. Bidder should review these representations and certifications and assure that Bidder can make the representations and certifications in good faith, before executing and submitting its Bid.
- B. If Bidder is awarded the Contract, Bidder (as Contractor) will make similar express representations and certifications when it executes the Agreement.

ARTICLE 7—INTERPRETATIONS AND ADDENDA

- 7.01 Owner on its own initiative may issue Addenda to clarify, correct, supplement, or change the Bidding Documents.
- 7.02 Bidder shall submit all questions about the meaning or intent of the Bidding Documents to Engineer in writing to the Owner as indicated in the Invitation to Bid Interpretations or clarifications considered necessary by Engineer in response to such questions will be posted by Addenda on the County website and Georgia Procurement Registry.
- 7.03 Only responses set forth in an Addendum will be binding. Oral and other interpretations or clarifications will be without legal effect. Responses to questions are not part of the Contract Documents unless set forth in an Addendum that expressly modifies or supplements the Contract Documents.

ARTICLE 8—BID SECURITY

- 8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of **5** percent of Bidder’s maximum Bid price (determined by adding the base bid and all alternates) and in the form of a Bid bond issued by a surety meeting the requirements of Paragraph 6.01 of the General Conditions. Such Bid bond will be issued in the form included in the Bidding Documents.
- 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, furnished the required Contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract 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, in whole in the case of a penal sum bid bond, and to the extent of Owner’s

damages in the case of a damages-form bond. Such forfeiture will be Owner's exclusive remedy if Bidder defaults.

- 8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until 90 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within 7 days after the Bid opening.

ARTICLE 9—CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and (b) ready for final payment, and (c) Milestones (if any) are to be achieved, are set forth in the Agreement.
- 9.02 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 10—SUBSTITUTE AND "OR EQUAL" ITEMS

- 10.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or "or-equal" items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or "or-equal" item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.
- 10.02 All prices that Bidder sets forth in its Bid will 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.

ARTICLE 11—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 11.01 A Bidder must be prepared to retain specific Subcontractors and Suppliers for the performance of the Work if required to do so by the Bidding Documents or in the Specifications. If a prospective Bidder objects to retaining any such Subcontractor or Supplier and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.
- 11.02 The apparent Successful Bidder, and any other Bidder so requested, must submit to Owner a list of the Subcontractors or Suppliers proposed for the following portions of the Work within five days after Bid opening:
 - A. **Civil Site**
 - B. **Electrical**
 - C. **HVAC**
 - D. **Plumbing**

- 11.03 If requested by Owner, such list must be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor or Supplier. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor or Supplier, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder will 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.
- 11.04 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 and Suppliers. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor or Supplier, 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 7.07 of the General Conditions.

ARTICLE 12—PREPARATION OF BID

- 12.01 The Bid Form is included with the Bidding Documents.
- A. All blanks on the Bid Form must be completed by typing or printing with ink and the Bid Form signed in ink. Erasures or alterations must be initialed in ink by the person signing the Bid Form. A Bid price must 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."
- 12.02 If Bidder has obtained the Bidding Documents as Electronic Documents, then Bidder shall prepare its Bid on a paper copy of the Bid Form printed from the Electronic Documents version of the Bidding Documents. The printed copy of the Bid Form must be clearly legible, printed on 8½ inch by 11-inch paper and as closely identical in appearance to the Electronic Document version of the Bid Form as may be practical. The Owner reserves the right to accept Bid Forms which nominally vary in appearance from the original paper version of the Bid Form, providing that all required information and submittals are included with the Bid.
- 12.03 A Bid by a corporation must 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 must be shown.
- 12.04 A Bid by a partnership must 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 official address of the partnership must be shown.
- 12.05 A Bid by a limited liability company must 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 official address of the firm must be shown.
- 12.06 A Bid by an individual must show the Bidder's name and official address.

- 12.07 A Bid by a joint venture must be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.
- 12.08 All names must be printed in ink below the signatures.
- 12.09 The Bid must contain an acknowledgment of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.
- 12.10 Postal and e-mail addresses and telephone number for communications regarding the Bid must be shown.
- 12.11 The Bid must contain evidence of Bidder's authority to do business in the state where the Project is located, or Bidder must certify in writing that it will obtain such authority within the time for acceptance of Bids and attach such certification to the Bid.
- 12.12 If Bidder is required to be licensed to submit a Bid or perform the Work in the state where the Project is located, the Bid must contain evidence of Bidder's licensure, or Bidder must certify in writing that it will obtain such licensure within the time for acceptance of Bids and attach such certification to the Bid. Bidder's state contractor license number, if any, must also be shown on the Bid Form.

ARTICLE 13—BASIS OF BID

13.01 *Lump Sum*

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

13.02 *Allowances*

- A. For Allowances, the Bid Price must include the amount established by the Owner on the Bid Form

ARTICLE 14—SUBMITTAL OF BID

- 14.01 The Bidding Documents include 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 2 of the Bid Form.
- 14.02 A Bid must be received no later than the date and time prescribed and at the place indicated in the Advertisement or invitation to bid and must 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, and must 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 must be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid must be addressed to the location designated in the Advertisement.
- 14.03 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 15—MODIFICATION AND WITHDRAWAL OF BID (NOT USED)

ARTICLE 16—OPENING OF BIDS

- 16.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. 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.

ARTICLE 17—BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 17.01 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 18—EVALUATION OF BIDS AND AWARD OF CONTRACT

- 18.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.
- 18.02 Owner reserves the right to negotiate or reject any unbalanced bid, as stated in the Additional Terms and Conditions, Item #12 Unbalanced Bid.
- 18.03 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible.
- 18.04 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, whether in the Bid itself or in a separate communication to Owner or Engineer, then Owner will reject the Bid as nonresponsive.
- 18.05 If Owner awards the contract for the Work, such award will be to the responsible Bidder submitting the lowest responsive Bid.
- 18.06 *Evaluation of Bids*
- A. In evaluating Bids, Owner will consider whether 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.
- 18.07 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.
- 18.08 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 19—BONDS AND INSURANCE

- 19.01 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, other required bonds (if any),

and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by required bonds and insurance documentation.

- 19.02 Article 8, Bid Security, of these Instructions, addresses any requirements for providing bid bonds as part of the bidding process.

ARTICLE 20—SIGNING OF AGREEMENT

- 20.01 When Owner issues a Notice of Award to the Successful Bidder, it will 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 must 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 10 days thereafter, Owner will 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.

ARTICLE 21—STATUTORY AND FUNDING-FINANCING REQUIREMENTS (NOT USED)

ARTICLE 22—SALES AND USE TAXES

- 22.01 Owner is exempt from Georgia state sales and use taxes (O.C.G.A. § 48-8-3) on materials and equipment to be incorporated in the Work. (Exemption Documentation ST-5). Said taxes must be included in the Bid. Refer to Paragraph SC-7.10 of the Supplementary Conditions for additional information.

ARTICLE 23—CONTRACTS TO BE ASSIGNED (NOT USED)

Fayette County, Georgia
Fayetteville, Georgia
FCWS – Crosstown WTP Chemical System Upgrades

Invitation to Bid 26150-B

BID FORM

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 1—OWNER AND BIDDER

- 1.01 This Bid is submitted to: **Fayette County Purchasing Department, 140 Stonewall Avenue West, Suite 204, Fayetteville, Georgia 30214**
- 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—ATTACHMENTS TO THIS BID

- 2.01 The required documents to be submitted with and made a condition of this Bid are listed in the Checklist of Required Documents in 00 11 13 Invitation to Bid.

ARTICLE 3—BASIS OF BID—LUMP SUM BIDS

- 3.01 *Lump Sum Bids*
- A. Bidder will complete the Work in accordance with the Contract Documents for the following lump sum (stipulated) price(s), together with any Unit Prices indicated in Paragraph 3.02:
1. Lump Sum Price (Single Lump Sum)

Item No. 1	Yard Piping/ Site Work	\$
Item No. 2	Sodium Hypochlorite Bulk System	\$
Item No. 3	Sodium Hypochlorite Metering System	\$
Item No. 4	Fluoride Bulk System	\$
Item No. 5	Fluoride Metering System	\$
Item No. 6	Water Softening System	\$
Item No. 7	Tepid Water System and Water Heaters	\$
Item No. 8	HVAC	\$

- B. All specified allowance(s) to be approved by County Manager are included in the price(s) set forth below.

Item No. 1	Lump Sum Allowance Materials Testing Laboratory	\$ 10,000.00
Item No. 2	Lump Sum Allowance Owner-Directed Changes	\$ 30,000.00
Item No. 3	Lump Sum Allowance Unforeseen Conditions	\$ 10,000.00
Total for all Lump Sum Allowances		\$ 50,000.00

3.02 *Total Bid Price (Lump Sum)*

Total Bid Price (Total of all Lump Sum Bids)	\$

ARTICLE 4—BASIS OF BID—COST-PLUS FEE (NOT USED)

ARTICLE 5—PRICE-PLUS-TIME BID (NOT USED)

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—BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

7.01 *Bid Acceptance Period*

- A. 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.

7.02 *Instructions to Bidders*

- A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

7.03 *Receipt of Addenda*

- A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

ARTICLE 8—BIDDER’S REPRESENTATIONS AND CERTIFICATIONS

8.01 *Bidder’s Representations*

A. In submitting this Bid, Bidder represents the following:

1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
6. 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 the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder’s (Contractor’s) safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Bidder 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.
8. 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.
9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

8.02 *Bidder's Certifications*

A. The Bidder certifies the following:

1. 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.
2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
3. Bidder has not solicited or induced any individual or entity to refrain from bidding.
4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.02.A:
 - a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.
 - b. 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.
 - c. 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.
 - d. 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.

BIDDER hereby submits this Bid as set forth above:

Bidder:

(typed or printed name of organization)

By:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Date:

(typed or printed)

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

Attest:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Date:

(typed or printed)

Address for giving notices:

Bidder's Contact:

Name:

(typed or printed)

Title:

(typed or printed)

Phone:

Email:

Address:

Bidder's Contractor License No.: (if applicable)

BID BOND (PENAL SUM FORM)

Bidder Name: Address <i>(principal place of business)</i> :	Surety Name: Address <i>(principal place of business)</i> :
Owner Name: Fayette County, Georgia Address <i>(principal place of business)</i> : 140 Stonewall Avenue West Fayetteville, GA 30214	Bid Project <i>(name and location)</i> : FCWS – Crosstown WTP Chemical System Upgrades, 3500 Tdk Blvd, Peachtree City, GA 30269 Bid Due Date:
Bond Penal Sum: Date of Bond:	
Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.	
Bidder	Surety
_____ <i>(Full formal name of Bidder)</i>	_____ <i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature) (Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<i>Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.</i>	

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder occurs upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation will be null and void if:
 - 3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2. All Bids are rejected by Owner, or
 - 3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond will be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

SECTION 00 45 13
QUALIFICATIONS STATEMENT

ARTICLE 1—GENERAL INFORMATION

1.01 Provide contact information for the Business:

Legal Name of Business:			
Corporate Office			
Name:		Phone number:	
Title:		Email address:	
Business address of corporate office:			
Local Office			
Name:		Phone number:	
Title:		Email address:	
Business address of local office:			

1.02 Provide information on the Business's organizational structure:

Form of Business:	☐ Sole Proprietorship ☐ Partnership ☐ Corporation		
☐ Limited Liability Company ☐ Joint Venture comprised of the following companies:			
1.			
2.			
3.			
Provide a separate Qualification Statement for each Joint Venturer.			
Date Business was formed:		State in which Business was formed:	
Is this Business authorized to operate in the Project location?		☐ Yes ☐ No ☐ Pending	

1.03 Identify all businesses that own Business in whole or in part (25% or greater), or that are wholly or partly (25% or greater) owned by Business:

Name of business:		Affiliation:	
Address:			

Name of business:		Affiliation:	
Address:			
Name of business:		Affiliation:	
Address:			

1.04 Provide information regarding the Business's officers, partners, and limits of authority.

Name:		Title:	
Authorized to sign contracts:	☐ Yes ☐ No	Limit of Authority:	\$
Name:		Title:	
Authorized to sign contracts:	☐ Yes ☐ No	Limit of Authority:	\$
Name:		Title:	
Authorized to sign contracts:	☐ Yes ☐ No	Limit of Authority:	\$
Name:		Title:	

ARTICLE 2—LICENSING

2.01 Provide information regarding licensure for Business:

Name of License:			
Licensing Agency:			
License No:		Expiration Date:	
Name of License:			
Licensing Agency:			
License No:		Expiration Date:	

ARTICLE 3—DIVERSE BUSINESS CERTIFICATIONS (NOT USED)

ARTICLE 4—SAFETY

4.01 Provide information regarding Business's safety organization and safety performance.

Name of Business's Safety Officer:		
Safety Certifications		
Certification Name	Issuing Agency	Expiration

4.02 Provide Worker's Compensation Insurance Experience Modification Rate (EMR), Total Recordable Frequency Rate (TRFR) for incidents, and Total Number of Recorded Manhours (MH) for the last

3 years and the EMR, TRFR, and MH history for the last 3 years of any proposed Subcontractor(s) that will provide Work valued at 10% or more of the Contract Price. Provide documentation of the EMR history for Business and Subcontractor(s).

Year									
Company	EMR	TRFR	MH	EMR	TRFR	MH	EMR	TRFR	MH

ARTICLE 5—FINANCIAL

- 5.01 Provide information regarding the Business's financial stability. Provide the most recent audited financial statement, and if such audited financial statement is not current, also provide the most current financial statement.

Financial Institution:			
Business address:			
Date of Business's most recent financial statement:		☐ Attached	
Date of Business's most recent audited financial statement:		☐ Attached	
Financial indicators from the most recent financial statement			
Contractor's Current Ratio (Current Assets ÷ Current Liabilities)			
Contractor's Quick Ratio ((Cash and Cash Equivalents + Accounts Receivable + Short Term Investments) ÷ Current Liabilities)			

ARTICLE 6—SURETY INFORMATION

- 6.01 Provide information regarding the surety company that will issue required bonds on behalf of the Business, including but not limited to performance and payment bonds.

Surety Name:			
Surety is a corporation organized and existing under the laws of the state of:			
Is surety authorized to provide surety bonds in the Project location?	☐ Yes ☐ No		
Is surety listed in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" published in Department Circular 570 (as amended) by the Bureau of the Fiscal Service, U.S. Department of the Treasury? ☐ Yes ☐ No			
Mailing Address (principal place of business):			

Physical Address (principal place of business):			
Phone (main):		Phone (claims):	

ARTICLE 7—INSURANCE

- 7.01 Provide information regarding Business's insurance company(s), including but not limited to its Commercial General Liability carrier. Provide information for each provider.

Name of insurance provider, and type of policy (CLE, auto, etc.):			
Insurance Provider		Type of Policy (Coverage Provided)	
Are providers licensed or authorized to issue policies in the Project location?		☐ Yes ☐ No	
Does provider have an A.M. Best Rating of A-VII or better?		☐ Yes ☐ No	
Mailing Address (principal place of business):			
Physical Address (principal place of business):			
Phone (main):		Phone (claims):	

ARTICLE 8—CONSTRUCTION EXPERIENCE

- 8.01 Provide information that will identify the overall size and capacity of the Business.

Average number of current full-time employees:	
Estimate of revenue for the current year:	
Estimate of revenue for the previous year:	

- 8.02 Provide information regarding the Business's previous contracting experience.

Years of experience with projects like the proposed project:				
As a general contractor:		As a joint venturer:		
Has Business, or a predecessor in interest, or an affiliate identified in Paragraph 1.03:				
Been disqualified as a bidder by any local, state, or federal agency within the last 5 years? ☐ Yes ☐ No				

Been barred from contracting by any local, state, or federal agency within the last 5 years? ☐ Yes ☐ No
Been released from a bid in the past 5 years? ☐ Yes ☐ No
Defaulted on a project or failed to complete any contract awarded to it? ☐ Yes ☐ No
Refused to construct or refused to provide materials defined in the contract documents or in a change order? ☐ Yes ☐ No
Been a party to any currently pending litigation or arbitration? ☐ Yes ☐ No
Provide full details in a separate attachment if the response to any of these questions is Yes.

- 8.03 List all projects currently under contract in Schedule A and provide indicated information.
- 8.04 List a minimum of three and a maximum of six projects completed in the last 5 years in Schedule B and provide indicated information to demonstrate the Business's experience with projects similar in type and cost of construction.
- 8.05 In Schedule C, provide information on key individuals whom Business intends to assign to the Project. Provide resumes for those individuals included in Schedule C. Key individuals include the Project Manager, Project Superintendent, Quality Manager, and Safety Manager. Resumes may be provided for Business's key leaders as well.

ARTICLE 9—REQUIRED ATTACHMENTS

- 9.01 Provide the following information with the Statement of Qualifications:
- A. If Business is a Joint Venture, separate Qualifications Statements for each Joint Venturer, as required in Paragraph 1.02.
 - B. Certification of Business's safety performance if required by Paragraph 4.02.
 - C. Financial statements as required by Paragraph 5.01.
 - D. Attachments providing additional information as required by Paragraph 8.02.
 - E. Schedule A (Current Projects) as required by Paragraph 8.03.
 - F. Schedule B (Previous Experience with Similar Projects) as required by Paragraph 8.04.
 - G. Schedule C (Key Individuals) and resumes for the key individuals listed, as required by Paragraph 8.05.
 - H. Additional items as pertinent.

Qualifications Statement

This Statement of Qualifications is offered by:

Business: _____
(typed or printed name of organization)

By: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(date signed)

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

Attest: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address for giving notices:

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address: _____

Phone: _____

Email: _____

Qualifications Statement

Schedule A—Current Projects

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Qualifications Statement

Schedule B—Previous Experience with Similar Projects

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Qualifications Statement

Schedule B—Previous Experience with Similar Projects

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Schedule C—Key Individuals

Project Manager			
Name of individual			
Years of experience as project manager			
Years of experience with this organization			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	
Project Superintendent			
Name of individual			
Years of experience as project superintendent			
Years of experience with this organization			
Number of similar projects as project superintendent			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

Qualifications Statement

Safety Manager			
Name of individual			
Years of experience as project manager			
Years of experience with this organization			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	
Quality Control Manager			
Name of individual			
Years of experience as project superintendent			
Years of experience with this organization			
Number of similar projects as project superintendent			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

END OF SECTION

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

This Agreement is by and between **Fayette County, Georgia** ("Owner") and ("Contractor").

Terms used in this Agreement have the meanings stated in the General Conditions and the Supplementary Conditions.

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: **Construction of a Sodium Hypochlorite and Fluoride Chemical system, complete with, but not limited to, bulk tanks, day tanks, transfer pumps, metering pumps, water softening system, tepid water system and abandonment of the existing chemical equipment.**

ARTICLE 2—THE PROJECT

- 2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: **Upgrade the existing post treatment chemical systems for Fayette County Water System and the Crosstown WTP**

ARTICLE 3—ENGINEER

- 3.01 The Owner has retained **Arcadis U.S., Inc.** ("Engineer") to act as Owner's representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.
- 3.02 The part of the Project that pertains to the Work has been designed by **Engineer**.

ARTICLE 4—CONTRACT TIMES

- 4.01 *Time is 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 complete within **335** 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 **365** calendar days after the date when the Contract Times commence to run.
- 4.03 *Liquidated Damages*
- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and

Milestones not achieved within the Contract Times, as duly modified (e.g., rain days or other allowed days). These liquidated damages are not established as a penalty but are calculated and agreed upon in advance by the Owner and the Contractor due to the uncertainty and difficulty of making a determination as to the actual and consequential damages which are incurred by the Owner and the general public as a result of the failure on the part of the Contractor to complete the Work on time. 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 \$250 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.
 2. *Completion of Remaining Work*: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$500 for each day that expires after such time until the Work is completed and ready for final payment.
 3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive, and will not be imposed concurrently.
- B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

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 and Allowances, a lump sum as indicated in the Contractor's Bid Form.
- 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) as indicated in the Contractor's Bid Form.

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, Allowances, and Unit Price Work (subject to final Unit Price adjustment) as indicated in the Contractor's Bid Form.

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 the basis of Contractor's Applications for Payment on or about the **25th** 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 the value of the Work completed (with the balance being retainage).
 - b. **95** percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to **100** percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less **200** percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 *Final Payment*

- A. Upon final completion and acceptance of the Work, Owner shall pay the remainder of the Contract Price in accordance with Paragraph 15.06 of the General Conditions.

6.04 *Consent of Surety*

- A. Owner will not make final payment, or return or release retainage at Substantial Completion or any other time, unless Contractor submits written consent of the surety to such payment, return, or release.

6.05 *Interest*

- A. All amounts not paid when due will bear interest at the rate of **six (6)** percent per annum.

ARTICLE 7—CONTRACT DOCUMENTS

7.01 *Contents*

- A. The Contract Documents consist of all of the following:

1. This Agreement.
2. Bonds:
 - a. Performance bond (together with power of attorney).
 - b. Payment bond (together with power of attorney).
3. General Conditions.
4. Supplementary Conditions.
5. Additional Terms and Conditions
6. Specifications as listed in the table of contents of the project manual (copy of list attached).
7. Drawings (not attached but incorporated by reference) consisting of **83** sheets with each sheet bearing the following general title: **FCWS – Crosstown WTP Chemical Upgrades**.
8. Addenda (numbers **[number]** to **[number]**, inclusive).
9. 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.
 - e. Warranty Bond, if any.
- B. The Contract Documents listed in Paragraph 7.01.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 7.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 Contractor's Representations

- A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:
 1. Contractor has examined and carefully studied the Contract Documents, including Addenda.
 2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.

4. Contractor has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
5. 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 Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.
7. 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.
8. 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.
9. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. 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.

8.02 *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 8.02:
 1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

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

8.03 *Standard General Conditions*

- A. Owner stipulates that if the General Conditions that are made a part of this Contract are EJCDC® C-700, Standard General Conditions for the Construction Contract (2018), 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 **[indicate date on which Contract becomes effective]** (which is the Effective Date of the Contract).

Owner:

(typed or printed name of organization)

By: _____
(individual's signature)

Date: _____
(date signed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Address for giving notices:

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

Phone: _____

Email: _____

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

Contractor:

(typed or printed name of organization)

By: _____
(individual's signature)

Date: _____
(date signed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

(If **[Type of Entity]** is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Address for giving notices:

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

Phone: _____

Email: _____

License No.: _____
(where applicable)

State: _____

SECTION 00 52 14

ADDITIONAL TERMS AND CONDITIONS

ITB 26150-B FCWS – Crosstown WTP Chemical System

Upgrades

1. **Definitions:** The term “contractor” as used herein and elsewhere in these Terms and Conditions shall be used synonymously with the term “successful bidder.” The term “County” shall mean Fayette County, Georgia.
2. **Bid is Offer to Contract:** Each bid constitutes an offer to become legally bound to a contract with the County, incorporating the invitation to bid and the bidder’s bid. The binding offer includes compliance with all terms, conditions, special conditions, specifications, and requirements stated in the invitation to bid, except to the extent that a bidder takes written exception to such provisions. All such terms, conditions, special conditions, specifications, and requirements will form the basis of the contract. The bidder should take care to answer all questions and provide all requested information, and to note any exceptions in the bid submission. Failure to observe any of the instructions or conditions in this invitation to bid may result in rejection of the bid.
3. **Binding Offer:** See 00 21 13, Article 8.03.
4. **Bidder’s Questions:** As appropriate, the County will post answers to questions and/or other information concerning the invitation to bid in the form of an addendum on the County’s website at www.fayettecountyga.gov. It is the responsibility of the prospective bidder to check the website for any addenda issued for this invitation to bid.
5. **References:** Include with your bid a list of three (3) jobs that your company has done that are of the same or similar nature to the work described in this invitation to bid on the form provided. Include all information as requested on the form.
6. **Bid Submission:** Submit your bid, along with any addenda issued by the County, in a sealed opaque envelope with the following information written on the outside of the envelope:
 - a. The bidder’s company name,
 - b. The bid number, which is **26150-B**, and
 - c. The bid name, which is **FCWS – Crosstown WTP Chemical System Upgrades**.

Mail or deliver one (1) original bid, signed in ink by a company official authorized to make a legal and binding offer, and one (1) copy on a flash drive, to:

Fayette County Government
Purchasing Department
140 Stonewall Avenue West, Suite 204
Fayetteville, GA 30214
Attention: Contracts Administrator

You may submit bids in person, by U.S. mail, or by a commercial carrier. Do not submit bids by facsimile, e-mail, or other electronic means. Once submitted, all bids become the property of Fayette County.

7. **Bid Preparation Costs:** The bidder shall bear all costs associated with preparing the bid.
8. **Late Bids:** Bids not received by the time and date of the scheduled bid opening will not be considered unless the delay is a result of action or inaction by the County.
9. **More than One Bid:** Do not submit alternate bids or options, unless requested or authorized by the County in the Invitation to Bid. If a responder submits more than one bid without being requested or authorized to do so, the County may disqualify the bids from that responder, at the County's option.
10. **Bid Corrections or Withdrawals:** The bidder may correct a mistake, or withdraw a bid, before the bid opening by sending written notification to the Director of Purchasing. Bids may be withdrawn after the bid opening only with written authorization from the Director of Purchasing.
11. **Defects or Irregularities in Bids:** The County reserves the right to waive any defect or irregularity in any bid received. In case of a discrepancy between unit prices and extended prices, the unit price will govern unless the facts or other considerations indicate another basis for correction of the discrepancy.
12. **Unbalanced Bid:** If the County determines that the apparent low bid is unbalanced, the County retains the rights to negotiate with the apparent low bidder for the purpose of correcting the bid imbalance without changing the overall bid amount. If the apparent low bidder and the County cannot reach agreement, the County may deem the apparent low bid non-responsive. In such case, the County reserves the right to award to the next-lowest bidder, or to reject any and all bids and re-advertise the project.
13. **Prices Held Firm:** Prices quoted shall be firm for the period of the contract, unless otherwise specified in the bid. All prices for commodities, supplies, equipment, or other

products shall be quoted FOB Destination, Fayette County or job site.

14. **Brand Name:** See 00 21 13, Article 10.
15. **Bidder Substitutions:** Bidders offering substitutions or deviations from specifications stated in the invitation to bid, shall list such substitutions or deviations on the "Exceptions to Specifications" sheet provided, or on a separate sheet to be submitted with the bid. The absence of such list shall indicate that the bidder has taken no exception to the specifications. The evaluation of bids and the determination as to equality and acceptability of products or services offered shall be the responsibility of the County.
16. **Samples:** When the County requires samples as part of the bid and vendor selection process, bidders must provide requested samples within the time allotted, and at no cost to the County unless otherwise specified. Any goods provided under contract shall conform to the sample submitted. The County will return samples only at the bidder's request, and at the bidder's expense, if they are not destroyed by testing.
17. **Non-Collusion:** By responding to this invitation to bid, the bidder represents that the bid is not made in connection with any competing bidder, supplier, or service provider submitting a separate response to this invitation to bid and is in all respects fair and without collusion or fraud.
18. **Bid Evaluation:** Award will be made to the lowest responsive, responsible bidder, taking into consideration payment terms, vendor qualifications and experience, quality, references, any exceptions listed, and/or other factors deemed relevant in making the award. The County may make such investigation as it deems necessary to determine the ability of the bidder to perform, and the bidder shall furnish to the County all information and data for this purpose as the County may request. The County reserves the right to reject any bid item, any bid, or all bids, and to re-advertise for bids.
19. **Payment Terms and Discounts:** The County's standard payment terms are Net 30. Any deviation from standard payment terms must be specified in the resulting contract, and both parties must agree on such deviation. Cash discounts offered will be a consideration in awarding the bid, but only if they give the County at least 15 days from receipt of invoice to pay. For taking discounts, time will be computed from the date of invoice acceptance by the County, or the date a correct invoice is received, whichever is the later date. Payment is deemed made, for the purpose of earning the discount, on the date of the check.

20. **Trade Secrets – Confidentiality:** If any person or entity submits a bid or proposal that contains trade secrets, an affidavit shall be included with the bid or proposal. The affidavit shall declare the specific included information which constitutes trade secrets. Any trade secrets must be either (1) placed in a separate envelope, clearly identified and marked as such, or (2) at a minimum, marked in the affidavit or an attached document explaining exactly where such information is, and otherwise marked, highlighted, or made plainly visible. See O.C.G.A. § 50-18-72 (A)(34).
21. **Trade Secrets – Internal Use:** In submitting a bid, the bidder agrees that the County may reveal any trade secret materials contained in the bid to all county staff and officials involved in the selection process, and to any outside consultant or other third parties who may assist in the selection process. The bidder agrees to hold harmless the County and each of its officers, employees, and agents from all costs, damages, and expenses incurred in connection with refusing to disclose any material which the bidder has designated as a trade secret.
22. **Ethics – Disclosure of Relationships:** Before a proposed contract in excess of \$10,000.00 is recommended for award to the Board of Commissioners or the County Administrator, or before the County renews, extends, or otherwise modifies a contract after it has been awarded, the contractor must disclose certain relationships with any County Commissioner or County Official, or their spouse, mother, father, grandparent, brother, sister, son or daughter related by blood, adoption, or marriage (including in-laws). A relationship that must be reported exists if any of these individuals is a director, officer, partner, or employee, or has a substantial financial interest in the business, as described in Fayette County Ordinance Chapter 2, Article IV, Division 3 (Code of Ethics).

If such relationship exists between your company and any individual mentioned above, relevant information must be presented in the form of a written letter to the Director of Purchasing. You must include the letter with any bid, proposal, or price quote you submit to the Purchasing Department.

In the event that a contractor fails to comply with this requirement, the County will take action as appropriate to the situation, which may include actions up to and including rejection of the bid or offer, cancellation of the contract in question, or debarment or suspension from award of a county contract for a period of up to three years.

23. **Contract Execution & Notice to Proceed:** After the Board of Commissioners makes an award, all required documents are received by the County, and the contract is fully executed with signature of both parties, the County will issue a written Notice to Proceed. The County shall not be liable for payment of any work done or any costs incurred by any bidder prior to the County issuing the Notice to Proceed.

24. **Unavailability of Funds:** This contract will terminate immediately and absolutely at such time as appropriated and otherwise unobligated funds are no longer available to satisfy the obligations of the County under the contract.
25. **Insurance:** The successful bidder shall procure and maintain the following insurance, to be in effect throughout the term of the contract, in at least the amounts and limits as follows:
- a. **General Liability Insurance:** \$1,000,000 combined single limit per occurrence, including bodily and personal injury, destruction of property, and contractual liability.
 - b. **Automobile Liability Insurance:** \$1,000,000 combined single limit each occurrence, including bodily injury and property damage liability.
 - c. **Worker's Compensation & Employer's Liability Insurance:** Workers Compensation as required by Georgia statute.
 - d. **Builder's "All Risk" Insurance:** In the event the contractor is performing construction services under the contract, contractor shall procure and maintain "all-risk" builder's insurance, providing coverage for the work performed under the contract, and the materials, equipment or other items incorporated therein, while the same are located at the construction site, stored off-site, or at the place of manufacture. The policy limit shall be at least 100% of the value of the contract, including any additional costs which are normally insured under such policy.

Before a contract with the successful bidder is executed, the successful bidder shall provide Certificates of Insurance for all required coverage. The successful offeror can provide the Certificate of Insurance after award of the contract but must be provided prior to execution of the contract document by both parties. The certificate shall list an additional insured as follows:

Fayette County, Georgia, 140 Stonewall Avenue West, Fayetteville, GA 30214

Arcadis U.S., Inc., 2839 Paces Ferry Rd SE, Suite 1000, Atlanta GA, 30339

26. **Bid Bond:** You must include a bid bond with your bid, equal to five percent (5%) of the total amount bid. Bid bonds shall be provided by a surety which appears on the U.S. Treasury's list of approved bond sureties (Circular 570).
27. **Performance and Payment Bonds:** Prior to execution of a contract, the successful bidder shall submit performance and payment bonds each equal to 100 percent of the contract

value, provided by a surety which appears on the U.S. Treasury's list of approved bond sureties (Circular 570).

28. **Building Permits:** Work performed for the County requiring building permits by licensed contractors will not have permit fees assessed, although any re-inspection fees for disapproved inspections will be the responsibility of the contractor prior to final inspections and the Certificate of Occupancy or Certificate of Completion being issued.
29. **Unauthorized Performance:** The County will not compensate the contractor for work performed unless the work is authorized under the contract, as initially executed, or as amended.
30. **Assignment of Contract:** Assignment of any contract resulting from this invitation to bid will not be authorized, except as provided in the standard general conditions of the construction contract, section 18.08
31. **Indemnification:** The contractor shall indemnify and save the County and all its officers, agents, and employees harmless from all suits, actions, or other claims of any character, name and description brought for or on account of any damages, losses, or expenses to the extent caused by or resulting from the negligence, recklessness, or intentionally wrongful conduct of the contractor or other persons employed or utilized by the contractor in the performance of the contract. The contractor shall pay any judgment with cost which may be obtained against the County growing out of such damages, losses, or expenses.
32. **Severability:** The invalidity of one or more of the phrases, sentences, clauses, or sections contained in the contract shall not affect the validity of the remaining portion of the contract. If any provision of the contract is held to be unenforceable, then both parties shall be relieved of all obligations arising under such provision to the extent that the provision is unenforceable. In such case, the contract shall be deemed amended to the extent necessary to make it enforceable while preserving its intent.
33. **Delivery Failures:** If the contractor fails to deliver contracted goods or services within the time specified in the contract or fails to replace rejected items in a timely manner, the County shall have authority to make open-market purchases of comparable goods or services. The County shall have the right to invoice the contractor for any excess expenses incurred or deduct such amount from monies owed the contractor. Such purchases shall be deducted from contracted quantities.
34. **Substitution of Contracted Items:** The contractor shall be obligated to deliver products awarded in this contract in accordance with terms and conditions specified herein. If a contractor is unable to deliver the products under the contract, it shall be the contractor's responsibility to obtain prior approval of the ordering agency to deliver an acceptable

substitute at the same price quoted in the contractor's original bid. In the event any contractor consistently needs to substitute or refuses to substitute products, the County reserves the right to terminate the contract or invoke the "Delivery Failures" clause stated herein.

35. **Inspection and Acceptance of Deliveries:** The County reserves the right to inspect all goods and products delivered. The County will decide whether to accept or reject items delivered. The inspection shall be conclusive except with respect to latent defects, fraud, or such gross mistakes as shall amount to fraud. Final inspection resulting in acceptance or rejection of the products will be made as soon as practicable, but failure to inspect shall not be construed as a waiver by the County to claim reimbursement or damages for such products which are later found to be in non-conformance with specifications. Should public necessity demand it, the County reserves the right to use or consume articles delivered which are substandard in quality, subject to an adjustment in price to be determined by the Purchasing Director.
36. **Termination for Cause:** The County may terminate the contract for cause by sending written notice to the contractor of the contractor's default in the performance of any term of this agreement. As appropriate, the County will compensate the contractor for completed performance, and for any partially completed performance as determined by the County to be adequately performed. Termination shall be without prejudice to any of the County's rights or remedies by law.
37. **Termination for Convenience:** The County may terminate the contract for its convenience at any time with 7 days' written notice to the contractor, as stipulated in the standard General Conditions of the contract, section 16.03.
38. **Force Majeure:** Neither party shall be deemed to be in breach of the contract to the extent that performance of its obligations is delayed, restricted, or prevented by reason of any act of God, natural disaster, act of government, or any other act or condition beyond the reasonable control of the party in question.
39. **Governing Law:** This agreement shall be governed in accordance with the laws of the State of Georgia. The parties agree to submit to the jurisdiction in Georgia, and further agree that any cause of action arising under this agreement shall be required to be brought in the appropriate venue in Fayette County, Georgia.

END OF SECTION

PERFORMANCE BOND

Contractor Name: Address <i>(principal place of business)</i> :	Surety Name: Address <i>(principal place of business)</i> :
Owner Name: Fayette County, Georgia Mailing address <i>(principal place of business)</i> : 140 Stonewall Avenue West Fayetteville, GA 30214	Contract Description <i>(name and location)</i> : FCWS – Crosstown WTP Chemical System Upgrades, 3500 Tdk Blvd, Peachtree City, GA 30269 Contract Price: Effective Date of Contract:
Bond Bond Amount: Date of Bond: <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i> Modifications to this Bond form: ☐ None ☐ See Paragraph 16	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.	
Contractor as Principal	Surety
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____	By: _____
<i>(Signature)</i>	<i>(Signature)(Attach Power of Attorney)</i>
Name: _____	Name: _____
<i>(Printed or typed)</i>	<i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____	Attest: _____
<i>(Signature)</i>	<i>(Signature)</i>
Name: _____	Name: _____
<i>(Printed or typed)</i>	<i>(Printed or typed)</i>
Title: _____	Title: _____
<i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i>	

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

1. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.
2. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:
 - 2.1. The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default;
 - 2.2. The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
 - 2.3. The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.
3. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.
4. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:
 - 4.1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;
 - 4.2. Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;
 - 4.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

- 4.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:
 - 5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
 - 5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.
5. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.
6. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:
 - 6.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
 - 6.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and
 - 6.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.
7. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.
8. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.
9. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
10. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.
11. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.

12. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.
13. Definitions
- 13.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.
- 13.2. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.
- 13.3. *Contractor Default*—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.
- 13.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
- 13.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
14. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
15. Modifications to this Bond are as follows: **NONE**

PAYMENT BOND

Contractor Name: Address <i>(principal place of business)</i> :	Surety Name: Address <i>(principal place of business)</i> :
Owner Name: Fayette County, Georgia Mailing address <i>(principal place of business)</i> : 140 Stonewall Avenue West Fayetteville, GA 30214	Contract Description <i>(name and location)</i> : FCWS – Crosstown WTP Chemical System Upgrades, 3500 Tdk Blvd, Peachtree City, GA 30269 Contract Price: Effective Date of Contract:
Bond Bond Amount: Date of Bond: <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i> Modifications to this Bond form: ☐ None ☐ See Paragraph 18	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.	
Contractor as Principal	Surety
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i>	

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond will arise after the following:
 - 5.1. Claimants who do not have a direct contract with the Contractor
 - 5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2. Pay or arrange for payment of any undisputed amounts.
 - 7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety

shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.
11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. Definitions

16.1. *Claim*—A written statement by the Claimant including at a minimum:

16.1.1. The name of the Claimant;

16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;

- 16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
 - 16.1.4. A brief description of the labor, materials, or equipment furnished;
 - 16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 - 16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
 - 16.1.7. The total amount of previous payments received by the Claimant; and
 - 16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
- 16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
- 16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
- 16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
- 16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
18. Modifications to this Bond are as follows: **NONE**

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



Endorsed By



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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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 document prepared by Contractor, in a form acceptable to Engineer, to request 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; 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; 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.

- 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.
 - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.
 - d. 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), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations 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 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. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
 - 21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the

recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.
23. *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.
24. *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.
 - a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
 - b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.
 - c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
27. *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.
28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
29. *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.
30. *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.
31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.
32. *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.

33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.
34. *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.
35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals.
36. *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.
37. *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.
38. *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 or areas furnished by Owner which are designated for the use of Contractor.
39. *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.
40. *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.
41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers’ instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. *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 of such Work.

43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.
44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
45. *Supplier*—A manufacturer, fabricator, supplier, distributor, 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.
46. *Technical Data*
- a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.
 - b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.
 - c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.
47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.
48. *Unit Price Work*—Work to be paid for on the basis of unit prices.
49. *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.
50. *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 Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:* 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:* The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:* The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - 1. does not conform to the Contract Documents;
 - 2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - 3. 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 Paragraph 15.04).
- E. *Furnish, Install, Perform, Provide*
 - 1. The word “furnish,” when used in connection with services, materials, or equipment, means 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, means 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, means 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. *Contract Price or Contract Times*: References to a change in “Contract Price or Contract Times” or “Contract Times or Contract Price” or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term “or both” is not expressed.
- G. 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 Performance and Payment Bonds; Evidence of Insurance*

- A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.
- C. *Evidence of Owner’s Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), 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 signed 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 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 *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 the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will 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.
 - 4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents 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 Electronic Documents.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one Contract Document 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 versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will 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.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will 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.
- G. Nothing in the Contract Documents creates:
 - 1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
 - 2. 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.

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, means 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, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer 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 or Engineer 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 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 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 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 in writing 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.

- 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 notify Owner and Contractor in writing 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 versions, 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 precludes 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 30th 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 60th day after the day of Bid opening or the 30th 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 may 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 must 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 will 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 Contract Price or 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. Such an adjustment will 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 third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and
 - 4. Acts of war or terrorism.

- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
 2. Contractor shall not be entitled to an adjustment in Contract Price 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. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
 3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
1. The circumstances that form the basis for the requested adjustment;
 2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;
 3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;
 4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and
 5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.
- Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.
- F. 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, together with the provisions of Paragraphs 4.05.D and 4.05.E.
- G. Paragraph 8.03 addresses 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.

ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor in writing 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, or to improvements, structures, utilities, or similar facilities located at such adjacent lands 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 7.13, 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 in a court of competent jurisdiction; 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 will 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 of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;
2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and
3. Technical Data contained in such reports and drawings.

- B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

- C. *Reliance by Contractor on Technical Data:* 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 Paragraph 1.01.A.46.b.

- D. *Limitations of Other Data and Documents:* 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;
 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;
 3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
 4. 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:
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;
 2. is of such a nature as to require a change in the Drawings or Specifications;
 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 whether it is necessary for Owner to obtain 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; 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. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- E. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, 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 subject to the provisions of Paragraphs 4.05.D and 4.05.E.
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;
 - 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 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, then any such adjustment will 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, 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.
- F. *Underground Facilities; Hazardous Environmental Conditions:* Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:
1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 2. complying with applicable state and local utility damage prevention Laws and Regulations;

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;
 4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 5. 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 on the Drawings, or was not shown or indicated on the Drawings 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), notify Owner and Engineer in writing regarding such Underground Facility.
- C. *Engineer's Review:* Engineer will:
1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;
 2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;
 3. obtain any pertinent cost or schedule information from Contractor; 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
 4. 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. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- F. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

or indicated on the Drawings, 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. 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;
 - b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and
 - c. 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, then any such adjustment will 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, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.
 4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;
2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; 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 on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. 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;
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, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, 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. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.
- 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, 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 obligates 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 obligates 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 Contractor's obligations under the Contract. These bonds must 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 terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.
- B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.
- C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

Regulations, and must be issued and signed by a surety named in “Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies” as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, 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 must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

- D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.
- E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.
- F. 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.
- G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.
- H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

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. Alternative forms of insurance coverage, including but not limited to self-insurance and “Occupational Accident and Excess Employer’s Indemnity Policies,” are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.
- D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages 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, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.

- E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages 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, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.
- F. 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, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. 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.
- H. Contractor shall require:
 - 1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and
 - 2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.
- I. If either party does not purchase or maintain 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.
- J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.
- K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) 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 will be adjusted accordingly.

- L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.
- M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.
- N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, 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 and Engineer.

6.03 *Contractor's Insurance*

- A. *Required Insurance:* Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.
- B. *General Provisions:* The policies of insurance required by this Paragraph 6.03 as supplemented must:
 - 1. include at least the specific coverages required;
 - 2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;
 - 3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, 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;
 - 4. apply with respect to the performance of the Work, whether such performance is 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; and
 - 5. include all necessary endorsements to support the stated requirements.
- C. *Additional Insureds:* The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:
 - 1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;
 - 2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;
 - 3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

4. not seek contribution from insurance maintained by the additional insured; and
5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other 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 Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.
- B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.
- C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.
- 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 advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.
- E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. 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 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

- A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer 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.

1. 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, risks, 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 individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater 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.
 2. None of the above waivers extends 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. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, 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, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.
1. 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 all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.
- C. The waivers in this Paragraph 6.05 include the waiver of rights 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 insured peril, risk, or cause of loss.
- D. Contractor shall be responsible for assuring that each Subcontract 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 fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

6.06 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 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 6.04 shall maintain such proceeds in a segregated account, and 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, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

- A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 *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.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *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 maintain good discipline and order at the Site.

- B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.
- C. 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 will 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.

7.04 *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 must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will 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 must 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.

7.05 *"Or Equals"*

- A. *Contractor's Request; Governing Criteria:* Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, 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 equipment or material, or items from other proposed Suppliers, under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that the proposed item:
 - 1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

- 2) 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) has a proven record of performance and availability of responsive service; and
 - 4) is not objectionable to Owner.
- b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) the item 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 will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.
- E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 Substitutes

- A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material 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 equipment or material under the circumstances described below. To the extent possible such requests must 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 equipment or material from anyone other than Contractor.
 2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.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 equipment or material that Contractor seeks to furnish or use. The application:
 - a. will 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 the item specified; and
 - 3) be suited to the same use as the item 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 the item specified; and
 - 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. will 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 will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.
- B. Contractor shall retain specific Subcontractors and Suppliers 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 or Supplier 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 5 days.
- E. Owner may require the replacement of any Subcontractor or Supplier. 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 or Suppliers 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 or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.
- F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, 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 or Supplier, whether initially or as a replacement, will 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 solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.
- J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.
- K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.
- L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.
- M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *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 an 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 will be disclosed 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.

7.09 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. 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.

7.10 *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.

7.11 *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. 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 is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.
- C. Owner or Contractor may give written 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 written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *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.

7.13 *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.
- B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.
- C. 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.
- D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.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).
- E. 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.
- F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that 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.
- G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
- H. 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.

- I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
- J. Contractor's duties and responsibilities for safety and protection will 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.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as 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 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 by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

- 1. Before submitting a Shop Drawing or Sample, Contractor shall:
 - a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determine and verify:
 - 1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;
 - 2) 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
 - 3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;
 - c. confirm that the Submittal is complete with respect to all related data included in the Submittal.
- 2. Each Shop Drawing or Sample must 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 Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.
- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.
1. *Shop Drawings*
 - a. Contractor shall submit the number of copies required in the Specifications.
 - b. Data shown on the Shop Drawings must 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.C.
 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.C.
 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. *Engineer's Review of Shop Drawings and Samples*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. 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, comply with the requirements of 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 will 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 or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 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, will 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 or Sample will 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.C.4.

D. Resubmittal Procedures for Shop Drawings and Samples

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 Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:
 - a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.
 - b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.
 - c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

- d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.
- 2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03, 2.04, and 2.05.
- F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

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 is entitled to rely on Contractor's warranty and guarantee.
- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:
 - 1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and
 - 2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.
- C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 - 1. abuse, or improper modification, 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.
- D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:
 - 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. The end of the correction period established in Paragraph 15.08;
 - 8. Any inspection, test, or approval by others; or

9. Any correction of defective Work by Owner.
- E. 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 will 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 losses, damages, costs, and judgments (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 from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage 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 will 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.

7.19 Delegation of Professional Design Services

- A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.
- B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.
- C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

- D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.
- E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:
 - 1. Checking for conformance with the requirements of this Paragraph 7.19;
 - 2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and
 - 3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.
- F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.
- G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

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 third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.
- D. 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.

- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, 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.
- F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

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 for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, 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. 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 will 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, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will 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 or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

- 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.
 - 1. 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 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 8.03.B.
 - 2. 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 Contractor.
- C. 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 will 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 (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 10.07. 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 *Resident 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 the Supplementary Conditions and in Paragraph 10.07.
- B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

- A. Engineer has the authority to reject Work in accordance with Article 14.
- B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.
- C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.
- D. Engineer's authority as to changes in the Work is set forth in Article 11.

E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 *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.

10.06 *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.

10.07 *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, will 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 Contractor under 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 10.07 also apply to the Resident Project Representative, if any.

10.08 *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 of which Engineer has been informed.

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

- A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
- B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.
- C. All changes to the Contract that 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, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
 - 1. Changes in 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 11.05, (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 that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

- A. 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 11.07 regarding change of Contract Price.

- B. If Owner has issued a Work Change Directive and:
 - 1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.
 - 2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

- A. 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.
- B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *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. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Work 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 must be performed under the applicable conditions of the Contract Documents.
- C. Nothing in this Paragraph 11.05 obligates 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.

11.06 *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.C.2.

11.07 *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 must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must 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);
 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 11.07.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 11.07.C).
- C. *Contractor's Fee:* When applicable, the Contractor's fee for overhead and profit will 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 will be 15 percent;
 - b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 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 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.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 5 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 will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
 - d. No fee will 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 of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
 - f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

11.08 *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 must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.
- B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

- A. *Purpose and Content:* Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

- B. *Change Proposal Procedures*

- 1. *Submittal:* Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.
- 2. *Supporting Data:* 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.
 - a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.
 - b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

The supporting data must 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.

- 3. *Engineer's Initial Review:* Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.
- 4. *Engineer's Full Review and Action on the Change Proposal:* Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must 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.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- C. *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 in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.
- D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *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 are subject 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;
 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; and
 4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.
- 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 rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, 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 will 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 will 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 will 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 will 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 will 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 will 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 will be incorporated in a Change Order or other written document 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. When needed 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 will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will 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 in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, 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, will 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 accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will 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, which 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 will 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 or retained for services specifically related to the Work.
 5. Other costs consisting of 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, 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.

- 1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

- 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.
 - 2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
 - 3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed 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 builder's risk or other property insurance established in accordance with Paragraph 6.04), 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 include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will 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 does not include any of the following items:
 - 1. Payroll costs and other compensation of Contractor's officers, executives, principals, general 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. The cost of purchasing, renting, or furnishing small tools and hand tools.
 - 3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
 - 4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
 - 5. 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.
 - 6. Expenses incurred in preparing and advancing Claims.
 - 7. 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*
 - 1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:
 - a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.
 - b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:
 - 1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.
 - 2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.
 - 2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

- E. *Documentation and Audit:* Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

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 for any of the foregoing will be valid.
- C. *Owner's Contingency Allowance:* Contractor agrees that an Owner's 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 for Work covered by allowances, and the Contract Price will 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, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:
 - a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
 - b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.
2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.
3. Adjusted unit prices will apply to all units of that item.

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 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 with such procedures and programs 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 will 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 will 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 will 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 written 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 will 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, 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 will 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 defective Work as required by Engineer, then Owner may, after 7 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 for 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.
 - 2. 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 must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) 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.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
4. 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;
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; 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 based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from 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 has occurred that would constitute a default by Contractor and therefore justify a termination for cause;
 - j. Liquidated or other 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; or
 - l. Other items entitle 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 will 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 will be treated as an amount due as determined by Paragraph 15.01.D.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 7 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 will 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 7 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 15.03.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 6.04 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 7.12), and other documents, Contractor may make application for final payment.
2. The final Application for Payment must 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 duly pending Change Proposals and Claims; 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 Final Application and Recommendation of Payment:* 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 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will 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. 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. *Notice of Acceptability:* In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. *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 and issuance of notice of the acceptability of the Work.
- E. *Final Payment Becomes Due:* Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

- A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim,

appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

- 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 as a Claim, 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 Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect 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 adjacent areas;
 - 2. correct such defective Work;
 - 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, 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 from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, 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 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). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.
- D. 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.
- E. 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.

- F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to 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 directly attributable to any such suspension. Any Change Proposal seeking such adjustments must 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) 10 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) written 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 7 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 will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

- A. Upon 7 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 for any loss of anticipated profits or revenue, post-termination overhead costs, 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 7 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, 7 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, pursuant to Article 12; and
 - 2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise 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;
 - 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 requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:
 - 1. in person, by a commercial courier service or otherwise, to the recipient's place of business;
 - 2. by registered or certified mail, postage prepaid, to the recipient's place of business; or
 - 3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

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 will not constitute a waiver of that provision, nor will 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 of the Contract or 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 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party 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.

18.09 *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.

18.10 *Headings*

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

SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

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SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

These Supplementary Conditions amend or supplement EJCDC® C-700, Standard General Conditions of the Construction Contract (2018). The General Conditions remain in full force and effect except as amended.

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—for example, "Paragraph SC-4.05."

Article 1—DEFINITIONS AND TERMINOLOGY

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

The terms "Contractor" and "CONTRACTOR" have the same meaning.

SC-1.01.A.22 Add the following to Paragraph 1.01.A.22:

The terms "Engineer" and "ENGINEER" have the same meaning.

SC-1.01.A.30 Add a new sentence to Paragraph 1.01.A.30 that is to read as follows:

The terms "Owner" and "OWNER" have the same meaning.

SC-1.01.A.40 Add a new sentence to Paragraph 1.01.A.40 that is to read as follows:

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

SC-1.01.A.45 Add a new sentence to Paragraph 1.01.A.45 that is to read as follows:

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

Article 2—PRELIMINARY MATTERS

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 signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies (including all endorsements, and identification of applicable self-insured retentions and deductibles) of insurance required to be provided by Contractor in this Contract. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

- C. *Evidence of Owner's Insurance:* After receipt from Contractor of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor copies of the policies of insurance to be provided by Owner in this Contract (if any). Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

2.02 *Copies of Documents*

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

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

SC-2.02 Delete Paragraph 2.02.A in its entirety and insert the following new paragraph in its place:

- A. Owner shall furnish to Contractor **one** printed copy of conformed Contract Documents incorporating and integrating all Addenda and any amendments negotiated prior to the Effective Date of the Contract (including one fully signed counterpart of the Agreement), and **one** in electronic portable document format (PDF). Additional printed copies of the conformed Contract Documents will be furnished upon request at the cost of reproduction.

2.06 *Electronic Transmittals*

SC-2.06 Delete Paragraph 2.06.B in its entirety and insert the following in its place:

- B. Electronic Means are established in Specification Section 01 31 26, Electronic Document Protocol.

SC-2.06 Supplement Paragraph 2.06 of the General Conditions by adding the following paragraph:

- D. *Requests by Contractor for Electronic Documents in Other Formats*
1. Release of any Electronic Document versions of the Project documents in formats other than those identified in the Electronic Documents Protocol (if any) or elsewhere in the Contract will be at the sole discretion of the Owner.
 2. To extent determined by Owner, in its sole discretion, to be prudent and necessary, release of Electronic Documents versions of Project documents and other Project information requested by Contractor ("Request") in formats other than those identified in the Electronic Documents Protocol (if any) or elsewhere in the Contract will be subject to the provisions of the Owner's response to the Request, and to the following conditions to which Contractor agrees:
 - a. The content included in the Electronic Documents created by Engineer and covered by the Request was prepared by Engineer as an internal working document for Engineer's purposes solely, and is being provided to Contractor on an "AS IS" basis without any warranties of any kind, including, but not limited to any implied warranties of fitness for any purpose. As such, Contractor is advised and acknowledges that the content may not be suitable for Contractor's application, or may require substantial modification and independent verification by Contractor. The content may include limited resolution of models, not-to-scale schematic representations and symbols, use of notes to convey design concepts in lieu of accurate graphics, approximations, graphical simplifications, undocumented intermediate revisions, and other devices that may affect subsequent reuse.

- b. Electronic Documents containing text, graphics, metadata, or other types of data that are provided by Engineer to Contractor under the request are only for convenience of Contractor. Any conclusion or information obtained or derived from such data will be at the Contractor's sole risk and the Contractor waives any claims against Engineer or Owner arising from use of data in Electronic Documents covered by the Request.
 - c. Contractor shall indemnify and hold harmless Owner and Engineer and their subconsultants from all claims, damages, losses, and expenses, including attorneys' fees and defense costs arising out of or resulting from Contractor's use, adaptation, or distribution of any Electronic Documents provided under the Request.
 - d. Contractor agrees not to sell, copy, transfer, forward, give away or otherwise distribute this information (in source or modified file format) to any third party without the direct written authorization of Engineer, unless such distribution is specifically identified in the Request and is limited to Contractor's subcontractors. Contractor warrants that subsequent use by Contractor's subcontractors complies with all terms of the Contract Documents and Owner's response to Request.
 - e. Contractor agrees to execute ENGINEER's standard agreement for release of electronic files (copy attached to Specification Section 01 n78 39. Record Documents) and shall abide by the provisions of such agreement for release of electronic files.
3. In the event that Owner elects to provide or directs the Engineer to provide to Contractor any Contractor-requested Electronic Document versions of Project information that is not explicitly identified in the Contract Documents as being available to Contractor, the Owner shall be reimbursed by Contractor on an hourly basis (at \$260 per hour) for any engineering costs necessary to create or otherwise prepare the data in a manner deemed appropriate by Engineer.

Article 3—**CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE**

No suggested Supplementary Conditions in this Article.

Article 4—**COMMENCEMENT AND PROGRESS OF THE WORK**

No suggested Supplementary Conditions in this Article.

Article 5—**SITE, SUBSURFACE AND PHYSICAL CONDITIONS, HAZARDOUS ENVIRONMENTAL CONDITIONS**

5.03 *Subsurface and Physical Conditions*

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

- E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which Contractor may rely: **If there are no such reports, so indicate in the table.**

Report Title	Date of Report	Technical Data
Report of Subsurface Exploration and Geotechnical Engineering Evaluation – South Fayette and Crosstown WTP.	June 20, 2025	Recommendations of mat foundations for support of chemical bulk systems

- F. The following table lists the drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data, and specifically identifies the Technical Data upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
NONE		

At the contractor's request, existing Water Treatment Plant drawings may be made available.

- G. Contractor may examine copies of reports and drawings identified in SC-5.03.E and SC-5.03.F that were not included with the Bidding Documents at **Fayette County Water System** during regular business hours, or may request copies from Engineer.

Article 6—**BONDS AND INSURANCE**

6.01 *Performance, Payment, and Other Bonds*

SC-6.01 Add the following paragraphs immediately after Paragraph 6.01.A:

1. *Required Performance Bond Form:* The performance bond that Contractor furnishes will be in the form of EJCDC® C-610, Performance Bond (2010, 2013, or 2018 edition).
2. *Required Payment Bond Form:* The payment bond that Contractor furnishes will be in the form of EJCDC® C-615, Payment Bond (2010, 2013, or 2018 edition).

6.02 *Insurance—General Provisions*

SC-6.02 Add the following paragraph immediately after Paragraph 6.02.B:

1. Contractor may obtain worker's compensation insurance from an insurance company that has not been rated by A.M. Best, provided that such company (a) is domiciled in the state in which the Project is located, (b) is certified or authorized as a worker's compensation insurance provider by the appropriate state agency, and (c) has been accepted to provide worker's compensation insurance for similar projects by the state within the last 12 months.

6.03 *Contractor's Insurance*

SC-6.03 Supplement Paragraph 6.03 with the following provisions after Paragraph 6.03.C:

- E. *Workers' Compensation and Employer's Liability:* Contractor shall purchase and maintain workers' compensation as required by Georgia statute.
- F. *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 claims for:

1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,
 2. damages insured by reasonably available personal injury liability coverage, and
 3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- G. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage.
 - a. Such insurance must 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, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
 4. Underground, explosion, and collapse coverage.
 5. Personal injury coverage.
 6. 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). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.
 7. 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.
- H. *Commercial General Liability—Excluded Content:* The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:
1. Any modification of the standard definition of "insured contract" (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
 2. Any exclusion for water intrusion or water damage.
 3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
 4. Any exclusion of coverage relating to earth subsidence or movement.
 5. Any exclusion for the insured's vicarious liability, strict liability, or statutory liability (other than worker's compensation).

6. Any limitation or exclusion based on the nature of Contractor's work.
7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

I. *Commercial General Liability—Minimum Policy Limits*

Commercial General Liability	Policy limits of not less than:
Bodily Injury and Property Damage—Each Occurrence	\$1,000,000

- J. *Automobile Liability:* Contractor shall purchase and maintain automobile liability insurance 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 must be written on an occurrence basis.

Automobile Liability	Policy limits of not less than:
Combined Single Limit	
Combined Single Limit (Bodily Injury and Property Damage)	\$1,000,000

Article 7—CONTRACTOR'S RESPONSIBILITIES

7.02 *Supervision and Superintendence*

- SC-7.02 Amend Paragraph 7.02.B of the General Conditions by adding the following sentence:
- Unless the Owner otherwise agrees in writing, the superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

7.03 *Labor; Working Hours*

- SC-7.03 Add the following new subparagraphs immediately after Paragraph 7.03.C:

1. Regular working hours will be Monday through Friday, excluding holidays, occurring between the hours of 7:00 AM and 7:00 PM, unless restricted otherwise. Contractor shall establish a 40-hour work week with regular scheduled work times, e.g., four 10-hour days or five 8-hour days, within the hours and days allowed above. Approval for specific work outside regular scheduled work times shall be requested no less than 48 hours prior to the requested work period. Contractor shall request approval of changes in regular scheduled work times no less than one week prior to the desired change. Occasional unscheduled overtime on weekdays may be permitted provided reasonable notice is given to Engineer .
2. Owner's legal holidays are: New Year's Day, Martin Luther King Day, Memorial Day, Juneteenth, Independence Day, Labor Day, Veterans Day, Thanksgiving, Day After Thanksgiving, Christmas Eve, and Christmas Day.

SC-7.03 Add the following new paragraph immediately after Paragraph 7.03.C:

- D. Contractor shall be responsible for the cost of any overtime pay or other expense incurred by the Owner for Engineer's services (including those of the Resident Project Representative, if any), Owner's representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day. If Contractor is responsible but does not pay, or if 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.

7.10 *Taxes*

SC-7.10 Add a new paragraph immediately after Paragraph 7.10.A:

- A. Owner is exempt from payment of sales and compensating use taxes of the State of **Georgia** and of cities and counties thereof on all materials to be incorporated into the Work.
 - 1. Contractor will furnish the required invoices to Owner for use in the purchase of supplies and materials to be incorporated into the Work, for submittal to the State.

7.13 *Safety and Protection*

SC-7.13 Amend the second sentence of Paragraph 7.13.G by deleting the words "...the Supplementary Conditions or Specifications." and replace with the words Specification Section 01 35 23, Safety Requirements".:

7.14 *Hazard Communication Programs*

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

- B. Contractor shall provide a centralized location for the maintenance of the safety data sheets or other hazard communication information required to be made available by any employer on the Site. Location of the safety data sheets or other hazard communication information shall be readily accessible to the employees of all employers on the Site.

Article 8—**OTHER WORK AT THE SITE**

No suggested Supplementary Conditions in the Article

Article 9—**OWNER'S RESPONSIBILITIES**

No suggested Supplementary Conditions in this Article.

Article 10—**ENGINEER'S STATUS DURING CONSTRUCTION**

10.03 *Resident Project Representative*

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

- C. The Resident Project Representative (RPR) will be Engineer's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Engineer and Contractor. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of Contractor. The RPR will:

1. *Conferences and Meetings:* Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including Contractor's safety meetings), and as appropriate prepare and circulate copies of minutes thereof.
 2. *Safety Compliance:* Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.
 3. *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 Contractor's proper execution of the Work.
 4. *Review of Work; Defective Work*
 - a. Conduct on-Site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02, if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Observe whether any Work in place appears to be defective.
 - c. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection or approval.
 5. *Inspections and Tests*
 - a. Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to those performed by public or other agencies having jurisdiction over the Work.
 - b. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.
 6. *Payment Requests:* Review Applications for Payment with Contractor.
 7. *Completion*
 - a. Participate in Engineer's visits regarding Substantial Completion.
 - b. Assist in the preparation of a punch list of items to be completed or corrected.
 - c. Participate in Engineer's visit to the Site in the company of Owner and Contractor regarding completion of the Work, and prepare a final punch list of items to be completed or corrected by Contractor.
 - d. Observe whether items on the final punch list have been completed or corrected.
- D. The RPR will 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 construction.
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. Authorize Owner to occupy the Project in whole or in part.

Article 11—**CHANGES TO THE CONTRACT**

No suggested Supplementary Conditions in this Article.

Article 12—**CLAIMS**

SC-12.01 Delete Paragraph 12.01.D Mediation in its entirety and renumber subsequent paragraphs.

Article 13—**COST OF WORK; ALLOWANCES, UNIT PRICE WORK**

13.01 *Cost of the Work*

SC-13.01 Supplement Paragraph 13.01.B.5.c.(2) by adding the following sentence:

The equipment rental rate book that governs the included costs for the rental of machinery and equipment owned by Contractor (or a related entity) under the Cost of the Work provisions of this Contract is the most current edition of Rental Rate Blue Book for Construction Equipment, or the AED Green Book: Rental Rates & Specifications for Construction Equipment.

SC-13.01 Supplement Paragraph 13.01.C.2 by adding the following definition of small tools and hand tools:

- a. For purposes of this paragraph, "small tools and hand tools" means any tool or equipment whose current price if it were purchased new at retail would be less than \$500.

Article 14—**TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK**

No suggested Supplementary Conditions in this Article.

Article 15—**PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD**

15.01 *Progress Payments*

SC-15.01 Amend Paragraph 15.01D.1 of the General Conditions by replacing “Ten days” with “Thirty days”.

15.03 *Substantial Completion*

SC-15.03 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, will 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 this Article 15.

Article 16—**SUSPENSION OF WORK AND TERMINATION**

No suggested Supplementary Conditions in this Article.

Article 17—**FINAL RESOLUTIONS OF DISPUTES**

17.01 *Methods and Procedures*

SC-17.01 Amend Paragraph 17.01.B.3 of the General Conditions by adding the following sentence:

The parties agree to submit to the jurisdiction in Georgia, and further agree that any cause of action arising under this agreement shall be required to be brought in the appropriate venue in Fayette County, Georgia.

17.02 *Attorneys’ Fees*

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

17.02 *Attorneys’ Fees*

- A. 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.

Article 18—**MISCELLANEOUS**

SC-18.11 Add the following new paragraph immediately after Paragraph 18.10:

SC-18.11 *Confidential Information*

- A. All Drawings, Specifications, technical data, and other information furnished to Contractor either by Owner or Engineer or developed by Contractor or others in connection with the Work are, and will remain, the property of Owner or Engineer, and shall not be copied or

otherwise reproduced or used in any way except in connection with the Work, or disclosed to third parties or used in any manner detrimental to the interests of Owner or Engineer.

- B. The following information is not subject to the above confidentiality requirements:
 - 1. information in the public domain through no action of Contractor in breach of the Contract Documents; or
 - 2. information lawfully possessed by Contractor before receipt from Owner or Engineer; or
 - 3. information required to be disclosed by Laws or Regulations, or by a court or agency of competent jurisdiction. However, in the event Contractor shall be so required to disclose such information, Contractor shall, prior to disclosure, provide reasonable notice to Owner and Engineer, who shall have the right to interpose all objections Owner may have to the disclosure of such information.
- C. Contractor shall not disclose to any third party the nature of its Work on the Project, nor engage in publicity or public media disclosures with respect to the Project without the prior written consent of Owner.

SECTION 01 11 13

SUMMARY OF WORK

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. This Section includes the following Articles:

<u>Article</u>	<u>Title</u>
1.1	Section Includes
1.2	Location and Description of Work
1.3	Other Construction Contracts
1.4	Work by Others
1.5	Work by OWNER
1.6	Sequence and Progress of Work
1.7	CONTRACTOR's Use of Site
1.8	Easements and Rights-of-Way
1.9	Notices to Owners and Authorities of Properties Adjacent to the Work
1.10	Salvage of Materials and Equipment
1.11	Partial Utilization by OWNER

1.2 LOCATION AND DESCRIPTION OF WORK

- A. The Work is located at the OWNER's Crosstown WTP at 3500 TDK Blvd Peachtree City GA 30269.
- B. The Work to be performed under this Contract includes, but is not limited to, constructing the Work described below and all related appurtenances. The Work includes, but is not limited to the Basis of Bid as listed in **Section 00 41 13 Article 3**
- C. Contracting Method: The Project shall be constructed under one prime Contract.
- D. Hazardous Environmental Conditions:
1. To the best of Owner's knowledge, information, and belief, the prior use of the Site has been a water treatment facility since 1984.

1.3 OTHER CONSTRUCTION CONTRACTS (NOT USED)

1.4 WORK BY OTHERS (NOT USED)

1.5 WORK BY OWNER

- A. OWNER will perform the following in connection with the Work:
 - 1. Operate all existing valves, gates, pumps, equipment, and appurtenances that will affect OWNER's operation, unless otherwise specified or indicated.

1.6 SEQUENCE AND PROGRESS OF WORK

- A. Sequencing:
 - 1. Incorporate sequencing of the Work into the Progress Schedule.
 - 2. Recommended Sequence.
 - a. Construct Bulk Storage Systems and Fill Stations
 - b. Demolish existing equipment/etc. in proposed Fluoride Metering Room
 - c. Construct Fluoride metering equipment and day tank storage
 - d. Startup Fluoride bulk and metering systems
 - e. Demo Existing (now abandoned) Dry Fluoride system and all other equipment in proposed Hypo Metering Room
 - f. Construct Sodium Hypochlorite (Hypo) metering equipment and day tank storage in old Dry Fluoride room
 - g. Startup Hypo bulk and metering systems
 - h. Temporary bypass of the proposed softening system will be required. Bypass not to exceed 30 days.
 - i. Demo Bulk Chlorine Feed & Storage rooms after new Sodium Hypochlorite system has been tested and operational for a minimum of two weeks or once Engineer approval to proceed with construction is provided
 - j. Construct Water Softening System, Hot Water mechanical room and Tepid Water System.
 - k. Startup Water Softening and Tepid Water Systems

1.7 CONTRACTOR'S USE OF SITE

- A. Move stored materials and equipment that interfere with operations of OWNER, and others performing work for OWNER.
- B. CONTRACTOR's use of the Site shall be confined to the areas shown.
- C. Limits on CONTRACTOR's use of the Site are:
 - 1. As indicated in Section 01 14 19, Use of Site.
 - 2. Do not use the Site for operations other than those required for the Project.

1.8 EASEMENTS AND RIGHTS-OF-WAY (NOT USED)

1.9 NOTICES TO OWNERS AND AUTHORITIES OF PROPERTIES ADJACENT TO THE WORK (NOT USED)

1.10 SALVAGE OF MATERIALS AND EQUIPMENT

- A. Existing materials and equipment removed and not shown or specified to be reused in the Work will become CONTRACTOR's property. Contractor to coordinate with Owner prior to removing any equipment
- B. Removal, Storage, Handling, Reinstallation:
 - 1. Carefully remove in manner to prevent damage all materials and equipment shown or indicated to be salvaged and reused or to remain property of OWNER.
 - 2. Store and protect salvaged items shown or indicated to be used in the Work.
 - 3. Replace in-kind or with new items those items of materials and equipment damaged during removal, storage, or handling through CONTRACTOR's actions, negligence, or improper procedures.

1.11 PARTIAL UTILIZATION BY OWNER

- A. Prior to Substantial Completion of the entire Work under the Contract, substantially complete the Work as follows:
 - 1. Refer to milestone requirements in Section 01 13 13 – Milestones for order of work to be complete prior to substantially complete with the entire project.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01 13 13

MILESTONES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section describes Work to be substantially completed to comply with Milestones indicated in the Agreement. This Section is not intended to describe all the Work or its constraints, interrelationships, or sequential requirements required.
2. CONTRACTOR shall provide all labor, materials, equipment, tools, and incidentals required to perform the Work in accordance with the Contract Times provisions of the Contract Documents.
3. To achieve each Milestone indicated in this Section, substantially complete those elements of the Work indicated starting with Article 1.2 of this Section, together with related equipment, systems, and appurtenant Work and activities.
4. Comply with the General Conditions, as may be modified by the Supplementary Conditions, regarding partial utilization and property insurance.

1.2 MILESTONE REQUIREMENTS

A. Milestones:

1. Fluoride System
2. Sodium Hypochlorite System
3. Water Softening System
4. Tepid Water System

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

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SECTION 01 14 16

COORDINATION WITH OWNER'S OPERATIONS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. This Section includes requirements for coordinating with OWNER's operations during the Project and includes requirements for tie-ins and shutdowns necessary to complete the Work without impact on OWNER's operations except as allowed in this Section.
 - 2. CONTRACTOR shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to coordinate with OWNER's operations during the Work in accordance with this Section.
- B. Coordination:
 - 1. Review construction procedures under other Specifications sections and coordinate Work that will be performed with or before the Work specified in this Section.
- C. Related Sections:
 - 1. Section 01 11 13, Summary of Work.
- D. Except for shutdowns specified in this Section, perform the Work such that OWNER's facilities remain in continuous satisfactory operation during the Project. Schedule and conduct the Work such that the Work does not: impede OWNER's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products or effluent, cause odors or other nuisances, or affect the public health, safety, and convenience.
- E. Work not specifically covered in this Section or in referenced Sections may, in general, be completed, within the Contract Times, at any time during regular working hours in accordance with the Contract Documents, subject to the requirements in this Section.
- F. As a substitute to the procedures specified in this Section, CONTRACTOR may propose providing additional temporary facilities that can eliminate or mitigate a constraint without additional cost to OWNER, provided such additional temporary facilities: do not present hazards to the public, personnel, structures, and equipment; that such additional temporary facilities do not adversely affect OWNER's ability to comply with Laws and Regulations, permits, and operating requirements; that such temporary facilities do not generate or foster the generation of odors and other nuisances; and that requirements of the Contract Documents are fulfilled.

- G. Coordinate shutdowns with OWNER and ENGINEER. When possible, combine multiple tie-ins into a single shutdown to reduce impacts on OWNER's operations and processes.
- H. Operation of Existing Systems and Equipment during the Work:
 - 1. Do not shut off or disconnect existing operating systems or equipment, unless accepted by ENGINEER in writing.
 - 2. Operation of existing systems and equipment will be by OWNER unless otherwise specified or indicated.
 - 3. Where necessary for the Work, CONTRACTOR shall seal or bulkhead OWNER-operated gates and valves to prevent leakage that may affect the Work, OWNER's operations, or both.
 - 4. Provide temporary watertight plugs, bulkheads, and line stops as required. After completing the Work, remove seals, plugs, bulkhead, and line stops to satisfaction of ENGINEER.

1.2 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Substitute Sequence Submittal: When deviation from specified sequence or procedures is proposed, furnish submittal explaining in detail the proposed sequence or procedures and associated effects, including evidence that OWNER's operations will not be adversely affected, to an extent greater than originally contemplated in the Contract Documents, by proposed substitution. List benefits of proposed substitution, including benefits to Progress Schedule. Submit in accordance with Section 01 25 00, Substitution Procedures, and other requirements of the Contract Documents regarding substitution requests.
- B. Informational Submittals: Submit the following:
 - 1. Shutdown Planning Submittal:
 - a. For each shutdown, submit an inventory of labor, materials, and equipment required to perform the shutdown, an estimate of time required to accomplish the complete shutdown including time for OWNER to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.
 - b. Furnish submittal to ENGINEER and OWNER not less than seven 10 working days prior to proposed shutdown start date. Do not start shutdown until obtaining ENGINEER and OWNER's acceptance of shutdown planning submittal.
 - 2. Shutdown Notification: After ENGINEER's acceptance of shutdown planning submittal and prior to starting the shutdown, submit written notification to OWNER and ENGINEER of date and time each shutdown is to start. Submit notification not less than 72 hours in advance of each shutdown.

1.3 GENERAL CONSTRAINTS

- A. Indicated in the Contract Documents are the sequence and shutdown durations, where applicable, for OWNER'S equipment, systems, and conduits (including piping and ducting) that are to be taken out of service temporarily for the Work. New materials, equipment, and systems may be used by OWNER after the specified field quality controls and testing are successfully completed and the materials or equipment are Substantially Complete in accordance with the Contract Documents.
- B. The following constraints apply to coordination with OWNER's operations:
 - 1. Operational Access: OWNER'S personnel shall have access to equipment and areas of the facility that remain in operation.
 - 2. Temporary Partitions and Enclosures: Provide temporary partitions and enclosures necessary to maintain dust-free, heated, and ventilated spaces in areas of the facility that are adjacent to the Work and that must be kept operational. Comply with Section 01 51 05, Temporary Utilities.
 - 3. Schedule and perform equipment and system start-ups for Monday through Thursday. Equipment and systems shall not be placed into operation on Friday, Saturday, and Sunday without prior approval of OWNER, unless specifically indicated otherwise in the Contract Documents.
 - 4. Dead End Valves or Conduits: Provide blind flanges, watertight bulkheads, or valve at temporary and permanent terminuses of conduits, including piping and ducting. Blind flanges and bulkheads shall be suitable for the service and braced and blocked, as required, or otherwise restrained as directed by ENGINEER. Temporary valves shall be suitable for their associated service. Where valve is provided at permanent terminus of conduit, including piping or ducting, also provide on downstream side of valve a blind flange with drain/flushing connection.
 - 5. OWNER & ENGINEER will assist CONTRACTOR in dewatering process tanks, basins, conduits, and other work areas to be dewatered for shutdowns. Maintain clean and dry work area by pumping and properly disposing of fluid and other material that accumulates in work areas.
 - 6. Draining and Cleaning of Conduits, Tanks, and Basins:
 - a. Unless otherwise shown or indicated, CONTRACTOR shall dewater process tanks, basins, conduits (including piping) at beginning of each shutdown. Flush, wash down, and clean tanks, basins, conduits (including piping), and other work areas.
 - b. CONTRACTOR shall remove liquids and solids and dispose of them at appropriate location at the Site as directed by ENGINEER. Unless otherwise specified or indicated, contents of tanks, basins, and conduits (including piping) undergoing modifications shall be transferred to existing process tanks or conduits at the Site with capacity sufficient to accept such discharges, using hoses, temporary piping, temporary pumps, or other means provided by CONTRACTOR. Discharge of fluids across floors is not allowed.
 - c. If drainage point is not available on the conduit (including piping) to be drained, provide a wet tap using tapping saddle and valve or other method approved by ENGINEER. Uncontrolled spillage of contents of conduits (including piping) is not allowed.

- d. Spillage shall be brought to ENGINEER's attention immediately, both verbally and in writing, and reported in accordance with Laws and Regulations. CONTRACTOR shall wash down spillage to floor drains or sumps or other appropriate location and flush the system to prevent clogging and odors. If spillage is not suitable for discharge to the drainage system, such as chemical spills, as determined by ENGINEER, CONTRACTOR shall remove spillage by other method, such as vacuum truck, sorbents, or other method acceptable to ENGINEER.

1.4 SEQUENCE OF WORK

- A. Perform the Work in the sequence as specified in Section 01 11 13, Summary of Work.

1.5 TIE-INS

- A. Table 01 14 16-A in this Section lists connections by CONTRACTOR to existing facilities. Table 01 14 16-A may not include all tie-ins required for the Work; CONTRACTOR shall perform tie-ins required to complete the Work as shown or indicated regardless of whether tie-in is indicated in Table 01 14 16-A. For tie-ins not indicated in Table 01 14 16-A, obtain requirements for tie-ins from ENGINEER by requesting an interpretation or clarification.

1.6 SHUTDOWNS

- A. General:
 1. Terminology: A "shutdown" is when a portion of the normal operation of OWNER's facility, whether equipment, systems, conduit (including piping and ducting), has to be temporarily suspended or taken out of service to perform the Work.
 2. Work that may interrupt normal operations shall be accomplished at times convenient to OWNER unless otherwise indicated in the Contract Documents.
 3. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, materials, equipment, spare parts, both temporary and permanent, necessary to successfully perform the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to commencing the associated shutdown. Demonstrate to ENGINEER's satisfaction that CONTRACTOR has complied with such requirements before commencing the shutdown.
 4. If CONTRACTOR's operations cause an unscheduled interruption of OWNER's operations, immediately re-establish satisfactory operation for OWNER.
 5. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of OWNER's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by CONTRACTOR if, in ENGINEER's opinion, CONTRACTOR did not comply with requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in performing the Work and complying with applicable permits, Laws, and Regulations.

8. Work requiring service interruptions shall be performed during scheduled shutdowns.
 10. CONTRACTOR shall coordinate requirements for temporary, short-term shutdowns of smaller conduits (including piping and ducting), equipment, and systems with ENGINEER and OWNER as outlined in 1.2 – SUBMITTALS of this section. Where necessary, obtain ENGINEER's interpretation or clarification before proceeding.
- B. Shutdowns of Electrical Systems:
1. Comply with Laws and Regulations, including the National Electric Code.
 2. CONTRACTOR shall lock out and tag circuit breakers and switches operated by OWNER and shall verify that affected cables and wires are de-energized to ground potential before shutdown Work is started.
 3. Upon completion of shutdown Work, remove the locks and tags and notify ENGINEER that facilities are available for use.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL

- A. In addition to requirements of this Section, comply with Section 01 73 29, Cutting and Patching, and Section 01 73 24, Connections to Existing Facilities, and other Contract Documents applicable to Work associated with shutdowns, tie-ins, temporary pumping (where applicable), and similar work.

3.3 SCHEDULES

- A. The schedules indicated below, attached following this Section's "End of Section" designation, are part of this Specifications Section:
1. Table 01 14 16-A, Schedule of Tie-ins.

++ END OF SECTION ++

TABLE 01 14 16-A SCHEDULE OF TIE-INS					
Tie-In No.	New Line Size and Service	Existing (Connecting) Line Size & Service	Tie-In Building/Location	Construction Stage	Remarks
1	2" – HFSA – PVC	2" FLUORIDE	Chemical Trench in proposed SHC metering room	---	Existing ball valve to be opened after completion of HFSA system
2	1 ½" – PLW – PVC	1 ½" PLANT WATER	Above door in the proposed HFSA metering room	---	---
3	2" – PLW – PVC	6" PLANT WATER	In yard outside of the proposed HFSA bulk storage secondary containment	---	Pot hole and verify location of existing 6" Plant Water prior to ordering equipment. Notify ENGINEER of any discrepancies
4	2" – HW – CU	2" HOT WATER	In the Post – Treatment Chemical building in the hall outside of the electrical room door	---	---
5	2" – PW – CU	2" POTABLE WATER	In the Post – Treatment Chemical building in the Maintenance Area outside of the Phosphate room	---	---

SECTION 01 21 00

CONTINGENCY ALLOWANCES

PART 1 – GENERAL

1.1 SCOPE

- A. Scope:
 - 1. This Section includes administrative and procedural requirements governing contingency allowances:
- B. Authorization of Allowances:
 - 1. Work that will be paid under an allowance will be authorized in Owner's written instruction to Contractor using the form included with this Section or other written allowance authorization issued by Owner.
 - 2. Do not perform Work under an allowance without written authorization of Owner.

1.2 CONTINGENCY ALLOWANCE

- A. Contingency allowances are stipulated amounts available as reserve for sole use by Owner to cover unanticipated costs.
- B. When authorization of Work under contingency allowance is contemplated by Owner for a defined scope, submit Change Proposal to Engineer. Prepare Change Proposal in accordance with the General Conditions and Supplementary Conditions, except those payments within limit of contingency allowance shall exclude cost of bond and insurance premiums.

1.3 SCHEDULE OF ALLOWANCES

- A. Refer to Section 00 41 00 - Bid Form for the Contingency Allowances.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

- A. The document listed below and attached following this Section's "End of Section" designation, are part of this Specification Section.
 - 1. Allowance Authorization Form (one page).

+ + END OF SECTION + +

ALLOWANCE AUTHORIZATION

Project: _____	Authorization Number: _____
_____	From: _____
To: _____	Date: _____
_____	Engineer Project No.: _____
Re: _____	Contract For: _____

You are authorized to perform the following item(s) of Work and to adjust the Contract allowance amount accordingly:

1. [Allowance Title] / [Title of Change]:

THIS IS NOT A CHANGE ORDER AND DOES NOT INCREASE OR DECREASE THE CONTRACT PRICE

Original Allowance	\$ _____
Allowance Expenditures prior to this Authorization.....	\$ _____
Allowance Balance prior to this Authorization.....	\$ _____
Allowance will be decreased by this Authorization.....	\$ _____
New Allowance Balance.....	\$ _____

RECOMMENDED BY

ARCADIS U.S., Inc.
Engineer

By _____ Date _____

OWNER APPROVAL

Owner

By _____ Date _____

CONTRACTOR ACCEPTANCE

Contractor

By _____ Date _____

☐ Attachments

Copies: ☐ Owner ☐ Contractor ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ File

SECTION 01 22 13

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Items listed starting in Article 0 of this Section refer to and are the same pay items listed in the Bid Form and constitute all pay items for completing the Work.
2. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, plant or facility services, CONTRACTOR's or ENGINEER's field offices, layout surveys, Project signs, sanitary requirements, testing, safety provisions and safety devices, submittals and record drawings, water supplies, power and fuel, maintenance of traffic, removal of waste, security, coordination with OWNER's operations, information technology (including hardware, software, and services) required during construction, commissioning where specified, bonds, insurance, or other requirements of the General Conditions, Supplementary Conditions, Division 01 Specifications, and other requirements of the Contract Documents.
3. Compensation for all services, items, materials, and equipment shall be included in prices stipulated for lump sum and unit price pay items listed in this Section and included in the Contract.

B. Each lump sum and unit price, as bid, shall include an amount considered by contractor to be adequate to cover contractor's overhead and profit for each separately identified item.

C. Bid prices included on the bid form shall be full compensation for all materials, labor, equipment, tools, construction equipment and machinery, heat, utilities, transportation, taxes, overhead, markup, incidentals and services necessary for the execution and completion of the work in the contract documents to be performed under this contract. For the work described, the allowance and unit price, actual used and installed quantities of each bid item shall be measured in the field and certified by the engineer and/or owner upon completion of construction in the manner set forth for each item in this and other sections of the specifications. Payment for all items listed on the bid form will constitute full compensation for all work shown and specified to be performed.

1.2 ENGINEER'S ESTIMATE OF QUANTITIES

- A. ENGINEER's estimated quantities for items of Unit Price Work, as included in the Contract, are approximate only and are included solely for purpose of comparing Bids and pricing. OWNER does not expressly or by implication agree that nature

of materials encountered below the ground surface or actual quantities of material encountered or required will correspond with the quantities included in the Contract at the time of award and reserves the right to increase or decrease quantities, and to eliminate quantities, as OWNER may deem necessary.

- B. CONTRACTOR and OWNER will not be entitled to adjustment in unit prices as a result of change in estimated quantity and agree to accept the unit prices accepted in the Bid as complete and total compensation for additions or deletions caused by changes or alterations in the Unit Price Work directed by OWNER.

1.3 RELATED PROVISIONS

- A. Payments to contractor: refer to general conditions, supplementary conditions, agreement, and section 01 29 76, progress payment procedures.
- B. Changes in contract price: refer to general conditions, supplementary conditions, and section 01 26 00, contract modification procedures.
- C. Schedule of values: refer to general conditions, supplementary conditions, and section 01 29 73, schedule of values.

1.4 BID ITEMS

- A. Lump sum payment will be full compensation for completing the work, as shown or indicated under division 01 through division 46, including owner/engineer directed work items.
- B. The following Item No. 1 through 8 comprises the Base Bid Total as listed on the Bid Form
 - 1. Item No. 1 – Yard Piping/ Site Work
 - a. Measurement and Payment: Lump sum payment for Item 1 will be full compensation for all installation of all buried piping, concrete sidewalks, chemical trenching & pull boxes, erosion control measures, and finished grading
 - 2. Item No. 2 – Sodium Hypochlorite Bulk Systems
 - a. Measurement and Payment: Lump sum payment for Item 2 will be full compensation for all work required to accept bulk chemicals including, concrete containment structure, engineered metal structure, access stairs, bulk tanks, fill station, all chemical piping, frost resistant hydrants, chemical transfer pumps & transfer piping to chemical metering room and all required instrumentation and electrical including SCADA integration.
 - 3. Item No. 3 – Sodium Hypochlorite Metering systems
 - a. Measurement and Payment: Lump sum payment for Item 3 will be full compensation for all work required to meter chemicals including demolition of existing equipment & existing wall, construction of concrete containment curbing, day tank & weigh scales, all chemical

piping, metering pump skid, and all required instrumentation and electrical including SCADA integration.

4. Item No. 4 – Fluoride Bulk System
 - a. Measurement and Payment: Lump sum payment for Item 4 will be full compensation for all work required to accept bulk chemicals including, demolition of existing concrete pad, construction of concrete containment structure, access stairs, bulk tanks, fill station, all chemical piping, frost resistant hydrants, chemical transfer pumps & transfer piping to chemical metering room and all required instrumentation and electrical including SCADA integration.
5. Item No. 5 – Fluoride Metering System
 - a. Measurement and Payment: Lump sum payment for Item 5 will be full compensation for all work required to meter chemicals including demolition of existing equipment & existing trench, construction of concrete containment curbing, day tank & weigh scales, all chemical piping & carrier water piping, metering pump skid, and all required instrumentation and electrical including SCADA integration.
6. Item No. 6 – Water Softening System
 - a. Measurement and Payment: Lump sum payment for Item 6 will be full compensation for all work required to deliver softened water including demolition of existing equipment, construction of concrete equipment pad, water softening system, brine tanks, all softened water piping, all plant water piping delivered to the softened water system, and all required instrumentation and electrical including SCADA integration.
7. Item No. 7 – Tepid Water System and Water Heaters
 - a. Measurement and Payment: Lump sum payment for Item 7 will be full compensation for all work required to deliver tepid water & hot water including demolition of existing equipment, construction of water heaters, mixing valves, all tepid water piping, all hot water piping, all potable water piping delivered to the hot water heaters, all eyewash and shower systems, and all required instrumentation and electrical
8. Item No. 8 – HVAC
 - a. Measurement and Payment: Lump sum payment for Item 7 will be full compensation for all work required to improve the HVAC systems including demolition of the existing HVAC systems, construction of new duct work, relocation of the existing outdoor unit, and all required instrumentation and electrical

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION 01 22 13 ++

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope: Section includes:
 - 1. Administrative and procedural requirements for selecting materials and equipment for the Project.
 - 2. Procedural requirements for substitutions of materials and equipment.
 - 3. Procedural requirements for substitute construction methods or procedures, when construction methods or procedures are specified.
- B. A proposed substitute will not be accepted for review if:
 - 1. Approval would require changes in design concept or a substantial revision of the Contract Documents.
 - 2. Approval would delay completion of the Work or the work of other contractors.
 - 3. Substitution request is indicated or implied on a Shop Drawing or other submittal, or on a request for interpretation or clarification, and is not accompanied by CONTRACTOR's formal and complete request for substitution.
- C. If proposed substitute is not approved, CONTRACTOR shall provide the specified materials, equipment, method, or procedure, as applicable.
- D. Approval of a substitute does not relieve CONTRACTOR from requirement for submitting Shop Drawings and other submittals in accordance with the Contract Documents.
- E. ENGINEER and OWNER have the right to rely upon the completeness and accuracy of the information included in CONTRACTOR's request for approval of a substitute, and CONTRACTOR accepts full responsibility for the completeness and accuracy thereof.
- F. When approved substitute is defective or fail to perform in accordance with the Contract Documents, responsibility for remedying the defect or failure resides solely with CONTRACTOR and Supplier.

1.2 SUBSTITUTE MATERIALS AND EQUIPMENT

- A. Requests for approval of substitute items of materials or equipment will be considered within a period of 30 days after the Effective Date of the Contract. After the end of specified period, substitution requests will be considered only in case of

unavailability of a specified item of material or equipment or other conditions beyond CONTRACTOR's control.

B. Procedure:

1. Submit requests for substitution in accordance with requirements for furnishing submittals, as indicated in Section 01 33 00, Submittal Procedures.
2. Submit separate request for each proposed substitute.
3. Submit request for substitution using forms attached to this Section. Complete all information requested on each form, and enclose with the forms supplementary information as required. In addition to requirements of the General Conditions and information required on substitution request forms, include with each substitute request the following:
 - a. Identification of the materials and equipment (as applicable), including manufacturer's name and address.
 - b. Manufacturer's literature with description of the materials and equipment, performance and test data, and reference standards with which materials and equipment comply.
 - c. Samples, when appropriate.
 - d. Name and address of similar projects on which the materials and equipment were used, date of installation, and names and contact information (including telephone number) for the facility operations and maintenance manager.

1.3 SUBSTITUTE CONSTRUCTION METHODS OR PROCEDURES

- A. Where construction methods or procedures are specified, for a period of 30 days after the Effective Date of the Contract, ENGINEER will consider CONTRACTOR's written requests for substitute construction methods or procedures shown or specified in the Contract Documents.
- B. The provisions of the General Conditions, as may be modified by the Supplementary Conditions, regarding substitute items of materials and equipment are hereby extended to apply to substitute construction methods or procedures.
- C. Procedure:
 1. Submit requests for substitution in accordance with requirements for furnishing submittals, as indicated in Section 01 33 00, Submittal Procedures.
 2. Submit separate request for each proposed substitute.
 3. Submit request for substitution using forms attached to this Section. Complete all information requested on each form, and enclose with the forms supplementary information as required. In addition to requirements of the General Conditions and information required on substitution request forms, include with each substitute request the following:
 - a. Detailed description of proposed method or procedure.
 - b. Itemized comparison of the proposed substitution with the specified method or procedure.
 - c. Drawings illustrating method or procedure.

- d. Other data required by ENGINEER to establish that proposed substitution is equivalent to specified method or procedure.

1.4 CONTRACTOR'S REPRESENTATIONS

- A. In submitting request for substitution, CONTRACTOR represents that:
 1. CONTRACTOR has read and fully understands the provisions regarding substitutes as indicated in the General Conditions, as may be modified by the Supplementary Conditions.
 2. Substitution request is complete and includes all information required by the Contract Documents.
 3. CONTRACTOR certifications required by the General Conditions, as may be modified by the Supplementary Conditions, are valid and made with CONTRACTOR's full knowledge, information, and belief.
 4. CONTRACTOR will provide the same or better guarantees or warranties for proposed substitute as for the specified materials, equipment, methods, or procedures, as applicable.
 5. CONTRACTOR waives all Claims for additional costs or extension of time related to proposed substitute that subsequently may become apparent.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

- A. The documents listed below, and attached following this Section's "End of Section" designation, are part of this Specification Section.
 1. Substitution Request Form (two pages).
 2. Product Substitution Checklist (one page).

+ + END OF SECTION + +

SUBSTITUTION REQUEST

Project: _____ Substitution Request Number: _____

To: _____ From: _____

Re: _____ Date: _____

Engineer Project. No. _____
Contract For: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitute: _____
Manufacturer: _____ Address: _____ Phone: _____
Trade Name: _____ Model No.: _____
Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 1 to 4 years old ☐ 5 to 10 years old ☐ More than 10 years old

Differences between proposed substitute and specified item: _____

☐ Point-by-point comparative data attached — REQUIRED BY THE CONTRACT DOCUMENTS

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Engineer: _____
Address: _____ Owner: _____
_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

Savings to Owner for accepting substitute: _____ (\$ _____)
(attach detailed, itemized estimate)

Proposed substitute changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.
(clarify whether change is to Substantial Completion, Milestone, or time for readiness for final payment)

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

SUBSTITUTION REQUEST

(Continued)

☐ Substitute product, method, or procedure is subject to payment of licensing fee or royalty (check if “yes” and attach information)

☐ Substitute product, method, or procedure is patented or copyrighted (check if “yes” and attach information)

The undersigned certifies:

- Representations in the General Conditions and in Section 01 25 00, Substitution Procedures, regarding substitutions are valid.
- Same or better warranty and guarantee will be furnished for proposed substitution as for specified item.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitute will have no adverse effect on other trades and will not affect or delay Progress Schedule.
- Cost data as stated above is complete. Claims for additional costs or time related to accepted substitution which may subsequently become apparent are waived.
- Proposed substitute does not affect dimensions and functional clearances.
- Payment will be made for Engineer’s review and changes, if any, to the design and Contract Documents, and construction costs caused by the substitute.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

Attachments: ☐

ENGINEER’S REVIEW AND ACCEPTANCE (OR NON-ACCEPTANCE) WILL BE DOCUMENTED IN A FIELD ORDER OR CHANGE ORDER, AS APPROPRIATE. _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ Engineer
☐ Other:

PRODUCT SUBSTITUTION CHECKLIST

Date: _____ Re: _____

Engineer Proj No.: _____ Manufacturer's Project No.: _____

Filing No.: _____ Contract For: _____

Item Equivalence:

- ☐ Is the submitted item equivalent to the specified item? _____
- ☐ Does it serve the same function? _____
- ☐ Does it have the same dimensions? _____
- ☐ Does it have the same appearance? _____
- ☐ Will it last as long? _____
- ☐ Does it comply with the same codes, and standards and performance requirements? _____
- ☐ Has the item been used locally, and where are the projects? _____

- ☐ Has a problem occurred with the item, and what was the remedy? _____

Effect on the Project:

- ☐ Will the substitute affect other aspects of the construction? _____
- ☐ Are any details affected and are changes required? _____
- ☐ What is the cost of the changes? _____
- ☐ Who pays for the required changes? _____
- ☐ Are Contract Times affected? _____

Effect on the Warranty:

- ☐ How does the proposed warranty differ from the specified warranty? _____

- ☐ Does the manufacturer have a track record of standing behind the warranty? _____

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope.

1. This Section expands upon provisions of the General Conditions, as may be modified by the Supplementary Conditions, and includes:
 - a. Requests for interpretation.
 - b. Written clarifications.
 - c. Minor changes in the Work and Field Orders.
 - d. Work Change Directives.
 - e. Proposal Requests.
 - f. Change Proposals.
 - g. Change Orders.

B. Submit Contract modification documents to ENGINEER, addressed to the contact person and contact information indicated in Section 01 33 00, Submittal Procedures, and in accordance with Section 01 31 26, Electronic Communication Protocols.

C. Retain at CONTRACTOR's office and at the Site complete copy of each Contract modification document and related documents, and ENGINEER's response.

1.2 REQUESTS FOR INTERPRETATION

A. General.

1. Transmit written requests for interpretation to ENGINEER. CONTRACTOR and OWNER may prepare and transmit requests for interpretation.
2. Prepare and transmit request for interpretation to obtain clarifications or interpretations of the Contract Documents. Report conflicts, errors, ambiguities, and discrepancies in the Contract Documents by requesting an interpretation.
3. Do not transmit request for interpretation when other form of communication is appropriate, such as CONTRACTOR's submittals, requests for approvals of substitutes, notices, ordinary correspondence, or other form of communication. Improperly

prepared or inappropriate requests for interpretation will be returned without response or action by ENGINEER.

4. Do not submit request for interpretation or clarification when:
 - a. answer may be obtained by observations at the Site; or
 - b. required information is clearly indicated in the Contract Documents; or
 - c. required information is included in industry standards referenced in the Contract Documents or Supplier's instructions that are consistent with the Contract Documents; or
 - d. are reasonably inferable from any of foregoing.
5. CONTRACTOR shall have sole financial responsibility for requests for interpretations or clarifications that are submitted late, out of sequence, or that are unnecessary.

B. Procedure.

1. Transmit requests for interpretation in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section. Include with each request for interpretation a separate letter of transmittal.
2. ENGINEER will provide timely review of requests for interpretation. Allow sufficient time for review and response.
3. ENGINEER will maintain log of requests for interpretation. Upon request, copy of log will be transmitted to requestor.
4. ENGINEER's response to requests for interpretation will be transmitted in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section. Each response to a request for interpretation will include a separate letter of transmittal.
5. ENGINEER's written response to each request for interpretation will be distributed to:
 - a. CONTRACTOR.
 - b. OWNER.
 - d. ENGINEER.
6. If ENGINEER requests additional information to make an interpretation, entity requesting the interpretation shall transmit the information requested within ten days, unless ENGINEER allows additional time, via correspondence referring to request for interpretation number.

7. Interpretations that One or Both Parties Believes Entails a Change to the Contract:
 - a. If CONTRACTOR or OWNER believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of ENGINEER's interpretation, so advise ENGINEER in writing before proceeding with the Work associated with the request for interpretation.
 - b. If, after this initial communication, either OWNER or CONTRACTOR believes that change in Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
- C. Preparation of Requests for Interpretation:
 1. Prepare each request for interpretation on the "Request for Interpretation" form included with this Section, or other form acceptable to ENGINEER.
 2. Number each request for interpretation as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First request for interpretation on the general contract for project titled, "Contract A15" would be, "RFI No. A15-GC-001".
 3. In space provided on form, describe the interpretation requested. Provide additional sheets as necessary. Include text and sketches as required in sufficient detail to describe the need for an interpretation.
 4. When applicable, request for interpretation shall include CONTRACTOR's recommended resolution.

1.3 WRITTEN CLARIFICATIONS

- A. General:
 1. Written clarifications, when required, will be initiated and issued by ENGINEER.
 2. Written clarifications do not change the Contract Price or Contract Times, and do not alter the Contract Documents.
 3. Written clarifications will be issued as correspondence or using clarification notice form, with additional information as required.
- B. Procedure.
 1. ENGINEER's written clarifications will be transmitted in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section.

2. Each written clarification will be distributed to:
 - a. CONTRACTOR.
 - b. OWNER.
 - d. ENGINEER.
3. Written Clarifications that One or Both Parties Believes Entails a Change to the Contract:
 - a. If CONTRACTOR or OWNER believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of ENGINEER's written clarification, so advise ENGINEER in writing before proceeding with the Work associated with the written clarification.
 - b. If, after this initial communication, either OWNER or CONTRACTOR believes that change in Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
4. If ENGINEER's written clarification is unclear, prepare and transmit a request for interpretation.

1.4 MINOR CHANGES IN THE WORK AND FIELD ORDERS

A. General:

1. Field Orders, when required, will be initiated and issued by ENGINEER.
2. Field Orders authorize minor variations in the Work but do not change the Contract Price or Contract Times.
3. Field Orders will be in the form of Engineers Joint Contract Documents Committee document EJCDC® C-942, "Field Order".
4. ENGINEER will maintain a log of Field Orders issued.

B. Procedure.

1. Field Orders will be transmitted in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section. Each Field Order will include a separate letter of transmittal.
2. Each Field Order will be distributed to:
 - a. CONTRACTOR.
 - b. OWNER.
 - d. ENGINEER.
3. Field Orders that One or Both Parties Believes Entails a Change to the Contract Price or Contract Times:

- a. If CONTRACTOR or OWNER believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of a Field Order, so advise ENGINEER in writing before proceeding with the Work associated with the Field Order.
 - b. If, after this initial communication, CONTRACTOR believes that change in Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
4. If the Field Order is unclear, submit request for interpretation.

1.5 WORK CHANGE DIRECTIVES

A. General:

1. Work Change Directives, when required, order additions, deletions, or revisions to the Work.
2. Work Change Directives do not change the Contract Price or Contract Times but are evidence that the parties to the Contract expect that the change ordered or documented by the Work Change Directive will be incorporated in subsequently issued Change Order following agreement by the parties as to the Work Change Directive's effect, if any, on the Contract Price or Contract Times..
3. Work Change Directives will be in the form of EJCDC® C-940, "Work Change Directive".

B. Procedure.

1. Work Change Directives signed by OWNER and ENGINEER will be transmitted in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section. Each Work Change Directive will include a separate letter of transmittal. CONTRACTOR shall print three originals of Work Change Directive for CONTRACTOR's signature.
2. CONTRACTOR shall promptly sign each original Work Change Directive and, within five days of receipt, return all originals to ENGINEER.
3. Original, signed Work Change Directives will be distributed as follows:
 - a. CONTRACTOR: One original.
 - b. OWNER: One original.
 - c. ENGINEER: One original.
4. One copy of each Work Change Directive will be distributed to:
 - a. Resident Project Representative (RPR).

5. Documentation of Costs:

- a. When basis of payment for Work ordered under a Work Change Directive will be paid as Cost of the Work, or when otherwise required by ENGINEER, document for the Work performed under each separate Work Change Directive, for each day, the following:
 - 1) Number and labor classifications of workers employed and hours worked.
 - 2) Construction equipment used including manufacturer, model, and year of manufacture, and number of hours such equipment was onsite and used for the Work under the Work Change Directive.
 - 3) Consumables and similar materials used.
 - 4) Receipts, bills, or invoices for and descriptions of materials and equipment incorporated into the Work.
 - 5) Invoices and labor and equipment breakdowns for Subcontractors and Suppliers.
 - 6) Other information required by OWNER or ENGINEER,
- b. Submit such information in a format acceptable to ENGINEER.
- c. Transmit such documentation to ENGINEER as a Change Proposal.

1.6 PROPOSAL REQUESTS

A. General:

1. Proposal Requests may be initiated by ENGINEER or OWNER.
2. Proposal Requests are for requesting the effect on the Contract Price and the Contract Times and other information relative to contemplated changes in the Work. Proposal Requests do not authorize changes or variations in the Work, and do not change the Contract Price or Contract Times or terms of the Contract.
3. Proposal Requests will be furnished using the "Proposal Request" form included with this Section.

B. Procedure.

1. Proposal Requests will be transmitted in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section. Each Proposal Requests will include a separate letter of transmittal.

2. Each signed Proposal Request will be transmitted to:
 - a. CONTRACTOR.
 - b. OWNER.
 - d. ENGINEER.
3. Transmit request for interpretation to clarify conflicts, errors, ambiguities, and discrepancies in Proposal Request.
4. Upon receipt of Proposal Request, CONTRACTOR shall prepare and transmit to ENGINEER a Change Proposal, in accordance with the Contract Documents, for the proposed Work described in the Proposal Request.

1.7 CHANGE PROPOSALS

A. General.

1. Prepare and transmit written Change Proposal to ENGINEER in response to each Proposal Request; or when CONTRACTOR believes a change in the Contract Price or Contract Times or other change to the terms of the Contract is required; or to 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.

B. Procedure.

1. Prepare and transmit Change Proposals within time limits indicated in the General Conditions, as may be modified by the Supplementary Conditions.
2. Transmit Change Proposals in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section. Include with each Change Proposal all required supporting documentation and a separate letter of transmittal.
3. ENGINEER's Review and Requests for Additional Information:
 - a. ENGINEER will review and act on each Change Proposal in accordance with, and within the time limits indicated in, the General Conditions, as may be modified by the Supplementary Conditions.
 - b. When ENGINEER requests additional information to render a decision, submit required information within five days of receipt of ENGINEER's request, unless ENGINEER allows more time. Submit the required information via correspondence that refers to the specific Change Proposal number.

- c. OWNER shall transmit to ENGINEER such comments, if any, that OWNER has on the Change Proposal, within 10 days of OWNER's receipt of the Change Proposal.
 - d. ENGINEER will render a written decision on the Change Proposal.
 - e. ENGINEER's response to Change Proposals will be transmitted in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section, the General Conditions, and the Supplementary Conditions.
 - 4. ENGINEER's response to each Change Proposal will be distributed to:
 - a. CONTRACTOR.
 - b. OWNER.
 - d. ENGINEER.
 - 5. If Change Proposal is recommended for approval by ENGINEER and is approved by OWNER, a Change Order will be issued or, when applicable, an appropriate use of contingency allowance will be authorized by OWNER.
 - 6. If parties do not agree on terms for the change, OWNER or CONTRACTOR may file a Claim against the other, in accordance with the General Conditions, as may be modified by the Supplementary Conditions.
- C. Preparation of Change Proposals:
- 1. Each Change Proposal shall be submitted on the "Change Proposal" form included with this Section, or other form acceptable to ENGINEER.
 - 2. Number each Change Proposal as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First Change Proposal for the general contract for project named "Contract A15" would be, "Change Proposal No. A15-GC-001".
 - 3. In space provided on Change Proposal form:
 - a. Describe scope of each proposed change. Include text and sketches on additional sheets as required to provide detail sufficient for ENGINEER's review and response. If a change item is submitted in response to Proposal Request, write in as scope, "In accordance with Proposal Request No." followed by the Proposal Request number. Submit written clarifications, if any, to scope of change.

- b. Submit justification for each proposed change. If change is in response to proposal request, write in as justification, "In accordance with Proposal Request No." followed by the proposal request number.
 - c. List the total change in the Contract Price and Contract Times for each separate change item included in the Change Proposal.
- 4. Unless otherwise directed by ENGINEER, attach to the Change Proposal detailed breakdowns of pricing (Cost of the Work and CONTRACTOR's fee) including:
 - a. List of Work tasks to accomplish the change.
 - b. For each task, labor cost breakdown including labor classification, total hours per labor classification, and hourly cost rate for each labor classification.
 - b. Construction equipment and machinery to be used, including manufacturer, model, and year of manufacture, and number of hours for each.
 - c. Detailed breakdown of cost of materials and equipment to be incorporated into the Work, including quantities, unit costs, and total cost, with Supplier's written quotations.
 - d. Breakdowns of the Cost of the Work and fee for Subcontractors, including labor, construction equipment and machinery, and materials and equipment incorporated into the Work, other costs, and Subcontractor fees (e.g., overhead and profit).
 - e. Breakdown of other costs eligible, in accordance with the General Conditions and the Supplementary Conditions under "Cost of the Work" provisions.
 - f. Other information required by ENGINEER.
 - g. CONTRACTOR's fees applied to eligible CONTRACTOR costs and eligible Subcontractor costs.

1.8 CHANGE ORDERS

A. General:

- 1. Change Orders will be recommended by ENGINEER (when required by the General Conditions), and will be signed by OWNER and CONTRACTOR, to authorize additions, deletions, or revisions to the Work, or changes to the Contract Price or Contract Times.
- 2. Change Orders will be in the form of EJCDC® C-941, "Change Order".

B. Procedure.

1. Change Orders for signature by CONTRACTOR will be transmitted in accordance with Section 01 31 26, Electronic Communication Protocols, and requirements of this Section. Each Change Order will include a separate letter of transmittal. CONTRACTOR shall print three originals of Change Order for CONTRACTOR's signature.
2. CONTRACTOR shall promptly sign each original Change Order and, within five days of receipt, return all originals to ENGINEER.
3. ENGINEER will sign each original Change Order and forward them to OWNER.
4. After approval and signature by OWNER, original Change Orders will be distributed as indicated below.
5. Original, signed Change Orders will be distributed as follows:
 - a. CONTRACTOR: One original.
 - b. OWNER: One original.
 - c. ENGINEER: One original.
6. One copy of each Change Order will be distributed to:
 - a. Resident Project Representative (RPR).

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

- A. The forms listed below, following this Section's "End of Section" designation, are part of this Specifications Section:
 1. Request for Interpretation form (one page).
 2. Proposal Request form (one page).
 3. Change Proposal form (one page).

END OF SECTION 01 26 00

REQUEST FOR INTERPRETATION

Owner: _____

Project _____ Name: _____

Contractor: _____ RFI _____ No. _____

Date Transmitted: _____ Date _____ Received: _____

Date Response Requested: _____ Date Response Transmitted: _____

Subject: _____

Specification Section and Paragraph: _____

Drawing References: _____

INTERPRETATION REQUESTED:

Signature: _____ Date: _____

ENGINEER'S RESPONSE:

Signature: _____

Date:

PROPOSAL REQUEST

Owner:

Project _____ Name: _____

Proposal Request No.: _____ Date: _____

Contract Name and No.: _____

Contractor: _____

Other Contracts Involved in Proposed Change:

TO CONTRACTOR: Please submit a complete Change Proposal for the proposed modifications described below. If the associated Change Proposal is approved, a Change Order or allowance authorization will be issued to authorize adjustment so the scope of the Work. This Proposal Request is not a Change Order, Work Change Directive, Field Order, or an authorization to proceed with the proposed Work described below.

SCOPE OF PROPOSED WORK:

1. *Item:*
2. *Item:*
3. *Item:*

Proposal requested by: _____

Signature

of

Requestor:

CHANGE PROPOSAL

Owner:

Project _____ Name: _____

Change Proposal No.: _____ Date: _____

Submitted in Response to Proposal Request No.: _____

Contract Name and No.: _____

Contractor: _____

Subject: _____

The following changes to the Contract are proposed:

SCOPE OF WORK: *(attach and list supporting information as required)*

1. *Item:*
2. *Item:*

JUSTIFICATION:

1. *Item:*
2. *Item:*

CHANGES IN CONTRACT PRICE AND CONTRACT TIMES:

We propose that the Contract Price and Contract Times be changed as follows:

For Contract Price, attach detailed cost breakdowns for Contractor and Subcontractors, Supplier quotations, and other information required.

For the Contract Times, state increase, decrease, or no change to Contract Times for Substantial Completion, readiness for final payment, and Milestones, if any. If increase or decrease, state specific number of days for changes to the Contract Times.

Description	Amount	Contract Times (days)	
		Substantial	Final
1. Item	\$0.00	0	0
2. Item	\$0.00	0	0
Total This Change Proposal	\$0.00	0	0

Changes to Milestones, if any:

Contractor represents that supporting data attached to this Change Proposal are accurate and complete. The requested time or price adjustment indicated in this Change Proposal is the entire adjustment to which Contractor believes it is entitled as a result of the proposed change(s) indicated herein.

Change Proposal by: _____

Signature of Proposer:

SECTION 01 29 73

SCHEDULE OF VALUES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall prepare and submit to ENGINEER for acceptance a Schedule of Values that allocates cost to each item of the Work. Schedule of Value list of line items shall correspond to each aspect of the Work, establishing in detail the portion of the Contract Price allocated to each major component of the Work.
2. Upon request of ENGINEER, support values with data that substantiate their correctness.
3. Submit preliminary Schedule of Values to ENGINEER for initial review. CONTRACTOR shall incorporate ENGINEER's comments into the Schedule of Values and resubmit to ENGINEER. ENGINEER may require corrections and re-submittals until Schedule of Values is acceptable.
4. Schedule of Values may be used as a basis for negotiating price of changes, if any, in the Work.
5. Schedule of Values and the Progress Schedule updates specified in Section 01 32 16, Progress Schedule, will be basis for preparing each Application for Payment.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Submit to ENGINEER Schedule of Values in the form and quantity required in Section 01 33 00, Submittal Procedures, and in accordance with Section 01 31 26, Electronic Communication Protocols.
2. Content of Schedule of Values submittals shall be in accordance with Article 1.3 of this Section.
3. Timing of Submittals:
 - a. Submit preliminary Schedule of Values within time limit indicated in the General Conditions.
 - b. Submittal of the Schedule of Values for acceptance by ENGINEER shall be in accordance with the General

Conditions. ENGINEER will not accept Applications for Payment without an acceptable Schedule of Values.

- c. When required by ENGINEER, promptly submit updated Schedule of Values to include cost breakdowns for changes in the Contract Price.

1.3 SCHEDULE OF VALUES FORMAT AND CONTENT

A. Organization and Major Elements of Schedule of Values

1. Prepare Schedule of Values on the “progress estimate” or “continuation sheets”, as applicable, of the Application for Payment form indicated in Section 01 29 76, Progress Payment Procedures.
2. Organization in Accordance with Specification Sections:
 - a. Within each work area, organize the Schedule of Values by the various Specifications Section numbers and titles included in the Contract Documents.
 - b. Label each row in the Schedule of Values with the appropriate Specifications Section number. Include an amount for each row in the Schedule of Values.
 - c. List sub-items of major products or systems, as appropriate or when requested by ENGINEER.
3. Include in Schedule of Values unit price payment items with their associated quantity. Provide in the Schedule of Values detailed breakdown of unit prices when required by ENGINEER.

B. Requirements for preliminary Schedule of Values and Schedule of Values are:

1. Subcontracted Work:
 - a. Schedule of Values shall show division of Work between CONTRACTOR and Subcontractors.
 - b. Line items for Work to be done by Subcontractor shall include the word, “(SUBCONTRACTED)”.
2. Apportionment between Materials and Equipment, and Installation:
 - a. Schedule of Values shall include breakdown of costs for materials and equipment, installation, and other costs used in preparing the Bid by CONTRACTOR and each Subcontractor.
 - b. List purchase and delivery costs for materials and equipment for which CONTRACTOR may apply for payment as stored materials.

3. Sum of individual values shown on the Schedule of Values shall equal the total of associated payment item. Sum of payment item totals in the Schedule of Values shall equal the Contract Price.
4. Overhead and Profit: Include in each line item a directly proportional amount of CONTRACTOR's overhead and profit. Do not include overhead and profit as separate item(s).
5. Include separate line item for each allowance, and for each unit price item.
6. Bonds and Insurance Costs: Include line item for bonds and insurance in amount not exceeding 2.0 percent of the Contract Price. This amount may be applied for in the first Application for Payment.
7. Include relevant items for the General Conditions, permits (when applicable), construction Progress Schedule, and other items required by ENGINEER. Include such items in Applications for Payment on payment schedule acceptable to ENGINEER.
8. Line items for Site maintenance such as dust control, snow removal, compliance with storm water pollution prevention plans and permits, spill prevention control and countermeasures plans, and for construction photographic documentation; temporary utilities and temporary facilities, field offices, temporary controls, field engineering, and similar Work shall be included in the Schedule of Values and proportioned in Applications for Payment throughout duration of the Work.
9. Mobilization and Demobilization:
 - a. Include separate line items under each appropriate payment item for mobilization and demobilization. Document for ENGINEER the activities included in mobilization and demobilization line items.
 - b. Mobilization will be limited to 2 percent of the Contract Price, and will be paid in one payment, of 100 percent of total amount for mobilization.
 - c. Demobilization shall be not less than 1%percent of the Contract Price and shall be included with the Application for Payment following Substantial Completion, or other schedule acceptable to ENGINEER.
10. Costs for Shop Drawings, Samples, and other submittals; operations and maintenance manuals; field testing; and training of operations and maintenance personnel shall be as follows, unless otherwise accepted by ENGINEER:
 - a. Up to eight percent of cost (including all associated overhead and profit) of each equipment item, exclusive of

transportation and installation costs associated with that item, may be allocated to preparation of Shop Drawings, Samples, and other submittals and may be included in the Application for Payment following ENGINEER's approval of Shop Drawings (and acceptance of other submittals, as applicable) required for fabricating or purchasing for that item for the Work.

- b. Up to three percent of total cost of each item (including all associated overhead and profit), including materials and equipment, and installation, may be apportioned to testing and included in the Application for Payment following ENGINEER's acceptance of the associated written field testing report(s).
 - c. Up to a total of four percent of equipment cost (including all associated overhead and profit), exclusive of transportation and installation costs, may be apportioned to operations and maintenance manuals and training of operations and maintenance personnel, which may be included in the Application for Payment following completion of training for that item.
- 11. Project Record Documents:
 - a. Include in the Schedule of Values a line item with appropriate value for Project record documents.
 - b. If adequate record documents are maintained, up to 50 percent of the value of the record documents line item will be eligible for payment, spread evenly over those progress payments in which construction at the Site is performed.
 - c. Remainder of Project record documents line item will be eligible for payment when complete record documents are submitted in accordance with the Contract Documents. If record documents submitted are unsatisfactory to ENGINEER, amount may be reduced via set-offs in accordance with the Contract Documents.
- 12. Schedule of Values shall include an itemized list of Work by work area, as applicable, for Work included in Section 01 14 16, Coordination with Owner's Operations.
- 13. Coordinate Schedule of Values with cost-loading of the Progress Schedule, in accordance with Section 01 32 16, Progress Schedule.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 29 76

PROGRESS PAYMENT PROCEDURES

PART 1 – GENERAL

1.1 PROGRESS PAYMENTS

A. Scope:

1. CONTRACTOR's requests for payment shall be in accordance with the Agreement, General Conditions and Supplementary Conditions, and the Specifications.
2. Form: Applications for Payment shall be in the form of Engineers Joint Contract Documents Committee (EJCDC) document EJCDC® C-620, "Contractor's Application for Payment", 2013 edition or later.

B. Procedure:

1. Review with Resident Project Representative (RPR) quantities and the Work proposed for inclusion in each progress payment. Application for Payment shall cover only the Work and quantities recommended by the RPR.
2. CONTRACTOR will be required to review with ENGINEER or RPR the status of record documents in connection with ENGINEER's review of each Application for Payment. Failure to maintain record document current will be just cause for ENGINEER to recommend a reduction in payment for record documents in accordance with Section 01 29 73, Schedule of Values, and will entitle OWNER to set-offs in accordance with the Contract Documents.
3. Submit to ENGINEER printed originals, each with CONTRACTOR's original, "wet" signature, of each complete Application for Payment and other documents to accompany the Application for Payment.
4. ENGINEER will act on request for payment in accordance with the General Conditions and Supplementary Conditions.

C. Each request for progress payment shall include:

1. Completed Application for Payment form, including summary/signature page, progress estimate sheets, and stored materials summary. Progress estimate sheets shall have the same level of detail as the Schedule of Values.
2. Documentation for Stored Materials and Equipment:
 - a. For materials and equipment not incorporated in the Work but suitably stored, submit documentation in accordance with the General Conditions and Supplementary Conditions.
 - b. UCC-1 Financial Statement:
 - 1) For each lot or delivery of stored materials and equipment for which payment is requested prior to installation of the item(s) at the Site, complete UCC-1, "Financial Statement" form. On UCC-1 form,

- indicate OWNER as “security party”; indicate Supplier as “debtor” when stored item(s) are in Supplier’s custody, and indicate CONTRACTOR as “debtor” when stored item(s) are in CONTRACTOR’s custody; and clearly indicate in detail all stored item(s) included in the filing as “collateral” on the form. Include attachments to the form when necessary to clearly and fully indicate in detail the associated “collateral”.
- 2) File completed UCC-1 form with the secretary of state in the state where the subject item(s) are stored.
 - 3) Include with Application for Payment the completed UCC-1 form together with evidence of filing with the required state(s). Submit UCC-1 form and related documentation once for each lot or delivery of stored items.
- c. Photographs of the stored items at the storage location, in accordance with requirements for progress photographs in Section 01 32 33, Photographic Documentation. Submit photographs sufficient to clearly indicate each stored item, clearly showing marking of OWNER’s property in accordance with Paragraph 1.2.C.1 of this section. Such photographs do not count as photographs required under Section 01 32 33, Photographic Documentation. For each month that such item(s) are stored, take and submit monthly new photographs of each stored item.
 - d. Legibly indicate on invoice or bill of sale the specific stored materials or equipment included in the payment request and corresponding bid/payment item number for each and the Supplier price for each item.
3. For Payment on the Basis of Cost of the Work Plus a Fee.
 - a. When Work included in an Application for Payment will be compensated on the basis of Cost of the Work plus a fee, whether when the entire Contract is compensated on the basis of Cost of the Work plus a fee or when the Application for Payment includes Change Order Work to be compensated on the basis of Cost of the Work plus a fee, the Application for Payment shall include documentation of the costs, including not less than the following:
 - 1) Number and labor classifications of workers employed and hours worked.
 - 2) Construction equipment used including manufacturer, model, and year of manufacture, and number of hours such equipment was onsite and used for the Work compensated on the basis of Cost of the Work.
 - 3) Consumables and similar materials used.
 - 4) Receipts, bills, or invoices for and descriptions of materials and equipment incorporated into the Work.
 - 5) Invoices and labor and equipment breakdowns for Subcontractors, and Suppliers’ onsite time, if any.
 - 6) Invoices for other expenses included in the Application for Payment, such as travel and subsistence expenses, costs for bonds and insurance,

- and all other costs and expenses for which compensation is sought in the subject Application for Payment on the basis of Cost of the Work.
- 7) Other information required by OWNER or ENGINEER,
- b. Costs for which progress payment is requested on the basis of Cost of the Work plus a fee and for which documentation acceptable to ENGINEER is not submitted will not be eligible for payment.
5. Listing of Subcontractors and Suppliers:
- a. In accordance with the General Conditions, submit not less than monthly updated listing of all Subcontractors and Suppliers known to CONTRACTOR, whether or not such entities have a contract directly with CONTRACTOR.
 - b. Submit complete information using the form attached to this Section.
6. Allowance Work:
- a. For payment requests that include payment for Work under an allowance, include with the progress payment request copy of OWNER's authorization of the associated allowance Work, in accordance with Section 01 21 00, Allowances.
7. Partial Release or Reduction of Retainage:
- a. For each Application for Payment where CONTRACTOR requests partial release or reduction of retainage in any amount (other than request for final payment), submit with associated progress payment request consent of surety to partial release or reduction of retainage, duly completed by CONTRACTOR and surety.
 - b. Acceptable form includes AIA® G707A™, "Consent of Surety to Reduction in or Partial Release of Retainage", 1994 or later edition, or other form acceptable to OWNER.
 - c. For payment requests that include reduction in or payment of retainage in an amount greater than that required by the Contract Documents, obtain OWNER's concurrence for partial release or reduction in retainage prior to submitting such Application for Payment.

D. Final Payment:

- 1. Requirements for request for final payment are in the General Conditions, as may be modified by the Supplementary Conditions, and Section 01 77 19, Closeout Requirements.

1.2 PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Restrictions:

- 1. Provisions of the General Conditions, as may be modified by the Supplementary Conditions, notwithstanding, only the following items of materials or equipment will be eligible for payment when suitably stored, prior to incorporation into the Work.

B. Observation of Stored Materials and Equipment Prior to Application for Payment:

1. General:
 - a. Prior to materials or equipment suitably stored but not yet incorporated into the Work can be eligible for payment, ENGINEER or Resident Project Representative (RPR) shall visit the storage location and verify the extent, condition, and storage environment of the stored items.
 - b. When the same material or equipment item is stored for more than two months, such visits to storage location shall be not less than once every two months.
 2. Cost Responsibility for Observations:
 - a. When storage location is less than 20 miles from the Site or less than 20 miles from ENGINEER's office, CONTRACTOR is not responsible for reimbursing OWNER for cost of ENGINEER's time and expenses for observing stored materials and equipment.
 - b. When storage location is more than 20 miles from the Site and more than 20 miles from ENGINEER's office, CONTRACTOR shall reimburse OWNER, via a set-off under the Contract Documents, for cost of ENGINEER's time and expenses, including travel time, to visit the storage location and observe the stored materials and equipment.
- B. Observation of Stored Materials and Equipment Prior to Application for Payment:
1. General:
 - a. Prior to materials or equipment suitably stored but not yet incorporated into the Work can be eligible for payment, ENGINEER or Resident Project Representative (RPR) shall visit the storage location and verify the extent, condition, and storage environment of the stored items.
 - b. When the same material or equipment item is stored for more than two months, such visits to storage location shall be not less than once every two months.
 2. Cost Responsibility for Observations:
 - a. When storage location is less than 20 miles from the Site or less than 20 miles from ENGINEER's office, CONTRACTOR is not responsible for reimbursing OWNER for cost of ENGINEER's time and expenses for observing stored materials and equipment.
 - b. When storage location is more than 20 miles from the Site and more than 20 miles from ENGINEER's office, CONTRACTOR shall reimburse OWNER, via a set-off under the Contract Documents, for cost of ENGINEER's time and expenses, including travel time, to visit the storage location and observe the stored materials and equipment.
- C. Other Requirements for Stored Items: Regardless of storage location, perform the following for stored materials and equipment for which payment is sought:
1. Clearly mark each stored container, crate, or item as follows: "Property of Gwinnett County DWR" using permanent marking. Such marking shall not blemish or deface the finish of items that will be exposed to view after installation at the Site.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

A. The forms listed below, following this Section's "End of Section" designation, are part of this Specification Section:

1. List of Subcontractors and Suppliers form (two pages).

+ + END OF SECTION + +

LIST OF SUBCONTRACTORS AND SUPPLIERS

Owner: _____

Project Name: _____

Contractor: _____ Date: _____

Contract Designation: _____

Indicate below complete information for each Subcontractor and Supplier known to Contractor, regardless of whether the firm has a direct contract with Contractor. Include all lower-tier Subcontractors and associated Suppliers. Copy and paste the paragraphs below as required to indicate all Subcontractors and Suppliers.

SUBCONTRACTORS

1. Subcontractor Name:

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Work Under Specifications Section Nos.:*
- *Brief Description of Work:*
- *Current Subcontract Price:*
- *Approximate Subcontract Start Date:*
- *Approximate Subcontract End Date:*

2. Subcontractor Name:

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Work Under Specifications Section Nos.:*
- *Brief Description of Work:*
- *Current Subcontract Price:*
- *Approximate Subcontract Start Date:*
- *Approximate Subcontract End Date:*

3. Subcontractor Name:

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Work Under Specifications Section Nos.:*
- *Brief Description of Work:*
- *Current Subcontract Price:*
- *Approximate Subcontract Start Date:*
- *Approximate Subcontract End Date:*

Total of Subcontract Prices for all subcontracts equals approximately ____ percent of the Contract Price (*Contractor to fill in blank monthly*)

SUPPLIERS

1. Supplier Name:

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Furnishing Items Under Specifications Section Nos.:*
- *Brief Description of Items:*
- *Current Purchase Order Amount:*
- *Approximate Purchase Order Date:*
- *Approximate Purchase Order End Date:*

2. Supplier Name:

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Furnishing Items Under Specifications Section Nos.:*
- *Brief Description of Items:*
- *Current Purchase Order Amount:*
- *Approximate Purchase Order Date:*
- *Approximate Purchase Order End Date:*

3. Supplier Name:

- *Address:*
- *Contact Person:*
- *Telephone No.:*
- *E-mail Address:*
- *Furnishing Items Under Specifications Section Nos.:*
- *Brief Description of Items:*
- *Current Purchase Order Amount:*
- *Approximate Purchase Order Date:*
- *Approximate Purchase Order End Date:*

SECTION 01 31 13

PROJECT COORDINATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall coordinate the Work, including testing agencies whether hired by CONTRACTOR, OWNER, or others; Subcontractors, Suppliers, and others with whom coordination is necessary, in accordance with the General Conditions, Supplementary Conditions, and this Section, to perform the Work within the Contract Times and in accordance with the Contract Documents.

B. Coordination:

In accordance with the General Conditions as may be modified by the Supplementary Conditions, CONTRACTOR shall cooperate with and coordinate the Work with other contractors, utility owners, utility service companies, OWNER's and facility manager's employees working at the Site, and other entities working at the Site, in accordance with Section 01 11 13, Summary of Work.

2. CONTRACTOR will not be responsible or liable for damage unless damage is through negligence of CONTRACTOR, or Subcontractors, Supplier, or other entity employed by CONTRACTOR.
3. Attend and participate in all project coordination and progress meetings, and report on the progress of the Work and compliance with the Progress Schedule.

C. Layout and Coordination Drawings:

1. Maintain sufficient competent personnel, drafting and computer-aided drafting/design (CADD) equipment, software, systems, and supplies for preparing layout drawings, coordination drawings, and record documents.
2. With the Contract Documents and Shop Drawings, use such coordination drawings as tools for coordinating the Work of various trades.
3. Where such coordination drawings are to be prepared by mechanical, electrical, plumbing, or heating-ventilating-air conditioning Subcontractors and other Subcontractors, ensure that each Subcontractor maintains required personnel and facilities at the Site.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 31 18

PRE-CONSTRUCTION CONFERENCE

PART 1. - GENERAL

1.1 DESCRIPTION

A. Scope:

1. A pre-construction conference will be held for the Project.
2. CONTRACTOR shall attend the conference prepared to discuss all items on the pre-construction conference agenda.
3. ENGINEER will distribute an agenda, preside at conference, and prepare and distribute minutes to all conference participants and others as requested.

B. Purpose of Pre-construction Conference:

1. Purpose of conference is to designate responsible personnel, establish working relationships, discuss preliminary schedules submitted by CONTRACTOR, and review administrative and procedural requirements for the Project.
2. Matters requiring coordination will be discussed and procedures for handling such matters will be established.
3. Unless otherwise indicated in the Contract Documents or otherwise agreed to by the entities involved, Site mobilization meeting will be part of the pre-construction conference.

1.2 PREPARATION FOR PRE-CONSTRUCTION CONFERENCE

A. Date, Time, and Location:

1. Conference will be held after execution of the Contract and before Work starts at the Site.
2. ENGINEER will establish the date, time, and location of conference and notify the interested and involved entities.

C. Submittals Required Prior to Pre-construction Conference:

1. Not less than three days prior to pre-construction conference, submit the following preliminary schedules in accordance with the General Conditions and other requirements of the Contract Documents:
 - a. Preliminary Progress Schedule.
 - b. Preliminary Schedule of Submittals.
 - c. Preliminary Schedule of Values.

- d. Listing of identity and general scope of Work or supply (as applicable) of planned Subcontractors and Suppliers. Indicate extent of each Subcontract proposed and overall percentage of Contract Price to be subcontracted.
- D. CONTRACTOR shall furnish information required and contribute appropriate items for discussion at the pre-construction conference.
- E. Handouts for Pre-Construction Conference:
 - 1. CONTRACTOR shall bring to the conference the following, with sufficient number of copies for each attendee:
 - a. Preliminary Progress Schedule, as submitted to ENGINEER.
 - b. Preliminary Schedule of Submittals, as submitted to ENGINEER.
 - c. Preliminary Schedule of Values, as submitted to ENGINEER.
 - d. Listing of identity and general scope of Work or supply of planned Subcontractors and Suppliers.
 - e. List of emergency contact information, in accordance with Section 01 35 23, Safety Requirements.

1.3 REQUIRED ATTENDEES

- A. Representative of each entity attending the conference shall be authorized to act on that entity's behalf.
- B. Contractor Attendance: Conference shall be attended by CONTRACTOR's:
 - 1. Project manager.
 - 2. Site superintendent
 - 3. Project managers for major Subcontractors, and major equipment Suppliers as CONTRACTOR deems appropriate.
- C. Other attendees will be representatives of:
 - 1. OWNER.
 - 2. ENGINEER.
 - 3. Resident Project Representative (RPR), if available.
 - 4. Authorities having jurisdiction over the Work, if available.
 - 5. Utility owners, as applicable.
 - 6. Others as requested by OWNER, CONTRACTOR, or ENGINEER.

1.4 AGENDA

- A. Preliminary Agenda: Be prepared to discuss in detail the topics indicated below. Revisions, if any, to the agenda below will be furnished to required attendees prior to the pre-construction conference.

1. Procedural and Administrative:
 - a. Personnel and Teams:
 - 1) Designation of roles and personnel.
 - 2) Limitations of authority of personnel, including personnel who will sign Contract modifications and make binding decisions.
 - 3) Subcontractors and Suppliers in attendance.
 - 4) Authorities having jurisdiction.
 - b. Procedures for communications and correspondence, including electronic communication protocols.
 - c. Copies of the Contract Documents and availability.
 - d. Subcontractors and Suppliers.
 - 1) Lists of proposed Subcontractors and Suppliers.
 - e. The Work and Scheduling:
 - 1) General scope of the Work.
 - 2) Contract Times, including Milestones (if any).
 - 3) Phasing and sequencing.
 - 4) Preliminary Progress Schedule.
 - 5) Critical path activities.
 - f. Safety:
 - 1) Responsibility for safety.
 - 2) Contractor's safety representative.
 - 3) Emergency procedures and accident reporting.
 - 4) Emergency contact information.
 - 5) Confined space entry permits.
 - 6) Hazardous materials communication program.
 - 7) Impact of Project on public safety.
 - g. Permits.
 - h. Review of insurance requirements and insurance claims.
 - i. Coordination:
 - 1) Project coordination, and coordination among contractors.
 - 2) Construction coordinator.
 - 3) Coordination with Owner's operations.

- 4) Progress meetings.
- 5) Preliminary Schedule of Submittals.
- 6) Procedures for furnishing and processing submittals.
- 7) Work not eligible for payment until submittals are approved or accepted (as required).
- 8) Construction photographic documentation.
- j. Submittals:
 - 1) Preliminary Schedule of Submittals.
 - 2) Submittal procedures.
 - 3) Contractor coordination and approval stamp.
 - 4) Meaning of Engineer's actions/submittal disposition.
 - 5) Preliminary discussion of initial, critical submittals.
 - 6) Construction photographic documentation.
- k. Substitutes and "Or-Equals":
 - 1) Product options.
 - 2) Procedures for proposing "or-equals".
 - 3) Procedures for proposing substitutes.
- l. Contract Modification Procedures
 - 1) Requests for interpretation
 - 2) Written clarifications
 - 3) Field Orders
 - 4) Proposal Requests
 - 5) Change Proposals
 - 6) Work Change Directives.
 - 7) Change Orders.
 - 8) Procedure for Claims and dispute resolution
- m. Payment:
 - 1) Owner's Project financing and funding, as applicable.
 - 2) Owner's tax-exempt status.
 - 3) Preliminary Schedule of Values
 - 4) Procedures for measuring for payment.
 - 5) Retainage.
 - 6) Progress payment procedures.

- 7) Prevailing wage rates and payrolls.
- n. Testing and inspections, including notification requirements.
- o. Disposal of demolition materials.
- p. Record documents.
- q. Preliminary Discussion of Contract Closeout:
 - 1) Procedures for Substantial Completion.
 - 2) Contract closeout requirements.
 - 3) Correction period.
 - 4) Duration of bonds and insurance.
- 2. Site Mobilization (if not covered in a separate meeting):
 - a. Working hours and overtime.
 - b. Field offices, storage trailers, and staging areas.
 - c. Temporary facilities.
 - d. Temporary utilities and limitations on utility consumption (where applicable).
 - e. Utility company coordination (if not done as a separate meeting).
 - f. Access to Site, access roads, and parking for construction vehicles.
 - g. Maintenance and protection of traffic.
 - h. Use of Site and premises.
 - i. Protection of property.
 - j. Security.
 - k. Temporary controls, such as sediment and erosion controls, noise controls, dust control, storm water controls, and other such measures.
 - l. Site barriers and temporary fencing.
 - m. Storage of materials and equipment.
 - n. Reference points and benchmarks; surveys and layouts.
 - o. Site maintenance during the Project.
 - p. Cleaning and removal of trash and debris.
 - q. Restoration.
- 3. General discussion and questions.
- 4. Next meeting.
- 5. Site visit, if required.

PART 2. - PRODUCTS (NOT USED)

PART 3. - EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 31 19

PROGRESS MEETINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Progress meetings will be held throughout the Project. CONTRACTOR shall attend each progress meeting prepared to discuss in detail all items on the agenda.
2. ENGINEER will preside at progress meetings and will prepare and distribute minutes of progress meetings to all meeting participants and others as requested.

1.2 PREPARATION FOR PROGRESS MEETINGS

A. Date and Time:

1. Regular Meetings: Monthly on a day and time agreeable to OWNER, ENGINEER, and CONTRACTOR.
2. Other Meetings: As required.

B. Location:

1. CONTRACTOR's field office at the Site or other location mutually agreed upon by OWNER, CONTRACTOR, and ENGINEER.

C. Handouts:

1. CONTRACTOR shall bring to each progress meeting not less than five (5) copies of each of the following:
 - a. List of Work accomplished since the previous progress meeting.
 - b. Up-to-date Progress Schedule.
 - c. Up-to-date Schedule of Submittals.
 - d. Detailed "look-ahead" schedule of Work planned through the next progress meeting, with specific starting and ending dates for each activity, including shutdowns, deliveries of important materials and equipment, Milestones (if any), and important activities affecting the OWNER, Project, and Site.
 - e. When applicable, list of upcoming, planned time off (with dates) for personnel with significant roles on the Project, and the designated contact person in their absence. s

1.3 REQUIRED ATTENDANCE

- A. Representatives present for each entity shall be authorized to act on that entity's behalf.
- B. Required Attendees:
 - 1. CONTRACTOR:
 - a. Project manager.
 - b. Site superintendent.
 - c. Safety representative.
 - d. When needed for the discussion of a particular agenda item, representatives of Subcontractors and Suppliers shall attend meetings.
 - 2. Construction coordinator (if any).
 - 3. ENGINEER:
 - a. Project manager or designated representative
 - b. Resident Project Representative (if any).
 - c. Others as required by ENGINEER.
 - 4. OWNER's representative(s), as required.
 - 5. Testing and inspection entities, as required.
 - 6. Others, as appropriate.

1.4 AGENDA

- A. Preliminary Agenda: Be prepared to discuss in detail the topics listed below. Revised agenda, if any, will be furnished to CONTRACTOR prior to first progress meeting. Progress meeting agenda may be modified by ENGINEER during the Project as required.
 - 1. Review, comment, and amendment (if required) of minutes of previous progress meeting.
 - 2. Review of progress since the previous progress meeting.
 - 3. Planned progress through next progress meeting.
 - 4. Review of Progress Schedule
 - a. Contract Times, including Milestones (if any)
 - b. Critical path.
 - c. Schedules for fabrication and delivery of materials and equipment.
 - d. Corrective measures, if required.
 - 5. Submittals:

- a. Review status of critical submittals.
- b. Review revisions to Schedule of Submittals.
- 6. Contract Modifications
 - a. Requests for interpretation
 - b. Written clarifications
 - c. Field Orders
 - d. Proposal Requests
 - e. Change Proposals
 - f. Work Change Directives.
 - g. Change Orders.
 - h. Claims.
- 7. Applications for progress payments.
- 8. Problems, conflicts, and observations.
- 9. Quality standards, testing, and inspections.
- 10. Coordination between parties.
- 11. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues.
- 12. Safety.
- 13. Permits.
- 14. Construction photographic documentation.
- 15. Record documents status.
- 16. Punch list status, as applicable.
- 17. Other business.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 31 26

ELECTRONIC COMMUNICATION PROTOCOLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section establishes the procedures with which the parties will comply regarding transmission or exchange of electronic data for the Project.
2. CONTRACTOR shall provide labor, materials, tools, equipment, services, utilities, and incidentals shown, specified, and required for complying with this Section throughout the Project.
3. This Section does not supersede the General Conditions, as may be modified by the Supplementary Conditions, regarding transmitting of the Contract Documents to CONTRACTOR after the Effective Date of the Contract.
4. In addition to the requirements of this Section, comply with requirements for exchange of electronic data in the following:
 - a. Section 01 32 16, Progress Schedule.
 - b. Section 01 32 33, Photographic Documentation.
 - c. Section 01 33 00, Submittal Procedures.
 - d. Section 01 78 39, Project Record Documents.

B. Coordination:

1. Except as otherwise explicitly stated herein, the terms of this Protocol will be incorporated into any other agreement or subcontract between a party and any third party for any portion of the Work on the Project, or any Project-related services, where that third party is, either directly or indirectly, required to exchange Electronic Documents with a party or with Engineer. Nothing herein will modify the requirements of the Contract regarding communications between and among the parties and their subcontractors and consultants.

C. Related sections:

1. Section 01 32 16, Progress Schedule.
2. Section 01 32 33, Photographic Documentation.
3. Section 01 33 00, Submittal Procedures.
4. Section 01 78 39, Project Record Documents.

1.2 TERMINOLOGY

- A. The term “Electronic Document” is defined in Paragraph 1.01.A.20 and the term “Electronic Means” is defined in Paragraph 1.01.A.21 of the General Conditions
- B. The following words or terms are not defined but, when used in this section, have the following meaning:
 - 1. “Confidential information” means electronic data that the transmitting party has designated as confidential and clearly marked with an indication such as “Confidential”, “Business Proprietary”, or similar designation.
 - 2. “Written” or “in writing” means any and all communications, including without limitation a notice, consent, or interpretation, prepared and sent to an address provided in the Contract Documents or otherwise agreed upon by the parties and ENGINEER using a transmission method set forth in this Section that allows the recipient to print or store the communication. Communications transmitted electronically are presumed received when sent in conformance with this Article 0.A.3.

1.3 ELECTRONIC DOCUMENTS

- A. Transmission of electronic data constitutes a warrant by the transmitting party to the receiving party that the transmitting party is one or more of the following:
 - 1. The copyright owner of the electronic data.
 - 2. Has permission from the copyright owner to transmit the electronic data for its use on the Project.
 - 3. Is authorized to transmit confidential information.
- B. Receiving party agrees to keep confidential information confidential and not to disclose it to another person except to (1) its employees, (2) those who need to know the content of the confidential information to perform services or construction solely and exclusively for the Project, or (3) its consultants, contractors, Subcontractors, and Suppliers whose contracts include similar restrictions on the use of electronic data and confidential information.
- C. Transmitting party does not convey any right in the electronic data or in the software used to generate or transmit such data. Receiving party may not use electronic data unless permission to do so is provided in the Contract Documents, or in a separate license.
- D. Unless otherwise granted in a separate license, receiving party’s use, modification, or further transmission of electronic data, as provided the Contract Documents, is specifically limited to the design and construction of the Project in accordance with this Section, and nothing contained in this Section conveys any other right to use the electronic data for any other purpose.
- E. To the fullest extent permitted by Laws and Regulations, receiving party shall indemnify and defend the transmitting party from and against all claims arising

from or related to receiving party's modification to, or unlicensed use of, electronic data.

- F. Means of Transmitting Electronic Data: Unless otherwise indicated in Table 01 31 26-A of this Section or elsewhere in the Contract Documents, transmission of electronic data for the Project will generally be via:
 - 1. E-mail and files attached to e-mail. Maintain e-mail system capable of transmitting and receiving files not less than 20 megabytes (MB) file size.

1.4 ELECTRONIC DATA PROTOCOLS

- A. Comply with the data formats, transmission methods, and permitted uses set forth in table 01 31 26-a, electronic data protocol table, below, when transmitting or using electronic data on the project. Where a row in the table has no indicated means of transmitting electronic data, use for such documents only printed copies transmitted to the receiving party via appropriate delivery method.

TABLE 01 31 26-A
ELECTRONIC DATA PROTOCOL TABLE (E-MAIL ATTACHMENTS)

Electronic Data	Data Format	Transmitting Party	Transmission Method	Receiving Party	Permitted Uses	Notes
1.04.A.1. Project communications						
General communications & correspondence	EM, PDF	O, E, C	EM, EMA	O, E, C	R	
Meeting notices and agendas	EM, PDF	E	EM, EMA	O, C	R	
Meeting minutes	PDF	E	EM, EMA	O, C	R	
1.04.A.2. Contractor's submittals to Engineer						
Shop Drawings	PDF	C	EMA	E	M (1)	(1)
Product data	PDF	C	EMA	E	M (1)	(1)
Informational and closeout submittals:	PDF	C	EMA	E	M (1)	(1) (6)
Documentation of delivery of maintenance materials submittals	PDF	C	EMA	E	M (1)	
1.04.A.3. Engineer's return of reviewed submittals to Contractor						
Shop Drawings	PDF	E	EMA	O., C	R	
Product data	PDF	E	EMA	O., C	R	
Informational and closeout submittals:	PDF	E	EMA	O., C	R	(6)
Documentation of delivery of maintenance materials submittals	PDF	E	EMA	O. C	R	
1.04.A.4. Contract Modifications Documents						
Requests for interpretation to Engineer	PDF	C., O	EMA	E	M (1)	(1)
Engineer's interpretations (RFI responses)	PDF	E	EMA	C, O	R	
Engineer's clarifications to Contractor	EM, PDF	E	EM, EMA	C, O	R	
Engineer's issuance of Field Orders	PDF	E	EMA	C, O	R	
Proposal Requests	PDF	E, O	EMA	C	R	
Change Proposals – submitted to Engineer	PDF	C	EMA	O, E	S	
Change Proposals – Engineer's response	PDF	E	EMA	C. O		
Work Change Directives (for Contractor signature)	PDF	E	EMA	C	R	(2)
Change Orders (for Contractor signature)	PDF	E	EMA	C	R	(2)
1.04.A.5. Applications for Payment						(3)
1.04.A.6. Claims and other notices						(4)
1.04.A.7. Closeout Documents						
Record drawings	DWG and PDF	C	EMA	E, O	M (5)	(5)
Other record documents	PDF	C	EMA	E. O	M (5)	(5)
Contract closeout documents						

A. Key to Electronic Data Protocol Table:
Data Format:

EM	.msg, .htm, .txt, .rtf, e-mail text
W	.docx, Microsoft® Word 2007 or later
EX	.xlsx, Microsoft® Excel 2007 or later
PDF	.pdf. Portable Document Format
DWG	.dwg. Autodesk AutoCAD 2013 drawing.

Transmitting Party:

O	OWNER
C	CONTRACTOR
E	ENGINEER

Transmission Method:

EM	Via e-mail
EMA	As an attachment to an e-mail transmission

Receiving Party:

O	OWNER
C	CONTRACTOR
E	ENGINEER

Permitted Uses:

S	Store and view only
R	Reproduce and distribute
I	Integrate (incorporate additional electronic data without modifying data received)
M	Modify as required to fulfill obligations for the Project

Notes:

- (1) Modifications by ENGINEER to CONTRACTOR's submittals and requests for interpretations are limited to printing out, marking-up, and adding comment sheets.
- (2) May be distributed only to affected Subcontractors and Suppliers. Print out, sign document, and return executed printed copy originals to ENGINEER.
- (3) Submit printed Applications for Payment with original ("wet") signatures.

- (4) Submit notices, including Claims, in accordance with the notice provisions of the General Conditions, as may be modified by the Supplementary Conditions.
- (5) Submit record drawings in native CAD format indicated when CONTRACTOR has executed ENGINEER's standard agreement for release of electronic files. In addition, always submit record drawings as a PDF file. Comply with requirements of Section 01 78 39, Project Record Documents.
- (6) For operation and maintenance data, also submit printed copies as required by Section 01 78 23, Operations and Maintenance Data.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 32 16

PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall prepare and submit Progress Schedules and related documents in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and this Section, unless otherwise accepted by ENGINEER.
2. Maintain and update Progress Schedules and related documents.
3. Progress Schedule shall be resource- and cost-loaded CPM Progress Schedule.
4. ENGINEER's acceptance of the Progress Schedule or related documents, and comments or opinions concerning activities in the Progress Schedule and related documents shall not control CONTRACTOR's independent judgment concerning means, methods, techniques, sequences and procedures of construction, unless the associated means, method, technique, sequence, or procedure is directed by the Contract Documents. CONTRACTOR is solely responsible for complying with the Contract Times.

B. Use of float:

1. Float belongs to the Project and may be used by OWNER or CONTRACTOR to accommodate changes in the Work, or to mitigate the effect of events that delay performance or compliance with the Contract Times.

Changes or delays that influence Activities that have float and that do not extend the Critical Path are not justification for an extension of the Contract Times.

C. Factors Affecting the Progress Schedule:

3. In preparing the Progress Schedule, take into consideration submittal requirements and submittal review times, time for fabricating and delivering materials and equipment, source quality control (including shop testing) and field quality control (including testing at the Site), Subcontractors' work, availability and abilities of workers, availability of construction equipment, weather conditions, restrictions in operations at the Site and coordination with OWNER's operations, and other factors that have the potential to affect completion of the Work within the Contract Times.
4. Comply with sequencing requirements indicated in the following:

- a. Section 01 11 13, Summary of Work.
- b. Section 01 13 13, Milestones.
- c. Section 01 14 16, Coordination with Owner's Operations.

1.2 DEFINITIONS

- A. The following terms are defined for this Section and supplement the terms defined in the General Conditions and Supplementary Conditions:
 - 1. Activity: An element of the construction work that has the following specific characteristics: consumes time, consumes resources, has a definable start and finish, is assignable, and is measurable.
 - 2. Constraint: An imposed date on the Progress Schedule or an imposed time between Activities. The Contract Times are Constraints.
 - 3. CPM Progress Schedule: Computerized Progress Schedule in Critical Path Method (CPM) format which accounts for the entire Work, defines the interrelationships between elements of the Work, reflects the uncompleted Work, and indicates the sequence with which the Work has been completed, indicates the sequence in which uncompleted Work will be completed, and indicates the duration of each Activity.
 - 4. Critical Path: The continuous chain of Activities with the longest duration for completion within the Contract Times.
 - 5. Early Start: The earliest possible date an Activity can start according to the assigned relationships among Activities.
 - 6. Early Finish: The earliest date an Activity can finish according to the assigned relationships among the Activities.
 - 7. Late Finish: The latest date an Activity can finish without extending the Contract Times.
 - 8. Late Start: The latest date an Activity can start without extending the Contract Times.
 - 9. Float: The time difference between the calculated duration of the Activity chain and the Critical Path.
 - 10. Total Float: The total number of days that an Activity (or chain of Activities) can be delayed without affecting the Contract Times.
 - 11. Network Diagram: A time-scaled logic diagram depicting the durations and relationships of the Activities.
 - 12. Work Areas, Area, or System: A logical breakdown of the Project elements or a group of Activities which, when collectively assembled, are readily identifiable on the Project (for example: yard piping, a structure or building, a treatment process, or other logical grouping).

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Progress Schedule Preparer:

- a. CONTRACTOR shall self-prepare and maintain the Progress Schedule using qualified employee with experience in scheduling, and experienced with the scheduling software required for the Project, and experience serving as Progress Schedule preparer on construction projects of similar type, size, and scope to this Project.
- b. Progress Schedule preparer shall have not less than five years experience using the schedule software required on construction projects of similar type, size, and scope as the Project.
- c. Prior to engaging a scheduling consultant or using a qualified employee, submit to ENGINEER the following:
 - 1) Name and address of proposed Progress Schedule preparer and the names of personnel who will be assigned to scheduling the Project.
 - 2) Information sufficient to demonstrate that proposed Progress Schedule preparer and scheduling personnel to be assigned to the Project possess qualifications complying with this Section. For each person assigned, submit list of similar type, size, contract value of projects, names and contact information of engineer or architect and owner.
- d. Engineer's Review of Qualifications:
 - 1) ENGINEER will respond to CONTRACTOR whether proposed scheduling personnel are acceptable within five (5) days after ENGINEER's receipt of complete qualifications.
 - 2) If qualifications are not acceptable, submit qualifications of acceptable personnel within five (5) days of receipt of ENGINEER's non-acceptance.
 - 3) ENGINEER's acceptance or non-acceptance of qualifications does not release CONTRACTOR from its obligations under the Contract Documents.

B. Scheduling Workshop Conferences:

1. Prior to preparing the preliminary Progress Schedule, CONTRACTOR shall meet with ENGINEER and OWNER for one (1) workshop conference, up to four (4) hours in duration, to review technical requirements and Progress Schedule development methods and procedures.

2. Required Attendance:
 - a. CONTRACTOR's project manager, site superintendent, and Progress Schedule preparer.
 - b. ENGINEER
 - c. OWNER may attend one or more scheduling workshop conferences.
3. ENGINEER will prepare minutes of the scheduling workshop conferences and distribute minutes to each attendee.

1.4 SUBMITTALS

- A. Quantity of each submittal required and timing of submittals are in this Section.
- B. Informational Submittals: Submit the following:
 1. Initial Progress Schedules:
 - a. Preliminary Progress Schedule with associated Network Diagrams and narrative report.
 - b. Acceptable Progress Schedule with associated Network Diagrams and narrative report.
 - c. Preliminary resource- and cost-loaded Progress Schedule and associated reports.
 - d. Acceptable resource- and cost-loaded Progress Schedule and associated reports.
 - e. Submit each Progress Schedule submittal with letter of transmittal complying with requirements of Section 01 33 00, Submittal Procedures.
 2. Progress Schedule Updates.
 - a. Progress Schedule updates shall comply with requirements of this Section, and shall include updated Progress Schedule, narrative report, updated Network Diagram when relationships among Activities are changed, and updated mathematical tabulations.
 - b. Submit updated Progress Schedule prior to each progress meeting. When a Progress Schedule remains unchanged from one progress meeting to the next, submit a written statement to that effect. In addition to monthly Progress Schedule submittals, also bring to progress meeting the number of printed copies of the updated Progress Schedule indicated in Section 01 31 19, Progress Meetings.
 3. Look-Ahead Schedules
 - a. Furnish 15-day look-ahead schedule at each progress meeting.

4. Time Impact Analyses: Submit in accordance with this Section.
5. Recovery Schedule: Submit in accordance with this Section.
6. Qualifications:
 - a. Submit qualifications of Progress Schedule preparer, and other personnel that will assist Progress Schedule preparer in preparing and maintaining the Progress Schedule.

1.5 INITIAL PROGRESS SCHEDULES

- A. Type and Organization of Progress Schedules:
 1. Prepare Progress Schedule using Oracle Primavera P6 software, unless other scheduling software is acceptable to OWNER.
 2. Sheet Size: 24 inches by 36 inches, unless otherwise accepted by ENGINEER.
 3. Time Scale: Indicate first date of each work week.
 4. Activity Designations: Indicate title and related Specifications Section number.
 5. Progress Schedules shall be CPM Progress Schedules.
 6. Organization:
 - a. Indicate on the separate Schedule of Submittals dates for submitting and reviewing Shop Drawings, Samples, and other submittals.
 - b. Group deliveries of materials and equipment into a separate sub-schedule that is part of the Progress Schedule.
 - c. Group construction into Work Area sub-schedules (that are part of the Progress Schedule) by Activity.
 - d. Clearly indicate the Critical Path on the Progress Schedule.
 - e. Organize each Work Area sub-schedule by Specifications Section number.
- C. Preliminary Progress Schedule:
 1. Within fifteen (15) days after the Contract Times commence running, CONTRACTOR shall submit to ENGINEER the preliminary Progress Schedule covering the entire Project, with associated Network Diagrams.
 2. Submit preliminary Progress Schedule in accordance Section 01 33 00, Submittal Procedures.
 3. ENGINEER will conduct a timely review of the preliminary Progress Schedule.
 4. Preliminary Progress Schedule shall comply with the Contract Documents relative to Progress Schedules, but need not be resource- or cost-loaded.

D. Initial Acceptance of Progress Schedule:

1. Not less than ten (10) days before submission of the first Application for Payment, a scheduling conference attended by CONTRACTOR, Progress Schedule preparer, ENGINEER, and others as appropriate will be held at the Site to review for acceptability to ENGINEER the preliminary Progress Schedule and associated Network Diagram and other reports and schedule-related documents required. Following the scheduling conference, CONTRACTOR shall have five (5) days to make corrections and adjustments and to complete and resubmit the Progress Schedule and associated Network Diagram. No progress payment will be made to CONTRACTOR until acceptable Progress Schedule, Network Diagram, and other reports and schedule-related documents required are submitted to ENGINEER.
2. Submit acceptable Progress Schedule, together with Network Diagram, reports, and other schedule-related documents required to accompany the initial acceptable Progress Schedule, in accordance with the Submittals Article of this Section, Section 01 31 26, Electronic Communication Protocols, and Section 01 33 00, Submittal Procedures. Also submit acceptable form of Progress Schedule in its native format generated by the scheduling software, transmitted using the transmission method indicated in Section 01 31 26, Electronic Communication Protocols.
3. The Progress Schedule will be acceptable to ENGINEER if it provides an orderly progression of the Work to completion within the Contract Times, in accordance with the Contract Documents. 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.
4. Initially-accepted Progress Schedule shall be identified as the baseline Progress Schedule.

E. Resource- and Cost-Loaded Progress Schedule:

1. Not more than ten (10) days after ENGINEER's acceptance of the Progress Schedule, submit to ENGINEER resource- and cost-loaded Progress Schedule complying with resource- and cost-loading requirements in this Section.
2. Submit of the preliminary and the acceptable resource- and cost-loaded Progress Schedules and associated reports to accompany the initial submittals of resource (and cost-loaded Progress Schedules in accordance with the Submittals Article of this Section, Section 01 31 26, Electronic Communication Protocols, and Section 01 33 00, Submittal Procedures. Also submit preliminary and acceptable form of resource- and cost-loaded Progress Schedules in its native format generated by the scheduling

software, transmitted using the transmission method indicated in Section 01 31 26, Electronic Communication Protocols.

3. Resource- and cost-loaded Progress Schedules will be reviewed by ENGINEER within ten (10) days of ENGINEER's receipt, and ENGINEER's comments will be transmitted to CONTRACTOR.
 4. Make revisions required in accordance with ENGINEER's comments and resubmit to ENGINEER within five (5) days of CONTRACTOR's receipt of ENGINEER's comments.
 5. Resource- and cost-loaded Progress Schedule accepted by ENGINEER shall be the basis for determining the amount of each CONTRACTOR progress payment.
- F. If the Progress Schedule reflects completion date(s) different than the Contract Times, the Contract Times are not thereby voided, nullified, or affected. The Contract Times govern. Where the Progress Schedule reflects completion date(s) that are earlier than the Contract Times, ENGINEER may accept such Progress Schedule with CONTRACTOR to specifically understand that no Change Request or Claim for additional Contract Times or additions to the Contract Price shall be brought against OWNER resulting from CONTRACTOR's failure to complete the Work by the earlier date(s) indicated on the accepted Progress Schedule.

1.6 PROGRESS SCHEDULE UPDATES

A. Updates:

1. Update the Progress Schedule not less-often than once per month. If during progress of the Work events develop that necessitate changes in the initially accepted Progress Schedule (e.g., baseline Progress Schedule), identify updated Progress Schedules sequentially as "Progress Schedule Revision 1", "2", "3", and continuing in sequence as required. Number the Progress Schedule submittals in accordance with Section 01 33 00, Submittal Procedures.
2. CONTRACTOR's Progress Schedule update shall include a narrative report in accordance with this Section. Narrative report shall include description of current progress and status of each Area of the Project, a description of progress for the period, a description of the Critical Path, a discussion of current or potential delays, Change Orders (pending and approved in since the previous Progress Schedule update), and other problems associated with maintaining the Work on schedule.
3. The update to the Progress Schedule shall be based on retained logic. Progress override logic is not allowed.
4. Required scheduling software, and schedule organization, format, and content for updated Progress Schedules are identical to that required in this Section for initial Progress Schedules.

5. Submit to ENGINEER updated Progress Schedule, together with Network Diagram (when required), reports, and other schedule-related documents required to accompany the updated Progress Schedule, in accordance with Section 01 31 26, Electronic Communication Protocols, and Section 01 33 00, Submittal Procedures. Also submit updated Progress Schedule in its native format generated by the scheduling software, transmitted using the transmission method indicated in Section 01 31 26, Electronic Communication Protocols.
 6. Submit updated Network Diagrams when revisions are proposed to the logic. Indicate in the narrative report delays that have occurred since the previous updated Progress Schedule. ENGINEER will not recommend payment by OWNER of progress payments until updated Progress Schedule is received, reviewed, and accepted by ENGINEER. Payment for out-of-sequence Work is not allowed.
- B. Monthly Schedule Meeting:
1. During the month, utilizing the previous month's 15-day look-ahead schedule. CONTRACTOR shall record the percent complete, start and finish dates of each scheduled Activity with the remaining duration for each Activity started but not completed, including Activities associated with procurement of materials and equipment.
 2. On the same day each month, not less than one week prior to a progress meeting, CONTRACTOR, Progress Schedule preparer, ENGINEER, and others as appropriate shall meet at the Site and tour the Work to review and update the schedule and progress information gathered by CONTRACTOR during the month. After acceptance of CONTRACTOR's updated data, Progress Schedule preparer shall use this information to update the Progress Schedule.

1.7 NETWORK DIAGRAMS (PERT CHARTS)

- A. Network Diagrams – General:
1. Prepare and submit Network Diagrams, as generated using the scheduling software suitable for printing on paper of the size indicated for Progress Schedules in this Section.
 2. Group Network Diagrams by Area and show the order and interdependence of Activities and sequence and quantities in which the Work will be accomplished.
 3. Do not use match lines on Network Diagrams. Depict interrelationships to or from Activities outside the Area shown using an Activity symbol with Activity number and description.
 4. In preparing Network Diagrams, comply with the basic concept of precedence diagramming method (PDM) network scheduling to show how start of a given Activity depends on completion of preceding Activities,

and how the Activity's completion may affect the start of subsequent Activities.

5. Level of schedule detail shall define the day-to-day Activities of the Work.

B. Network Diagram Content:

1. Clearly indicate the Critical Path and distinguish the Critical Path from other paths on the network.
2. Organize Network Diagrams by grouping into major Work Areas, including one for procurement of materials and equipment, and by specific Activity within each Area.
3. Logic diagrams shall include the following:
 - a. Activity number.
 - b. Activity description.
 - c. Activity duration (in work days).
 - d. Critical Path denoted.
 - e. Float for each Activity.
 - f. Activity or System designation.
 - g. Coded Area designation.
 - h. Responsibility code (e.g., CONTRACTOR, Subcontractor, trade, operation, Suppliers, or other entity responsible for accomplishing an Activity).
 - i. Shift number (if more than one shift per day is to be employed).

C. Network Diagram Revisions:

1. General:
 - a. When conditions develop that require revisions to logic or durations of the Network Diagram associated with the initially accepted Progress Schedule (e.g., baseline Progress Schedule), identify updates to the Network Diagram in the same manner required in this Section for Progress Schedule updates.
 - b. Revision of the logic or durations from the baseline Progress Schedule initially accepted by ENGINEER shall be submitted to ENGINEER for acceptance.
 - c. Incorporate into the Progress Schedule revisions to logic or duration accepted by ENGINEER, and include in monthly narrative report both a description of revisions and listing of Activities affected by revisions.
 - d. Changes resulting from Change Orders, Work Change Directives, Field Orders, allowance authorizations, and other additions or

deletions, shall be fully incorporated into the Progress Schedule and Network Diagram on the first update after the associated Change Orders, Work Change Directive, or allowance authorization is approved by OWNER, or Field Order issued by ENGINEER, including adjustments to the Contract Price (if any).

2. Submit revised Network Diagrams with updated Progress Schedule submittals.

1.8 RESOURCE AND COST LOADING REPORTS

A. Resource Loading:

1. After ENGINEER's initial acceptance of the Progress Schedule, CONTRACTOR shall assign resources for personnel labor-hours, materials, and equipment to each construction Activity within each responsibility code. Submit resource schedule reports with each updated Progress Schedule.

B. Cost Loading:

1. Assign to each Activity a total dollar amount commensurate with its value relative to the associated line item in the Schedule of Values accepted by the ENGINEER. Submit cost reports for the initially accepted cost-loaded Progress Schedule and each subsequent update of the Progress Schedule.
2. After the cost-loaded Progress Schedule is accepted by ENGINEER, each Application for Payment will be on the basis of earned revenue as indicated in updates of the Progress Schedule.

1.9 NARRATIVE REPORT

- A. Prepare and include with the preliminary Progress Schedule and each subsequent Progress Schedule submittal, written narrative report describing the schedule-related requirements of the Contract Documents and CONTRACTOR's plan and schedule for complying with such requirements. Narrative report shall describe the methods of sequencing and operation, resources to be employed, time frames for the construction of each of the major Systems on the Project, and time frames for complying with the Contract Times and CONTRACTOR's interim schedule milestones.

1.10 TIME IMPACT ANALYSIS

A. Time Impact Analyses – General:

1. Prepare and submit a time impact analysis when one or more of the following occurs: a Change Proposal is prepared, a Work Change Directive is issued that will affect the Progress Schedule, or when delays are experienced. Time impact analysis shall illustrate the influence of each Change Order, Work Change Directive, allowance authorization, or delay, as applicable, on the Contract Times and schedule milestones.

2. Each time impact analysis shall include a sketch (fragnet) demonstrating how CONTRACTOR proposes to incorporate the changes in the Work or, as applicable, delays into the Progress Schedule. Fragnet shall include all logic, resource and cost changes, and additions required as result of said Change Order, Work Change Directive, allowance authorization, or delay.
3. Fragnet shall show all CPM logic revisions for the Work associated with the Change Order, Work Change Directive, allowance authorization, or delay and its relationship to other Activities in the Network Diagram.
4. Time impact analysis shall demonstrate the time impact, based on date the Change Order, Work Change Directive, or allowance authorization was given to CONTRACTOR, or as applicable the date the delay was implemented; the status of the Work at that point in time; and the Activity duration of affected Activities. Activity duration used in the time impact analysis shall be those included in the latest update of the Progress Schedule accepted by ENGINEER, closest to the time of the start of the delay or start of the Change Order, Work Change Directive, or allowance authorization as adjusted by mutual, written agreement of the parties and ENGINEER.
5. Timing of Time Impact Analysis:
 - a. Submit each time impact analysis within five (5) days after the following, as applicable:
 - 1) Start of the delay.
 - 2) After the submittal of Change Proposal.
 - 3) After CONTRACTOR receipt of Work Change Directive.
 - b. When CONTRACTOR does not submit time impact analysis for a specific change or delay, within the specified period of time for such submittal, such non-submittal shall be construed that no extension of the Contract Times is required.

B. Evaluation by Engineer and Acceptance:

1. ENGINEER's evaluation of each time impact analysis comprised of complete information will be completed in timely manner after ENGINEER's receipt. Changes in the Contract Times will be made only by Change Order.
2. When mutual agreement is reached between the parties on effect of the change or delay in the Project, incorporate into the next Progress Schedule update the associated fragnets illustrating the influence of changes and delays.

1.11 RECOVERY SCHEDULES

A. Recovery Schedules – General:

1. When updated Progress Schedule indicates that the ability to comply with the Contract Times falls fifteen (15) or more days behind schedule, and there is no excusable delay, Change Order, or Work Change Directive to support an extension of the Contract Times, CONTRACTOR shall prepare and submit a Progress Schedule demonstrating CONTRACTOR's plan to accelerate the Work to achieve compliance with the Contract Times ("recovery schedule") for ENGINEER's acceptance.
2. Submit recovery schedule within five (5) days after submittal of updated Progress Schedule where need for recovery schedule is indicated.

Implementation of Recovery Schedule:

3. At no additional cost to OWNER, do one or more of the following: furnish additional labor, provide additional construction equipment, provide suitable materials, employ additional work shifts, expedite procurement of materials and equipment to be incorporated into the Work, and other measures necessary to complete the Work within the Contract Times.
4. Upon acceptance of recovery schedule by ENGINEER, incorporate recovery schedule into the next Progress Schedule update.

C. Lack of Action:

1. CONTRACTOR's refusal, failure, or neglect to take appropriate recovery action, or to submit a recovery schedule, shall constitute reasonable evidence that CONTRACTOR is not prosecuting the Work or separable part thereof with the diligence that will ensure completion within the Contract Times. Such lack of action shall constitute sufficient basis for OWNER to exercise remedies available to OWNER under the Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 32 33

PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all equipment, labor, materials required to provide the OWNER services specified, including:
 - a. Digital photography.
 - b. Digital videography.
2. Furnish photographic documentation for the following:
 - a. Pre-construction.
 - b. Construction progress.
 - c. Final.

B. Image Quality:

1. Photographic documentation shall be in color.
2. Photographic images shall be suitably staged and set up ("framed"), focused, and shall have adequate lighting to illuminate the Work and conditions that are the subject of the photograph.
3. For still photographs, use camera with minimum 16.0-megapixel resolution.

1.2 QUALITY ASSURANCE

- A. At the Site, ENGINEER or Resident Project Representative will indicate the views to be taken and will select time at which images will be taken. Photographic subjects, views, and angles will vary with progress of the Work.

1.3 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Pre-construction Photographic Documentation: Submit acceptable pre-construction photographic documentation (digital files) prior to mobilizing to and disturbing the Site. Submit pre-construction photographic documentation not later than the first Application for Payment, unless other schedule for pre-construction photographic documentation is accepted by ENGINEER.

2. Construction Progress Photographic Documentation: Submit acceptable construction progress photographic documentation (digital files) not less-often than monthly. Submit with each Application for Payment, unless otherwise agreed to by ENGINEER.

B. Closeout Submittals: Submit the following:

1. Final Photographic Documentation: Submit acceptable final photographic documentation (digital files) prior to requesting the final inspection by ENGINEER.

1.4 PHOTOGRAPHIC DOCUMENTATION – GENERAL

A. Digital Files of Photographs:

1. For each photograph taken, furnish high-quality digital image in “JPG” file format compatible with Microsoft Windows 7 and higher operating systems.
2. Image resolution shall be sufficient for clear, high-resolution prints. Minimum resolution shall be 150 dots per inch (dpi).
3. Do not imprint date and time in the image.
4. Electronic image filename shall describe the image; do not submit filenames automatically created by digital camera. For example, an acceptable electronic filename would be, “Dewatering Building – Looking West at Centrifuge No. 2.jpg”.
5. Form of Digital Submittal – Image File Upload:
 - a. Upload digital files of Project photographic documentation to the Project website
 - b. Upload files to new directory each time files are uploaded. Directory name shall be the date the photographs were taken (in the form of YEAR-MO-DAY), with brief general description of subject matter. Example: “2013-09-10 – Concrete Reinforcing in Slab”.

B. Videography:

1. Video shall be high-definition (HD), high-quality video of the Site and Project work.
2. All video files for the entire Project shall be submitted in one container file format. Video files shall be in one of the following container file formats:
 - a. AVI (Microsoft systems).
 - b. Flash Video (F4V, FLV; Adobe systems).
 - c. QuickTime File Format (MOV, QT; Apple, Inc.).

- d. MP4 (“MPEG-4 Part 14”).
3. Video image shall have imprinted date and time that video was taken.
4. Include audio narration sufficient to explain the scenes shown.
5. Form of Digital Submittal – Video File Upload:
 - a. Upload digital files of Project photographic documentation to the Project website
 - b. Upload files to new directory each time files are uploaded. Directory name shall be the date the video was taken (in the form of YEAR-MO-DAY), with brief general description of subject matter. Example: “2013-09-10 – Pouring Concrete Slab”.

1.5 PRE-CONSTRUCTION PHOTOGRAPHIC DOCUMENTATION

- A. Pre-construction Photographic Documentation:
 1. Obtain and submit sufficient pre-construction photographic documentation to record Site conditions prior to construction. Photographs shall document work areas of all prime contracts under the Project.
 2. Pre-construction photographs are not part of required number of construction progress photographs
 3. Furnish pre-construction video of all work areas included in all prime contracts on the Project, including indoor and outdoor work areas and staging areas.
- B. If disagreement arises on the condition of the Site and insufficient pre-construction photographic documentation was submitted prior to the disagreement, restore the grounds or area in question to extent directed by ENGINEER and to satisfaction of ENGINEER.

1.6 CONSTRUCTION PROGRESS PHOTOGRAPHIC DOCUMENTATION

- A. Progress Photographs:
 1. Take photographs not less often than twice per month.
 2. Take not less than five (5) photographs each time.
 3. Minimum number of progress photographs required will be fifteen (15), based on the Contract Times to Substantial Completion of the entire Project and scope of the Project on date the Contract Times commence running. Proportionately modify the extent of photographic documentation if scope of the Project or the Contract Times are modified.

4. Obtain and submit interior and exterior photographic documentation of each structure in the work area as directed by ENGINEER at the time photographic documentation is taken.

1.7 FINAL PHOTOGRAPHIC DOCUMENTATION

A. Final Photographs:

1. Take photographs at time and day acceptable to ENGINEER. Do not take final photographs prior to Substantial Completion of the entire Project. Work documented in final photographs shall be generally complete, including painting and finishing, furnishings, landscaping, and other visible Work
2. Take not less than twenty five (25) final photographs, based on scope of the Project at the time that the Contract Times commence running. Proportionately modify the number of final photographs if scope of Project is modified. Final photographs are not part of construction progress photographs required under Paragraph 1.6.A of this Section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall prepare and furnish submittals in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and this Section.
2. Provide submittals well in advance of need for the material or equipment, or procedure (as applicable), in the Work and with ample time required for delivery of materials and equipment and to implement procedures following ENGINEER's approval or acceptance of the associated submittal. Work covered by a submittal will not be included in progress payments until approval or acceptance of related submittals has been obtained in accordance with the Contract Documents.
3. CONTRACTOR is responsible for dimensions to be confirmed and corrected at the Site; quantities; information pertaining solely to fabrication processes; means, methods, sequences, procedures, and techniques of construction; safety precautions and programs incident thereto; and for coordinating the work of all trades.
4. CONTRACTOR's signature of submittal's stamp and letter of transmittal shall be CONTRACTOR's representation that CONTRACTOR has complied with his obligations under the Contract Documents relative to that submittal. ENGINEER and OWNER shall be entitled to rely on such representations by CONTRACTOR.
5. Provisions of the general conditions, as may be modified by the supplementary conditions, apply to all contractor-furnished submittals required by the contract documents, regardless of whether such submittals are other than shop drawings or samples.

B. Samples:

1. Submittal of Samples shall comply with the General Conditions, as may be modified by the Supplementary Conditions, this Section, and the Specifications Section in which the Sample is specified.
2. Furnish at the same time those Samples and submittals that are related to the same element of the Work or Specifications Section. ENGINEER will not review submittals without associated

Samples, and will not review Samples without associated submittals.

3. Samples shall clearly illustrate functional characteristics of materials, all related parts and attachments, and full range of color, texture, pattern, and materials.

C. Restrictions on Quantity of Submittals and Compensation of OWNER:

1. CONTRACTOR shall furnish required submittals with sufficient information and accuracy to obtain required approval or acceptance of submittal by ENGINEER with not more than the number of resubmittals indicated in the General Conditions (as may be modified by the Supplementary Conditions).
2. Total number of CONTRACTOR's submittals shall not exceed 25 percent above the total number of first-time submittals indicated in the Schedule of Submittals initially accepted by ENGINEER. ENGINEER will record ENGINEER's time for reviewing submittals of Shop Drawings, Samples, and other submittals and items requiring approval or acceptance, beyond the quantity of first-time submittals indicated in the Schedule of Submittals initially accepted by ENGINEER, and CONTRACTOR shall reimburse OWNER for ENGINEER's charges for such time.
3. In the event that CONTRACTOR requests a substitution for a previously approved item, Contractor shall reimburse OWNER for ENGINEER's charges for such time unless the need for such substitution is beyond the control of CONTRACTOR.
4. OWNER may impose set-offs against CONTRACTOR for the costs for which CONTRACTOR is to reimburse or compensate OWNER, in accordance with the General Conditions.

1.2 TYPES OF SUBMITTALS

- A. Submittal types are classified as follows: 1) Action Submittals, 2) Informational Submittals, 3) Closeout Submittals, and 4) Maintenance Material submittals. Type of each required submittal is designated in the respective Specifications Sections; when type of submittal is not designated in the associated Specification Section, submittal will be classified as follows:

1. Action Submittals include:
 - a. Shop Drawings.
 - b. Product data.
 - c. Delegated design submittals, which include documents prepared, sealed, and signed by a design professional retained by CONTRACTOR, Subcontractor, or Supplier for

materials and equipment to be incorporated into the completed Work. Delegated design submittals do not include submittals related to temporary construction unless specified otherwise in the related Specifications Section. Delegated design submittals include: design drawings, design data including calculations, specifications, certifications, and other submittals prepared by such design professional.

- d. Samples.
- e. Testing plans, procedures, and testing limitations.
- 2. Informational Submittals include:
 - a. Certificates.
 - b. Design data not sealed and signed by a design professional retained by CONTRACTOR, Subcontractor, or Supplier.
 - c. Pre-construction test and evaluation reports, such as reports on pilot testing, subsurface investigations, testing for a potential Hazardous Environmental Condition, and similar reports.
 - d. Supplier instructions, including installation data, and instructions for handling, starting-up, and troubleshooting.
 - e. Source quality control submittals (other than testing plans, procedures, and testing limitations), including results of shop testing.
 - f. Field or Site quality control submittals (other than testing plans, procedures, and testing limitations), including results of operating and acceptability tests at the Site.
 - g. Supplier reports.
 - h. Sustainable design submittals (other than sustainable design closeout documentation).
 - i. Special procedure submittals, including plans for shutdowns and tie-ins and other procedural submittals.
 - j. Qualifications statements.
 - k. Administrative submittals including:
 - 1) Progress Schedules.
 - 2) Schedules of Submittals.
 - 3) Schedules of Values.
 - 4) Photographic documentation.

- 5) Coordination drawings, when submittal of such is required.
 - 6) Copies of permits obtained by CONTRACTOR.
 - 7) Field engineering reports, survey data, and similar information.
 3. Closeout Submittals include:
 - a. Maintenance contracts.
 - b. Operations and maintenance data.
 - c. Bonds, such as special maintenance bonds and bonds for a specific material, equipment item, or system.
 - d. Warranty documentation.
 - e. Record documentation.
 - f. Sustainable design closeout documentation.
 - g. Software.
 - h. Keying.
 4. Maintenance Material Submittals include:
 - a. Spare parts.
 - b. Extra stock materials.
 - c. Tools.
 5. When type of submittal is not specified and is not included in the list above, request an interpretation from ENGINEER and ENGINEER will determine the type of submittal.
- B. Fixed Asset Report Submittals
1. The contractor shall include with each month's pay application a Fixed Asset Report, which is used to officially document the installed inventory of equipment, certain material items, and the structure itself. The report is to be developed in a MS Excel spreadsheet format and will include components of each facility constructed, added, expanded, etc., on the facility site. As work is completed the report will expand, being a cumulative summary of the installed facility work. Gwinnett County has a standard Fixed Asset Form that can be utilized (see example at the end of this section). Pay applications will not be processed until an approved Fixed Asset Report is provided each month.
 2. The format and content of the report to be filled out by the Contractor is as follows:
 - a. Description: Description of the specific asset.

- b. Quantity: The specific number of units installed.
 - c. Unit of Measurement: The method of determining the quantity (ex. Each, LF, CY, etc.).
 - d. Manufacturer Column: The name of the asset manufacturer.
 - e. Serial Number: The specific serial number for the asset.
 - f. Values: The cost of the asset.
- 3. At the conclusion of the project, the cumulative total of cost reported under the Fixed Asset Report will be the total contract value of the work.
 - 4. The report is to be submitted in both printed and electronic format.

C. Sales Tax Report

- 1. To be included with each month's pay application is a Sales Tax Report, which is used to officially document the Georgia Sales Tax expended in the procurement of treatment equipment. All equipment purchased for installation within the pump station site will be documented within this report and will be accounted for by item cost and sales tax paid to the State of Georgia. The report is to be developed in a MS Excel spreadsheet format and will include each equipment item purchased, into which facility it is installed, the cost of the individual equipment item/component/system, and the corresponding tax paid on the individual equipment item/component/system. As work is completed or equipment received, the report will be expanded, being a cumulative summary of the treatment equipment installed within the pump station site.
- 2. The format and content of the report is as follows:
 - a. The report is to be sorted by Area and Structure number in ascending order.
 - b. Column 1 - Labeled "Location": Identifies the location of the inventory included for that area of the facility. For this project, Location shall be designated as "Lanier Filter Plant".
 - c. Column 2 - Labeled "Description": Identifies the specific item being documented. This is to include the structure/facility/building itself and all equipment items within the structure/facility/building or area (e.g. heating and ventilation equipment etc.), all system components (e.g. transformers, VFD, motor control centers, etc.) and all tagged/numbered/discretely identified items or components (e.g. valves, pumps, power panels, etc.).

- d. Column 3 - Labeled "Manufacturer": Identifies the manufacturer of the specific item.
 - e. Column 4 - Labeled "Date of Sale": Identifies the date the invoice for the particular equipment item/component/system was paid.
 - f. Column 5 - Labeled "Item Cost": Identifies the actual cost of the specific item prior to the application of sales tax.
 - g. Column 6 - Labeled "Sales Tax Paid": Identifies the actual Georgia Sales Tax paid for the specific item.
- 3. Each Structure and Area is to have a subtotal line wherein the individual items are summed to develop a Structure/Area value, and the Area subtotals are summed to establish a total Georgia Sales Tax value paid for the work at Lanier filter Plant.
 - 4. The monthly reports shall be accompanied by certified copies of invoices showing the items costs and taxes paid and a copy of the checks used for payment.
 - 5. The report is to be submitted in both printed and electronic format.
- D. Not Included in this Section: Administrative and procedural requirements for following are covered elsewhere in the Contract Documents:
- 1. Requests for interpretations of the Contract Documents.
 - 2. Change Orders, Work Change Directives, and Field Orders.
 - 3. Applications for Payment
 - 4. Reports, documentation, and permit applications required to be furnished by CONTRACTOR to authorities having jurisdiction.

1.3 REQUIREMENTS FOR SCHEDULE OF SUBMITTALS

- A. Informational Submittals: Submit the following:
- 1. Schedule of Submittals:
 - a. Timing:
 - 1) Furnish submittal within time frames indicated in the Contract Documents.
 - 2) Submit updated Schedule of Submittals with each submittal of the updated Progress Schedule.
 - b. Content: In accordance with the General Conditions, as may be modified by the Supplementary Conditions, and this Section. Requirements for content of preliminary Schedule of Submittals and subsequent submittals of the Schedule of Submittals are identical. Identify on Schedule of Submittals all submittals required in the Contract

Documents. Updates of Schedule of Submittals shall show scheduled dates and actual dates for completed tasks. Indicate submittals that are on the Project's critical path. Indicate the following for each submittal:

- 1) Date by which submittal will be received by ENGINEER.
 - 2) Whether submittal will be for a substitution or "or-equal". Procedures for requesting approval of substitutes and "or-equals" are specified in the General Conditions, Section 01 33 00, Substitution Procedures,
 - 3) Date by which ENGINEER's response is required. Not less than 14 days shall be allowed for ENGINEER's review, starting upon ENGINEER's actual receipt of each submittal. Allow increased time for large or complex submittals.
 - 4) For submittals for materials or equipment, date by which material or equipment must be at the Site to avoid delaying the Work and to avoid delaying the work of other contractors, if any.
- c. Prepare Schedule of Submittals using same software, and in same format, specified for Progress Schedules in Section 01 32 16, Progress Schedule.
- d. Coordinate Schedule of Submittals with the Progress Schedule.
- e. Schedule of Submittals that is not compatible with the Progress Schedule, or that does not indicate submittals on the Project's critical path, or that places extraordinary demands on ENGINEER for time and resources, is unacceptable. Do not include submittals not required by the Contract Documents.
- f. In preparing Schedule of Submittals:
- 1) Considering the nature and complexity of each submittal, allow sufficient time for review and revision.
 - 2) Reasonable time shall be allowed for: ENGINEER's review and processing of submittals, for submittals to be revised and resubmitted, and for returning submittals to CONTRACTOR.
 - 3) Identify and accordingly schedule submittals that are expected to have long anticipated review times.

1.4 PROCEDURE FOR SUBMITTALS

B. Submittal Identification System: Use the following submittal identification system, consisting of submittal number and review cycle number.

1. Submittal Number: Shall be separate and unique number correlating to each individual submittal required. Assign submittal numbers as follows:
 - a. First part of submittal number shall be the applicable Specifications Section number, followed by a hyphen.
 - b. Second part of submittal number shall be a three-digit number (sequentially numbered from 001 through 999) assigned to each separate and unique submittal furnished under the associated Specifications Section.
 - c. Typical submittal number for the third submittal furnished for Section 40 05 53, Process Valves, would be “40 05 53-003”.
2. Review Cycle Number: Shall be a letter designation indicating the initial submittal or re-submittal associated with each submittal number:
 - a. “A” = Initial (first) submittal.
 - b. “B” = Second submittal (e.g., first re-submittal).
 - c. “C” = Third submittal (e.g., second re-submittal).
3. Examples:

Example Description	Submittal Identification	
	Submittal No.	Review Cycle
Initial (first) review cycle of the third submittal provided under Section 40 05 53, Process Valves	40 05 53-003-	A
Second review cycle (first re-submittal) of third submittal provided under Section 40 05 53, Process Valves	40 05 53-003-	B

C. Letter of Transmittal for Submittals:

1. Furnish separate letter of transmittal with each submittal. Each submittal shall be for one Specifications Section.
2. At beginning of each letter of transmittal, include a reference heading indicating: CONTRACTOR’s name, OWNER’s name, Project name, Contract designation, transmittal number, and submittal number.

3. For submittals with proposed deviations from requirements of the Contract Documents, letter of transmittal shall specifically describe each proposed variation.
- D. Contractor's Review and Stamp:
1. Contractor's Review: Before transmitting submittals to ENGINEER, review submittals to:
 - a. Ensure proper coordination of the Work;
 - b. Determine that each submittal is in accordance with CONTRACTOR's desires;
 - c. Verify that submittal contains sufficient information for ENGINEER to determine compliance with the Contract Documents.
 2. Incomplete or inadequate submittals will be returned without review.
 3. Contractor's Stamp and Signature:
 - a. Each submittal furnished shall bear CONTRACTOR's stamp of approval and signature, as evidence that submittal has been reviewed by CONTRACTOR and verified as complete and in accordance with the Contract Documents.
 - b. Submittals without CONTRACTOR's stamp and signature will be returned without review. Signatures that appear to be computer-generated will be regarded as unsigned and the associated submittal will be returned without review.
 - c. CONTRACTOR's stamp shall contain the following:

"Project Name: _____
 Contractor's Name: _____
 Contract Designation: _____
 Date: _____

----- *Reference* -----

Submittal Title: _____
 Specifications: _____
 Section: _____
 Page No.: _____
 Paragraph No.: _____
 Drawing No.: _____ of _____
 Location of Work: _____

Submittal No. and Review Cycle: _____
 Coordinated by Contractor with Submittal Nos.: _____

I hereby certify that the Contractor has satisfied Contractor's obligations under the Contract Documents relative to Contractor's review and approval of this submittal.

Approved for Contractor by: _____”

E. Submittal Marking and Organization:

1. Mark on each page of submittal and each individual component submitted with submittal number and applicable Specifications paragraph. Mark each page of each submittal with the submittal page number.
2. Arrange submittal information in same order as requirements are written in the associated Specifications Section.
3. Each Shop Drawing sheet shall have title block with complete identifying information satisfactory to ENGINEER.
4. Package together submittals for the same Specifications Section. Do not furnish required information piecemeal.

F. Format of Submittal and Recipients:

1. Action Submittals and Informational Submittals: Furnish in accordance with Table 01 33 00-A, except that submittals of Samples shall be as specified elsewhere in this Section:

**TABLE 01 33 00-A: SUBMITTAL CONTACTS
AND REQUIRED FORMAT**

	Address for Deliveries	Contact Person	E-mail Address	Format*	No. of Printed Copies
a.	Engineer: ARADIS U.S., Inc., 2839 Paces Ferry Road Suite 1000 Atlanta GA	TBD	TBD@Arcadis.com	E	Zero
b.	Owner: Fayette County Water System 245 McDonough Rd, Fayetteville, GA 30214	TBD	TBD	E	Zero
* Format: E = Electronic files; P = Printed copies. TBD = To Be Determined					

2. Samples:

- a. Securely label or tag Samples with submittal identification number. Label or tag shall include clear space at least four inches by four inches in size for affixing ENGINEER's

review stamp. Label or tag shall not cover, conceal, or alter appearance or features of Sample. Label or tag shall not be separated from the Sample.

- b. Submit quantity of Samples required in Specifications. If quantity of Samples is not indicated in the associated Specifications Section, furnish not less than two identical Samples of each item required for ENGINEER's approval. Samples will not be returned to CONTRACTOR. If CONTRACTOR requires Sample(s) for CONTRACTOR's use, so advise ENGINEER in writing and furnish additional Sample(s). CONTRACTOR is responsible for furnishing, shipping, and transporting additional Samples.
- c. Deliver one Sample to ENGINEER's field office at the Site. Deliver balance of Samples to ENGINEER at address indicated in Table 01 33 00-A, unless otherwise directed by ENGINEER.

3. Closeout Submittals:

- a. Furnish the following Closeout Submittals in accordance with Table 01 33 00-A: maintenance contracts; bonds for specific materials, equipment, or systems; warranty documentation; and sustainable design closeout documentation. On documents such as maintenance contracts and bonds, include on each document furnished original ("wet") signature of entity issuing said document. When original "wet" signatures are required, furnish such submittals in printed form and electronic form to ENGINEER, and to other entities furnish as indicated in Table 01 33 00-A.
- b. Operations and Maintenance Data: Submit in accordance with Section 01 78 23, Operation and Maintenance Data.
- c. Record Documentation: Submit in accordance with Section 01 78 39, Project Record Documentation.
- d. Software: Submit number of copies required in Specifications Section where the software is specified. If number of copies is not specified, provide two copies on compact disc in addition to software loaded on OWNER's computer(s) or microprocessor(s).

4. Maintenance Material Submittals: For spare parts, extra stock materials, and tools, furnish quantity of items specified in associated Specifications Section.

G. Electronic Submittals:

1. Format: Electronic files shall be in “portable document format” (.PDF). Files shall be electronically searchable.
2. Organization and Content:
 - a. Each electronic submittal shall be one file; do not divide individual submittals into multiple files each.
 - b. When submittal is large or contains multiple parts, furnish PDF file with bookmark for each section of submittal.
 - c. Content shall be identical to printed submittal. First page of electronic submittal shall be CONTRACTOR’s letter of transmittal.
3. Quality and Legibility: Electronic submittal files shall be made from the original and shall be clear and legible. Do not submit scans of faxed copies. Electronic file shall be full size of original, printed documents. Properly orient all pages for reading on a computer screen.
4. Provide sufficient Internet service and e-mail capability for CONTRACTOR’s use in transferring electronic submittals, receiving responses to electronic submittals, and associated electronic correspondence. Check not less than once per day for distribution of electronic submittals, electronic responses of submittal, and electronic correspondence related to submittals.
5. Submitting Electronic Files:
 - a. Transmit electronic files in accordance with Section 01 31 26, Electronic Communication Protocols.

H. Distribution:

1. Distribution of ENGINEER’s Response via Electronic Files: Upon completion of ENGINEER’s review, electronic submittal response will be distributed by ENGINEER to
 - a. CONTRACTOR.
 - b. OWNER.
 - c. ENGINEER’s file.
- I. Resubmittals: Refer to the General Conditions for requirements regarding resubmitting required submittals.

1.5 ENGINEER’S REVIEW

- A. Timing: ENGINEER’s review will conform with timing indicated in the Schedule of Submittals accepted by ENGINEER.
- B. Submittals not required by the Contract Documents will not be reviewed by ENGINEER and will not be recorded in ENGINEER’s submittal log.

All printed copies of such submittals will be returned to CONTRACTOR. Electronic copies of such submittals, if any, will not be retained by ENGINEER.

- C. Action Submittals, Results of ENGINEER's Review: Each submittal will be given one of the following dispositions by ENGINEER:
1. Approved: Upon return of submittal marked "Approved", order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER's approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents.
 2. Approved as Corrected: Upon return of submittal marked "Approved as Corrected", order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER's approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents, and in accordance with the corrections indicated in the ENGINEER's submittal response.
 3. Approved as Corrected – Resubmit: Upon return of submittal marked "Approved as Corrected – Resubmit", order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER's approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents, and in accordance with corrections indicated in ENGINEER's submittal response. Furnish to ENGINEER record re-submittal with all corrections made. Receipt of corrected re-submittal is required before materials or equipment covered in the submittal will be eligible for payment.
 4. Revise and Resubmit: Upon return of submittal marked "Revise and Resubmit", make the corrections indicated and re-submit to ENGINEER for approval.
 5. Not Approved: This disposition indicates material or equipment that cannot be approved. "Not Approved" disposition may also be applied to submittals that are incomplete. Upon return of submittal marked "Not Approved", repeat initial submittal procedure utilizing approvable material or equipment, with a complete submittal clearly indicating all information required.
- D. Informational Submittals, Results of ENGINEER's Review:
1. Each submittal will be given one of the following dispositions:
 - a. Accepted: Information included in submittal complies with the applicable requirements of the Contract Documents,

and is acceptable. No further action by CONTRACTOR is required relative to this submittal, and the Work covered by the submittal may proceed, and materials and equipment with submittals with this disposition may be shipped or operated, as applicable.

- b. Not Accepted: Submittal does not indicate compliance with applicable requirements of the Contract Documents and is not acceptable. Revise submittal and re-submit to indicate acceptability and compliance with the Contract Documents.
- 2. The following types of Informational Submittals, when acceptable to ENGINEER, will not receive a written response from ENGINEER. Disposition as “accepted” will be recorded in ENGINEER’s submittal log. When submittals of the following are not acceptable, ENGINEER will provide written response to CONTRACTOR
 - a. Material safety data sheets (MSDS).
 - b. Compaction testing reports.
 - c. Concrete testing reports.
 - d. Manufacturer’s instructions.
- E. Closeout Submittals, Results of ENGINEER’s Review: Dispositions and meanings are the same as specified for Informational Submittals. When acceptable, Closeout Submittals will not receive a written response from ENGINEER. Disposition as “accepted” will be recorded in ENGINEER’s submittal log. When Closeout Submittal is not acceptable, ENGINEER will provide written response to CONTRACTOR.
- F. Maintenance Material Submittals, Results of ENGINEER’s Review: Dispositions and meanings are the same as specified for Informational Submittals. When acceptable, Maintenance Material Submittals will not receive a written response from ENGINEER. Disposition as “accepted” will be recorded in ENGINEER’s submittal log. When Maintenance Material Submittal is not acceptable, ENGINEER will provide written response to CONTRACTOR, and CONTRACTOR is responsible for costs associated with transporting and handling of maintenance materials until compliance with the Contract Documents is achieved.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

3.1 ATTACHMENTS

- A. The documents listed below, and attached following this Section’s “End of Section” designation, are part of this Specification Section.

1. Example Fixed Asset Report Form (one page).
2. Example Sales Tax Report Form (one page).

+ + END OF SECTION + +

Example Fixed Asset Report Form

Asset Class	Description	Asset Main No Text	Account Determination	Inventory Number	Quantity	Unit of Measure	Inventory Note	Cost Center	Plant	Location	Fund
14500402	Generator				1	Each		1912006 0100		Ambercrest PS	504
14500402	Generator				1	Each		1912006 0100		Centerville PS	504
14500402	Generator				1	Each		1912006 0100		M & M Killian Hill PS	504
14500402	Generator				1	Each		1912006 0100		Magnolia Walk PS	504
14500402	Generator				1	Each		1912006 0100		Ridge Road PS	504
14500402	Generator				1	Each		1912006 0100		Sagamore Hills PS	504
14500402	Generator				1	Each		1912006 0100		Suwanee Ck PS	504
14500402	Generator				1	Each		1912006 0100		Northforke Peachtree Ck PS	504
14500402	Automatic Transfer Switch				1	Each		1912006 0100		Ambercrest PS	504
14500402	Automatic Transfer Switch				1	Each		1912006 0100		Centerville PS	504
14500402	Automatic Transfer Switch				1	Each		1912006 0100		M & M Killian Hill PS	504
14500402	Automatic Transfer Switch				1	Each		1912006 0100		Magnolia Walk PS	504
14500402	Automatic Transfer Switch				1	Each		1912006 0100		Ridge Road PS	504
14500402	Automatic Transfer Switch				1	Each		1912006 0100		Sagamore Hills PS	504
14500402	Controller				1	Each		1912006 0100		Northforke Peachtree Ck PS	504
14500103	site work							1912006 0100			504

Vendor	Manufacturer	Acquisition Method	Funding Source	WBS Element	Useful Life	Additional Text	Serial Number	Value
	Kohler			M0745-14-3-03	20		2009785	14700
	Cummins Onan			M0745-14-3-03	20		I120394426	17000
	Kohler			M0745-14-3-03	20		2009782	14700
	Cummins Onan			M0745-14-3-03	20		H030530100	15000
	Cummins Onan			M0745-14-3-03	20		L510311595	15500
	Kohler			M0745-14-3-03	20		2009758	14700
	Cummins Onan			M0745-14-3-03	20		A130441477	322000
	Cummins Onan			M0745-14-3-03	20		A130440437	170000
	Asco			M0745-14-3-03	20		8852700018E	6300
	Cummins Onan			M0745-14-3-03	20		I120391809	4000
	Asco			M0745-14-3-03	20		885271RE	6300
	Asco			M0745-14-3-03	20		885273RE	6000
	Asco			M0745-14-3-03	20		893740RE	6500
	Asco			M0745-14-3-03	20		885270002RE	6300
	Cummins Onan			M0745-14-3-03	20		1097	23106.14
								549791.6

Example Sales Tax Report Form

Item No.	Equipment or machinery	Function	Cost	Sales tax paid	Date paid	Pay Request No.
1	Frames	Cover for valve vault. Valves are an integral part of process piping used in the sprayfields.	\$1,914.00	\$114.84	11/19/1998	2
2	Reinforcing Steel	Used in construction of the irrigation pump station. This pump station pumps wastewater to the sprayfields for land treatment.	\$4,590.00	\$275.40	11/19/1998	2
3	PVC pipe and fittings	Onsite process piping. Piping is an integral part of the treatment process - it conveys wastewater from pump station to sprayfields.	\$23,780.00	\$1,426.80	11/19/1998	2
4	PVC pipe and fittings	Onsite process piping	\$7,354.80	\$441.29	11/19/1998	2
5	PVC pipe and fittings	Onsite process piping	\$10,613.60	\$636.82	11/19/1998	2
6	PVC pipe and fittings	Onsite process piping	\$12,077.20	\$724.63	11/19/1998	2
7	PVC pipe and fittings	Onsite process piping	\$31,223.60	\$1,873.42	11/19/1998	2
8	PVC pipe and fittings	Onsite process piping	\$13,190.40	\$791.42	11/19/1998	2
9	PVC pipe and fittings	Onsite process piping	\$39,672.78	\$2,380.37	11/19/1998	2
10	PVC pipe and fittings	Onsite process piping	\$11,688.80	\$701.33	11/19/1998	2
11	PVC pipe and fittings	Onsite process piping	\$4,477.20	\$268.63	11/19/1998	2
12	PVC pipe and fittings	Onsite process piping	\$7,844.00	\$470.64	11/19/1998	2
13	PVC pipe and fittings	Onsite process piping	\$1,517.40	\$91.04	11/19/1998	2
14	PVC pipe and fittings	Onsite process piping	\$13,190.40	\$791.42	11/19/1998	2
15	Ductile iron pipe and fittings	Onsite process piping	\$32,036.99	\$1,922.22	11/19/1998	2
16	Ductile iron pipe and fittings	Onsite process piping	\$244.26	\$14.86	11/19/1998	2
17	Ductile iron pipe and fittings	Onsite process piping	\$21,760.74	\$1,305.64	11/19/1998	2
18	Ductile iron pipe and fittings	Onsite process piping	\$2,228.21	\$133.69	11/19/1998	2
19	Ductile iron pipe and fittings	Onsite process piping	\$98,561.36	\$5,913.68	11/19/1998	2
20	Flange Bolt Sets	Onsite process piping	\$504.68	\$30.28	11/19/1998	2
21	Drain Valves	Onsite process piping - drain valves prevent freezing damage to sprinkler risers.	\$2,424.40	\$145.46	11/19/1998	2
22	Sprinklers	Onsite process piping - sprinklers irrigate wastewater on forested land for treatment.	\$51,228.40	\$3,073.70	11/19/1998	2
23	Screen	Used in the irrigation pump station to prevent clogging of sprinklers.	\$1,970.00	\$118.20	12/18/1998	3
24	Misc. metals	Onsite process piping - hatch for valve vault	\$1,565.00	\$93.90	12/18/1998	3
25	Misc. metals	Used in construction of the wastewater treatment operations bldg.	\$1,937.00	\$116.22	12/18/1998	3
26	Sprinklers	Onsite process piping - sprinklers irrigate wastewater on forested land for treatment.	\$1,213.44	\$72.81	12/18/1998	3
27	Brass adapters	Onsite process piping - adapter from ball valve to sprinkler on spray sprinkler risers	\$11,151.00	\$669.06	12/18/1998	3
28	Brass adapters	Onsite process piping - adapter from ball valve to sprinkler on spray sprinkler risers	\$2,124.00	\$127.44	12/18/1998	3
29	Tapping Saddles	Onsite process piping	\$5,572.63	\$334.36	12/18/1998	3
30	Gate Valves	Onsite process piping - sprayfield isolation valves	\$6,221.43	\$373.29	12/18/1998	3
31	Flange Bolt Sets	Onsite process piping - sprayfield isolation valves	\$292.68	\$17.56	12/18/1998	3
32	Ductile iron pipe and fittings	Onsite process piping	\$2,777.03	\$166.62	12/18/1998	3

SECTION 01 35 23

SAFETY REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. This Section augments the requirements elsewhere in the Contract Documents regarding CONTRACTOR's responsibilities for safety and protection and includes requirements for CONTRACTOR's safety representative and other safety requirements applicable to the Project.
 - 2. CONTRACTOR shall provide labor, materials, tools, equipment, training, certifications, protective measures, and incidentals shown, specified, and required to comply with CONTRACTOR's obligations under the Contract for safety and protection of personnel and property.
- B. Related sections: provisions of this section are coordinated with, but are not limited to, the following:
 - 1. Section 01 51 05, Temporary Facilities.
 - 2. Section 01 71 33, Protection of the Work and Property.

1.2 QUALITY ASSURANCE

- A. Qualifications:
 - 1. CONTRACTOR's Safety Representative:
 - a. ENGINEER's acceptance of CONTRACTOR's safety representative's qualifications does not in any way mitigate or relieve CONTRACTOR of CONTRACTOR's safety obligations under the Contract Documents.
 - b. CONTRACTOR's safety representative shall possess not less than five years of experience serving as the safety representative on projects similar to or larger in size than this Contract, and for type(s) of construction similar in nature to the Work.
 - c. CONTRACTOR's safety representative shall be experienced in the types of Work to be performed under the Contract and shall be experienced with safety precautions, procedures, and equipment appropriate for the safe performance of the Work.
 - d. Prior to the Effective Date of the Contract, shall have successfully completed a 30-hour OSHA Construction Safety and Health training course, and a 40-hour OSHA Hazardous Materials training course, and training for confined space entry.

- e. CONTRACTOR's safety representative shall be completely experienced with and knowledgeable of all applicable health and safety Laws and Regulations and with good safety practices and shall ensure compliance with such Laws and Regulations and practices at the Site.
- f. Minimum responsibilities of CONTRACTOR's safety representative are indicated in this Section.

B. Regulatory Requirements:

- 1. Conform to safety provisions to the Federal and State Department of Labor Occupational Safety and Health Act (OSH Act), and all other applicable federal, state, county, and local laws, ordinances, codes, the requirements set forth herein, and any regulations that may be specified elsewhere in these Contract Documents.
- 2. Comply with Safety and Health Regulations for Construction, promulgated by the Secretary of Labor under Section 107 of the Contract Work Hours and Safety Standards Act, as set forth in Title 29, CFR and all other laws, codes, and standards that apply.
- 3. The Contractor's failure to thoroughly familiarize himself with the safety provisions shall not relieve him from compliance with the obligations or relieve him of the penalties set forth therein.

1.3 SUBMITTALS

A. Informational submittals: submit the following:

- 1. Emergency contact information, in accordance with Article 0 of this Section.
- 2. Citations:
 - a. Copies of safety citations from authorities having jurisdiction and insurance companies, submitted within 24 hours of CONTRACTOR's receipt of such citations.
- 3. Qualifications Statements:
 - a. CONTRACTOR's Safety Representative: Submit name and qualifications of CONTRACTOR's safety representative, including summary of experience, and training received and valid certifications and accreditations applicable to the Project.

1.4 SAFETY REPRESENTATIVE RESPONSIBILITIES

A. General:

- 1. CONTRACTOR's safety representative shall have appropriate space at the Site to maintain and keep available safety records, up-to-date copies of pertinent safety Laws and Regulations, Material Data Sheets, CONTRACTOR's site-specific health and safety plan, copies of

OWNER's health and safety requirements with which CONTRACTOR shall comply, and the Site safety plan including information concerning foreseeable emergency conditions, and emergency contact information as required in Article 1.5 of this Section.

B. CONTRACTOR'S safety representative's responsibilities include:

1. Duties and responsibilities in accordance with the General Conditions.
2. CONTRACTOR's safety representative shall coordinate with CONTRACTOR's "competent person" required under Laws and Regulations.
3. CONTRACTOR's safety representative shall attend progress meetings in accordance with Section 01 31 19, Progress Meetings.
4. Schedule and conduct safety meetings and safety training programs as required by Laws and Regulations, CONTRACTOR's Site-specific health and safety plan (SSHASP), and good safety practices. Include in the SSHASP a specific schedule (dates) of such meetings and an outline of materials to be covered. Advise ENGINEER prior to the time and place of such meetings. Invite OWNER's personnel to meetings. Instruct CONTRACTOR's employees (and Subcontractors, Suppliers with personnel at the Site, and others for whom CONTRACTOR is responsible) on recognition of hazards, observance of precautions, of the contents of the SSHASP and other safety programs with which CONTRACTOR shall comply, and use of personal protective equipment (PPE) and safety equipment.
5. Determine that operators of specific construction equipment (and permanent equipment used for construction operations) are qualified by training and experience before such personnel are allowed to operate such equipment.
6. Develop and implement emergency response procedures, including names, locations, and contact telephone numbers for emergency services and medical assistance as indicated in requirements for the emergency contact list in Article 1.5 of this Section.
7. Post appropriate notices regarding health and safety Laws and Regulations at locations at the Site and CONTRACTOR's office that afford maximum exposure to personnel.
8. Post appropriate instructions and warning signs in regard to all hazardous areas and hazardous conditions that cannot be eliminated. Identification of such areas shall be based on experience, site surveillance, and severity of the associated hazard. Signage shall not be used in place of appropriate workplace controls.
9. Ascertain via personal inspection that safety Laws and Regulations and safety program requirements are enforced. Make inspections at appropriate frequencies to ensure that machines, tools, and equipment are

in a safe operating condition; and that all work areas are free of hazards to the extent practicable. Implement necessary and timely corrective actions to eliminate unsafe acts and unsafe conditions and submit to ARCADIS daily copy of findings resulting from inspection, using inspection checklist forms established in CONTRACTOR's SSHASP.

10. Submit to ENGINEER copies of safety citations from authorities having jurisdiction and insurance companies within 24 hours of CONTRACTOR's receipt of such citations.
11. Provide appropriate orientation to employees, visitors, Subcontractors, and Supplier personnel at the Site.
12. Perform all related tasks necessary to achieve the highest degree of safety that the nature of the Work allows.

1.5 EMERGENCY CONTACT INFORMATION

- A. CONTRACTOR shall submit list of emergency contact information for 24-hour use throughout the Project. Emergency contact information shall be updated and kept current throughout the Project. If personnel or contact information change, furnish updated emergency contact information list at the next progress meeting.
- B. CONTRACTOR's list of emergency contact information shall include:
 1. CONTRACTOR's project manager's office, field office, and cellular telephone numbers.
 2. CONTRACTOR's Site superintendent's office, field office, and cellular telephone numbers.
 3. CONTRACTOR's foreman's field office and cellular telephone numbers.
 4. CONTRACTOR's safety representative's office and cellular telephone numbers.
 5. Major Subcontractors' and Suppliers' office and cellular telephone numbers of project manager and foreman (when applicable).
- C. Additional emergency contact information:
 1. OWNER's project manager: office and cellular, telephone numbers.
 2. OWNER's central 24-hour emergency telephone number.
 3. ENGINEER's project manager's office and cellular telephone numbers.
 4. ENGINEER's project engineer's office and cellular telephone numbers.
 5. Resident Project Representative's office, field office and cellular telephone numbers.
 6. Utility companies' 24-hour contact telephone number(s), including gas, water, sewer, oil, telephone, cable television/telecommunications, and other companies or concerns having utilities in the vicinity of the Work.

7. Highway and street owners' 24-hour telephone number(s).
8. Emergency telephone numbers, including: "Emergency: Dial 911", and seven-digit telephone numbers for the hospital, ambulance, police, and fire department nearest to the Site. Furnish names of each of these institutions.
9. Other involved entities as applicable.
10. Include with list of emergency contact information an 8.5-inch by 11-inch map showing route from the Site to the nearest hospital.

1.6 SAFETY EQUIPMENT

A. General:

1. CONTRACTOR shall provide proper safety and rescue equipment, adequately maintained and readily available, for any foreseeable contingency.
2. Such equipment shall include items such as safety ropes and harnesses, fall-prevention devices, stretchers, water safety devices, oxygen breathing apparatus, resuscitators, gas detectors, oxygen deficiency indicators, combustible gas detectors, fire extinguishers and first-aid equipment in accordance with the Division 01 Specifications, and similar equipment as appropriate.
3. Keep safety equipment in protected areas. Check safety equipment at scheduled intervals.
4. Temporary First-Aid Facilities: Provide and maintain in accordance with Section 01 51 05, Temporary Facilities.

B. Safety Equipment Log:

1. Maintain a log indicating the person who checked the equipment, when equipment was checked, and that equipment was acceptable.
2. Update equipment log not less-often than monthly.
3. Include in safety representative's onsite records copies of equipment calibration records.

C. Provide replacement safety equipment when primary safety equipment is unavailable due to use or when undergoing maintenance.

D. Personal Protective Equipment (PPE):

1. All persons entering the work areas shall wear appropriate PPE required for the particular area.
2. Remove from the Site any person failing to comply with this or any other safety requirement.
3. Continuously provide all necessary PPE for ENGINEER's employees, Resident Project Representative, and consultants. ENGINEER will furnish for ENGINEER's employees and consultants' protective helmets

(hard hats), safety eyewear, reflective vests, and hearing protection.
CONTRACTOR shall furnish other equipment required.

1.7 EVACUATION DRILL

- A. Included in CONTRACTOR's SSHASP shall be evacuation drills, conducted not less-often than once every six months, held in coordination with existing facility's alarm signal under the control of OWNER's facility manager.
- B. Perform evacuation drill during regular working hours, scheduled to minimize disruption of the Work.
- C. Upon evacuation, CONTRACTOR and all personnel for whom CONTRACTOR is responsible, immediately advise ENGINEER's onsite personnel and OWNER's facility manager that all personnel have been evacuated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 35 43.13

ENVIRONMENTAL PROCEDURES FOR HAZARDOUS MATERIALS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, tools, and incidentals necessary to comply with environmental procedures for Constituents of Concern.
2. CONTRACTOR shall develop, implement, and maintain throughout the Project a hazardous materials management program (HMMP) in accordance with Laws and Regulations.
3. Constituents of Concern Brought to Site by CONTRACTOR: Transport, handle, store, label, use, and dispose of in accordance with this Section, other applicable provisions of the Contract Documents, and Laws and Regulations.
4. Constituents of Concern Generated by CONTRACTOR:
 - a. Materials containing Constituents of Concern shall be properly handled, stored, labeled, transported and disposed of by CONTRACTOR in accordance with Laws and Regulations, and this Section.
 - b. If CONTRACTOR will generate or has generated materials containing Constituents of Concern at the Site, obtain a USEPA identification number listing CONTRACTOR's name and address of the Site as generator of the Constituents of Concern. Obtain identification number from state environmental agency or similar authority having jurisdiction at the Site. Submit identification number within time frame specified in Article 1.3 of this Section.
 - c. CONTRACTOR shall be responsible for identifying, analyzing, profiling, transporting, and disposing of Constituents of Concern generated by CONTRACTOR.
5. Fines or civil penalties levied against OWNER for violations committed at the Site by CONTRACTOR, and costs to OWNER (if any) associated with cleanup of a Hazardous Environmental Condition created by CONTRACTOR shall be paid by CONTRACTOR. If CONTRACTOR has exacerbated a Hazardous Environmental Condition existing at the Site prior to the start of the Work, CONTRACTOR shall pay a share of costs associated with fines, civil penalties, and cleanup costs to in proportion equal to the extent of CONTRACTOR's responsibility for creating the Hazardous Environmental Condition and fines and civil penalties associated therewith.
6. Contractor to coordinate with the OWNER for contact to the environmental representative.

B. Enforcement of Laws and Regulations:

1. Interests of OWNER are that accidental spills and emissions, Site contamination, and injury of personnel at and near the Site are to be avoided.
2. When OWNER is aware of suspected violations, OWNER will notify CONTRACTOR, and authorities having jurisdiction if OWNER reasonably concludes that doing so is required by Laws or Regulations.
3. Responsibilities regarding Laws and Regulations shall be in accordance with the General Conditions, as may be modified by the Supplementary Conditions.

C. Related Sections:

1. Section 01 35 44, Spill Prevention Control and Countermeasures Plan.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with Laws and Regulations, including but not limited to the following:

1. GA EPD

1.3 SUBMITTALS

A. Informational Submittals: Submit the following to the entity(ies) specified for each:

1. Constituents of Concern (including Chemicals) Proposed for Use at the Site:
 - a. Content:
 - 1) Current (dated within the past two years) material safety data sheets (MSDS) in accordance with 29 CFR 1910.1200 (OSHA Hazard Communication Standard).
 - 2) Manufacturer of material or equipment containing such substance.
 - 3) Supplier (if different than manufacturer).
 - 4) Container size(s) and number of containers proposed to be at the Site.
 - 5) Minimum and maximum volume of material intended to be stored at the Site.
 - 6) Description of process or procedures in which Constituent of Concern will be used at the Site.
 - b. Furnish the information required above in sufficient time to obtain OWNER's acceptance not later least three days before bringing Constituent of Concern to the Site.
 - c. Submit to OWNER's environmental representative with copy to ENGINEER.
2. Material Containing Constituents of Concern Generated at the Site:
 - a. Submit for each Constituent of Concern generated at the Site identification number, analysis results, and number and size of storage containers at the Site.
 - b. Furnish such information within not less than 48 hours after CONTRACTOR's receipt of analytical results.
 - c. Submit to OWNER's environmental representative with copy to ENGINEER.
3. Permits:

- a. Submit copies of permits for storing, handling, using, transporting, and disposing of materials containing Constituents of Concern, obtained from authorities having jurisdiction.
 - b. Submit to OWNER's environmental representative with copy to ENGINEER.
4. Other Documents required for the HMMP: Submit to OWNER's environmental representative the requested documents within 72 hours of CONTRACTOR's receipt of such request. HMMP documents may include emergency/spill response plan, communication plan, and other documents.

1.4 HAZARDOUS MATERIALS MANAGEMENT

- A. Obtain OWNER's environmental representative's acceptance before bringing to the Site each material containing a Constituent of Concern.
- B. Communication Plan:
1. CONTRACTOR shall develop a communication plan relative to materials containing one or more Constituents of Concern.
 2. MSDS Notebooks:
 - a. At minimum, maintain at the Site two notebooks containing: 1) Inventory of materials containing a Constituent of Concern (including all chemicals); and, 2) Current (dated within the past two years) material safety data sheets (MSDS) for all materials being used to accomplish the Work, whether or not defined as a Constituent of Concern.
 - b. Keep one notebook in CONTRACTOR's field office at the Site; keep second notebook at location acceptable by OWNER's environmental representative.
 - c. Keep notebooks up-to-date as materials are brought to and removed from the Site.
- C. Emergency/Spill Response Plan: Develop, implement, and maintain an emergency/spill response plan, for each Constituent of Concern or each class/group of material containing a Constituent of Concern, as applicable. At minimum, response plan shall include the following:
1. Description of equipment available at the Site to contain or respond to emergency related to or spill of the material.
 2. Procedures for notifying, and contact information for: authorities having jurisdiction, emergency responders, OWNER, ENGINEER, the public as applicable, and other entities as required.
 3. Response coordination procedures between CONTRACTOR, OWNER, and others as appropriate.
 4. Site plan showing proposed location of Constituents of Concern storage area and location of spill containment/response equipment, and location of storm water drainage inlets and drainage routes, including storm sewers, ditches and swales, and surface waters.

5. Description of Constituent of Concern handling and spill response training provided to CONTRACTOR's and Subcontractors' employees, in accordance with 29 CFR 1926.21(b) and other Laws and Regulations.
 6. Comply with Section 01 35 44, Spill Prevention Control and Countermeasures Plan.
- D. Storage of Materials Containing Constituents of Concern and Storage of Non-Hazardous Materials:
1. Vessels containing materials with a Constituent of Concern shall bear applicable hazard diamond(s).
 2. Container Labeling:
 - a. Properly label each container of consumable materials, whether or not classified as containing a Constituent of Concern.
 - b. Stencil CONTRACTOR's name and, as applicable, Subcontractor's name, on each vessel containing a Constituent of Concern and, for non-hazardous materials, on each container over five-gallon capacity. Containers shall bear securely-attached label clearly identifying contents. Label containers that are filled from larger containers.
 - c. If OWNER becomes aware of unlabeled containers at the Site, OWNER's environmental representative will so advise CONTRACTOR. Properly label container(s) within one hour of receipt of such notice from OWNER or remove container from the Site.
 3. To greatest extent possible, store off-Site materials containing a Constituent of Concern until required for use in the Work.
- E. Area for Storing Materials Containing a Constituent of Concern:
1. Maintain designated storage area for materials containing a Constituent of Concern. Storage area shall include secondary containment to prevent release of spilled or leaking substances. Storage area shall include barriers to prevent vehicles from colliding with storage containers, and shall include protection from environmental factors such as weather.
 2. Provide signage in accordance with Laws and Regulations, clearly identifying the storage area.
- F. Not less than monthly, CONTRACTOR's safety representative shall meet with OWNER's environmental representative to review CONTRACTOR's HMMP documents, procedures, and inspect storage areas and the Site in general, to verify compliance with this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

Environmental Procedures for Hazardous Materials

++ END OF SECTION ++

SECTION 01 35 44

SPILL PREVENTION CONTROL AND COUNTERMEASURES PLAN

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section pertains to spill prevention control and countermeasures applicable to the Project under the provisions of 40 CFR 112 and other Laws and Regulations.
2. CONTRACTOR shall provide all labor, materials, equipment, tools, professional services (when required), and incidentals as shown, specified, and required to comply with Laws and Regulations regarding spill prevention control and countermeasures (SPCC) planning and compliance, including 40 CFR 112.
3. Single Prime Contract: CONTRACTOR shall determine whether a SPCC Plan is required. If SPCC Plan is required, CONTRACTOR shall prepare, implement, and maintain SPCC Plan as required by Laws and Regulations.

1.2 DETERMINATION OF NEED FOR SPCC PLAN FOR PROJECT

A. Determination of Need for SPCC Plan:

1. CONTRACTOR shall determine need for SPCC Plan for the Project.
2. CONTRACTOR's Professional Engineer:
 - a. If the Site will include storage of more than 10,000 gallons of oil in above-ground storage, or if the Site does not comply with oil discharge history criteria specified in 40 CFR 112, CONTRACTOR shall retain a qualified professional engineer to determine need for SPCC Plan for the Project and, if SPCC Plan is required, professional engineer shall prepare or supervise preparation of SPCC Plan for the Project.
 - b. If a professional engineer is not required to prepare the full SPCC Plan for the Project, but the SPCC Plan includes environmentally-equivalent SPCC measures, or impracticality determinations, CONTRACTOR shall retain a qualified professional engineer to prepare and certify those portions of the SPCC Plan dealing with environmentally equivalent measures and impracticality determinations; the balance of the SPCC Plan may be prepared by and be self-certified by CONTRACTOR.
3. Submit to ENGINEER letter presenting results of evaluation of whether a SPCC Plan is required for the Project in accordance with Laws and Regulations.

- B. SPCC Plan is required when the Project activities at the Site meet the following criteria:
1. The Site and activities thereon are not exempt from Laws and Regulations relative to SPCC planning and implementation.
 2. Oil is stored, used, transferred, or otherwise handled at the Site, unless otherwise exempted by Laws and Regulations.
 3. Maximum oil storage capacity at the Site equals or exceeds either of the following thresholds: 42,000 gallons of completely-buried capacity, or 1,320 of above-ground capacity. Capacity includes total storage tank volume and operational storage volume at the Site for contractors and Subcontractors, including bulk storage tanks, containers with 55-gallon storage capacity and larger, mobile tanks located at the Site, and other containers covered by Laws and Regulations. Exempt are motive storage containers, such as those on construction equipment and vehicles. Oil includes petroleum products, fuel oil, hydraulic fluid, oil sludge, oil refuse, oil mixed with wastes other than dredged material, synthetic oil, vegetable oil, animal fats and oils, and other oils defined in Laws and Regulations.
 4. There is reasonable expectation, based on location of the Site, that oil spill would reach navigable waters of the United States or adjoining shorelines.
- C. When SPCC Plan is not required, CONTRACTOR shall ensure that conditions that preclude the need for SPCC Plan for the Project, including the activities of all contractors and Subcontractors working on the Project at the Site, are maintained throughout duration of the Project. Should changes that affect the storage, use, or handling of oil at the Site occur, reassess the need for SPCC Plan for the Project at no additional cost to OWNER and submit to ENGINEER evaluation letter regarding need for SPCC Plan.

1.3 SPCC PLAN AND IMPLEMENTATION

- A. When SPCC Plan is required, develop SPCC Plan and submit for acceptance by OWNER, with copy to ENGINEER. SPCC Plan shall be specific to the Site and the Project and shall include the following:
1. Seal or stamp, original signature, and license number of CONTRACTOR'S professional engineer, when self-certification by CONTRACTOR is not allowed by Laws and Regulations.
 2. Site plan identifying the name (or tag number) and location of each tank and container that will contain a substance regulated in 40 CFR 112 and other Laws and Regulations, including above-ground and buried tanks. Site plan shall indicate general directions of storm water runoff, including storm sewers and drainage inlets (including arrows indicating directions of flow), and storm sewer outfall locations shown and labeled.
 3. For each tank and container shown or indicated on the Site plan, include a table that lists the tank or container's name and tag number, type of oil stored therein, and maximum storage capacity. List total storage capacity of

- all regulated tanks and containers at the Site covered by SPCC Laws and Regulations.
4. Predictions of direction, rate of flow, and total quantity of oil that could be discharged from the Site as result of storage tank or container failure.
 5. Operating procedures that prevent oil spills, including procedures for oil handling, details of secondary containment structures at fuel and oil transfer areas, and details and descriptions of equipment to be used for oil handling, including piping.
 6. Control Structures and Secondary Containment:
 - a. Furnish details of and descriptions of control measures installed at the Site by CONTRACTOR to prevent spill from reaching navigable waters of the United States and associated shorelines, including secondary containment and diversionary structures.
 - b. For on-shore Sites, one of the following must be used, at minimum: dikes, berms, or retaining walls; curbing; culverts, gutters, or other drainage systems; weirs, booms, or other barriers; spill diversion ponds; retention ponds; or sorbent materials.
 - c. Where appropriate, the SPCC Plan shall clearly demonstrate that containment or diversionary structures or equipment are not practical.
 - d. Include brittle fracture evaluation, where required, for field-constructed above-ground storage containers undergoing repair, alteration, construction, or change in service.
 7. Plans for countermeasures to contain, clean up, and mitigate effects of oil spill that reaches navigable waters of the United States or their shorelines, including written commitment of manpower, equipment, and materials to quickly control and remove spilled oil. Include estimation of time required to contain spill after spill occurs.
 8. Contact list and telephone numbers for facility response coordinator, National Response Center, cleanup contractors, and all appropriate federal, state, and local authorities having jurisdiction to be contacted in event of spill or discharge.
 9. Program for monthly inspections of the Site by CONTRACTOR for SPCC Plan compliance. Advise OWNER in writing of each inspection not less than 72 hours in advance.
 10. Measures for Site security relative to oil storage.
 11. Procedures for safely handling mobile containers such as totes, drums, and fueling vehicles and construction equipment that remain at the Site.
 12. Procedures and schedules for periodic testing of integrity of tanks and containers, and associated piping and valves.
 13. Plans for bulk storage container compliance.
 14. Plans for personnel training and oil spill prevention briefings.
 15. For SPCC Plans that do not follow the format listed in Laws and Regulations, provide cross-reference to requirements of Laws and Regulations, including 40 CFR 112.7.

- B. Obtain acceptance of SPCC Plan by OWNER, for coordination with OWNER's Site-specific SPCC Plan, if any.
- C. SPCC Plan shall be reviewed by CONTRACTOR's professional engineer (when professional engineer is required) and OWNER every five years, as applicable. CONTRACTOR shall perform updates and revisions of the Project's SPCC Plan as necessary and submit same in accordance with the provisions of this Section for submittal and acceptance of initial SPCC Plan.
- D. Post a copy of accepted, certified SPCC Plan in conspicuous location at the Site and furnish copies to OWNER, ENGINEER, other contractors, and Subcontractors as appropriate. All contractors shall comply with SPCC Plan.
- E. In event of violation of SPCC Plan or release of oils attributable to construction operations, CONTRACTOR shall:
 - 1. Immediately issue notifications in accordance with Laws and Regulations, including 40 CFR 110 and 40 CFR 112. When required by Laws and Regulations, report to National Response Center, US Environmental Protection Agency, and other authorities having jurisdiction, if any.
 - 2. Have spill clean-up performed in accordance with Laws and Regulations, the SPCC Plan, and requirements of authorities having jurisdiction.
 - 3. Pay fines and civil penalties (or responsible portion thereof) imposed on OWNER by authorities having jurisdiction, and pay costs associated with clean-up of spills.
 - 4. Should cleanup of spills attributable to CONTRACTOR be necessary, no resulting change in the Contract Price or Contract Times will be allowed. Should CONTRACTOR share responsibility for spill and cleanup with another entity, changes in Contract Price and Contract Times, if any, will be proportionate.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. CONTRACTOR's Professional Engineer:
 - a. When required by Laws and Regulations, engage a licensed, registered professional engineer legally qualified to practice in the jurisdiction where the Site is located and experienced in performing engineering services of the type required.
 - b. Submit qualifications data.
 - c. Responsibilities include but are not necessarily limited to:
 - 1) Carefully reviewing Laws and Regulations relative to SPCC.
 - 2) Preparing written requests for clarifications or interpretations of criteria specified in the Contract Documents for submittal to ENGINEER by CONTRACTOR, and obtaining from authorities having jurisdiction clarifications regarding Laws and Regulations as required.

- 3) Preparing or supervising the preparation of letter-report evaluation of need for SPCC Plan in accordance with the Contract Documents. Evaluation shall include professional engineer's seal or stamp, registration number, and original signature.
- 4) When SPCC Plan is required, preparing, supervising the preparation of, or reviewing the SPCC Plan (or designated portions thereof when oil storage at the Site will be 10,000 gallons or less) in accordance with the Contract Documents. SPCC Plan (or designated portions thereof) shall include professional engineer's seal or stamp, registration number, and original signature.
- 5) Periodically re-evaluating the need for SPCC Plan and issuing findings as letter-reports with seal or stamp, license number, and signature. When SPCC Plan is required, periodically evaluating the SPCC Plan and providing recommendations for compliance with Laws and Regulations, in accordance with the Contract Documents.
- 6) Certifying that:
 - a) it is familiar with the Laws and Regulations, including 40 CFR 112, and
 - b) it has visited, examined, and is familiar with the Site, planned modifications to the Site under the Project as such modifications pertain to SPCC Laws and Regulations, and
 - c) it has performed the evaluations and prepared SPCC Plan in accordance with the Contract Documents, and
 - d) procedures for required testing and inspections have been established, and
 - e) the said evaluations and SPCC Plan are adequate for the Project, and
 - f) the said evaluations and SPECC Plan complies with Laws and Regulations, applicable industry standards, and to prevailing standards of practice.

1.5 SUBMITTALS

- A. Informational Submittals: Submit the following:
 1. Certifications: With each evaluation letter and SPCC Plan submittal, include certification signed by preparer of submittal that the submittal complies with the Contract Documents and Laws and Regulations. Signature on all certifications shall be original.
 2. Evaluations:
 - a. Submit letter presenting results of evaluation of whether a SPCC Plan is required for the Project. Submit evaluation not later than fourteen days after the Contract Times commence running, unless longer time is allowed by ENGINEER.
 - b. Submit updated evaluations as required when conditions at the Site change. Submit updated evaluation not later than seven days after the

Spill Prevention Control and Countermeasures Plan

- conditions at the Site change, or within seven days of ENGINEER's request, unless longer time is allowed by ENGINEER.
3. SPCC Plan: When SPCC Plan is required:
 - a. Submit jointly to OWNER and ENGINEER. Submit within 14 days of receipt of ENGINEER's acceptance of evaluation submittal.
 - b. Update and resubmit the SPCC Plan, or acceptable SPCC Plan amendments, as required when conditions at the Site change. Submit updated SPCC Plan or amendments not later than seven days after the change in conditions at the Site change giving rise to the SPCC Plan change or amendment, or within seven days of ENGINEER's request, unless longer time is allowed by ENGINEER.
 4. SPCC Plan Distribution: When SPCC Plan is required, submit copies of letters transmitting SPCC Plan and amendments (if any) to contractors and Subcontractors working at the Site.
 5. Qualifications Statements: CONTRACTOR's professional engineer, when requested by ENGINEER or OWNER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 41 24

PERMIT REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes general requirements relative to permitting requirements of which OWNER and ENGINEER are aware that apply to the Project.
2. CONTRACTOR shall provide labor, materials, equipment, tools, and incidentals shown, specified, and required to obtain required permits and comply with required permits and licenses.
3. Obtain, pay for, and comply with required permits and licenses whether or not indicated in this Section or elsewhere in the Contract Documents.

B. Coordination:

1. Coordinate compliance with permit and license requirements with Work under other Sections and with other contractors, if any, working at the Site.
2. Coordinate with the Progress Schedule the time required to apply for and obtain required permits and licenses. Changes in Contract Times or Contract Price will not be authorized because of timing and costs associated with obtaining permits and licenses required for the Work.

1.2 MUNICIPAL PERMITS AND LICENSES

A. The anticipated necessary permits listed are the responsibility of the Owner and their status is as follows.:

1. Building Permit will be acquired by the Owner through Fayette County Department of Planning and Development and will be provided to the CONTRACTOR.
2. Fees for Building Permit, if necessary, are paid for by the CONTRACTOR, upon acquisition of the permit.

B. Licenses:

1. Municipal licenses are not required for the Work under this Project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 41 26

STORM WATER POLLUTION PREVENTION PLAN AND PERMIT

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes requirements for compliance with storm water pollution prevention plans (SWPPP) and permit(s) applicable to the Project.
2. CONTRACTOR shall comply with the Project's National Pollutant Discharge Elimination System (NPDES) Permit issued by Georgia Environmental Protection Division (EPD). Regarding this permit, CONTRACTOR shall be a co-permittee with OWNER and shall be responsible for providing necessary materials and taking appropriate measures to comply with requirements of the permit and minimize discharge of pollutants in storm water runoff from the Site.
3. Controls – General:
 - a. Prevent discharge of sediment to and erosion from the Site to surface waters, drainage routes, public streets and rights-of-way, and private property, including dewatering operations.
 - b. Prevent trash and demolition and construction debris from leaving the Site via storm water runoff.
 - c. Provide berms, dikes, and other acceptable methods of directing storm water around work areas to drainage routes.
 - d. Prior to starting the Work associated with such discharge, construction-related discharges to publicly owned conveyance or treatment systems shall be approved by owner of system to which the discharge will be directed.
4. Water Quality:
 - a. Do not cause or contribute to a violation of water quality standards, Laws, or Regulations.
 - b. Notify ENGINEER of revisions to the SWPPP necessary to protect receiving water quality and comply with applicable permits. Provide and implement measures to control pollutants in storm water runoff from the Site to prevent:
 - 1) Turbidity increases that will cause a substantial visible contrast to natural conditions.
 - 2) Increase in suspended, colloidal, and settleable solids that would cause sediment deposition or impair receiving water quality and use.
 - 3) Presence of residue from oil and floating substances, visible oil, and globules of grease.
5. CONTRACTOR shall pay civil penalties and other costs incurred by OWNER, including additional engineering, RPR, and inspection services, associated with

non-compliance with applicable permits related to storm water discharges associated with construction activity and sediment and erosion controls associated with the Work. OWNER may deduct as setoffs such amounts from payments due CONTRACTOR.

6. Contract Price includes all material, labor, and other permits and incidental costs related to:
 - a. Preparing SWPPP Revisions and other documents that are CONTRACTOR's responsibility, in accordance with this Section.
 - b. Installing and maintaining structural and non-structural items used in complying with the SWPPP and its revisions.
 - c. Clean-up, disposal, and repairs following wet weather events or spills caused by CONTRACTOR.
 - d. Implementing and maintaining "best management practices", as defined in applicable permits and Laws or Regulations, to comply with requirements that govern storm water discharges at the Site.
 5. Inspections of storm water, sediment, and erosion controls as specified.
- B. Documents: The following are part of the Work included under this Section:
1. Storm Water Pollution Prevention Plan (SWPPP):
 - a. Prepared by OWNER and filed with authorities having jurisdiction over storm water discharges during construction. The SWPPP is part of the Contract Documents.
 2. Sediment and Erosion Control Permit:
 - a. Prepared by OWNER and filed with the authority having jurisdiction over sediment and erosion control during construction. Sediment and erosion control permit is part of the Contract Documents.
 3. SWPPP Revisions:
 - a. Prepared by CONTRACTOR and submitted to ENGINEER.
 - b. CONTRACTOR shall file a SWPPP Revision prior to starting Work at the Site, and as required by authorities having jurisdiction.
 - c. SWPPP Revision shall include CONTRACTOR's proposed temporary means for storm water control during all phases of the Work and include plans for storm water conveyance and retention, as applicable. Coordinate with excavation plan submittals required in Division 31 of the Specifications.
 - d. Should CONTRACTOR-propose deviations to the SWPPP included in the Contract Documents, or if Project-specific modifications of the SWPPP are required because of field conditions, CONTRACTOR shall prepare and submit additional SWPPP Revisions as necessary, in accordance with requirements of authorities having jurisdiction and applicable permits.
 - e. Comply with Article 1.4 of this Section.
 - f. SWPPP Revisions shall use the SWPPP Revision form included in this Section, with supporting documents attached as required, or forms provided by authorities having jurisdiction.

- g. SWPPP Revisions that do not comply with the Contract Documents and are not required by authorities having jurisdiction will be regarded as substitutions, in accordance with the General Conditions and substitution procedures in the Specifications.
- 4. Storm Water Certification Statement:
 - a. To be prepared by CONTRACTOR and submitted to ENGINEER on the form included with this Section, or on a form provided by authority having jurisdiction.
 - b. Do not perform Work at the Site until the Storm Water Certification has been submitted to and accepted by ENGINEER.
- 5. Notice of Intent (NOI):
 - a. Prepared by OWNER or ENGINEER and submitted to authorities having jurisdiction following ENGINEER's receipt and acceptance of CONTRACTOR's SWPPP Revision and preliminary Progress Schedule.
 - b. NOI will be filed with authorities having jurisdiction by ENGINEER within ten days of ENGINEER's acceptance of CONTRACTOR's SWPPP Revision and preliminary Progress Schedule.
 - c. Do not perform Work at Site until NOI is submitted to authorities having jurisdiction.
- 6. Co-permittee Agreement:
 - a. Prepared by CONTRACTOR using forms included with the SWPPP, and submitted to ENGINEER within five days of the date the Contract Times commence running, for signature by OWNER.
 - b. ENGINEER will file co-permittee agreement with authorities having jurisdiction.
 - c. Do not perform Work at the Site until co-permittee agreement is submitted to authorities having jurisdiction.
- 7. Storm Water Inspection Report:
 - a. Prepared by ENGINEER's Resident Project Representative (RPR) using the form included with this Section, or a form provided by authority having jurisdiction.
 - b. Storm water inspection reports will be filed in a log book kept at the Site by RPR. Copy of each report will be furnished to CONTRACTOR upon request.
 - c. Storm water inspection report will be completed for each of the following:
 - 1) Pre-construction: After placement of storm water management measures, including sediment and erosion controls, and temporary field offices and other temporary facilities, prior to starting other Work at the Site.
 - 2) During the Work: Every seven days until Notice of Termination is completed. When the Site is stabilized relative to storm water, erosion, and discharge of sediment, inspection frequency during temporary shutdowns and seasonal shutdowns is once per month until Notice of Termination is completed.

3) Final: Final inspection report will be prepared prior to completion of Notice of Termination.

8. Notice of Termination (NOT):
 - a. Prepared by CONTRACTOR on the form included with storm water permit and submitted to ENGINEER for review and signature by OWNER.
 - b. ENGINEER will submit the NOT to authority having jurisdiction.
 - c. CONTRACTOR shall submit the NOT following completion of all Work that may result in pollution in storm water discharges, including landscaping Work.
 - d. Final Payment will not be made until the NOT is filed with authority having jurisdiction.

D. Coordination:

1. Coordinate requirements of this Section with requirements for earthwork, erosion control, and landscaping in the Contract Documents, applicable permit requirements, and Laws and Regulations.
2. Implement SWPPP controls and practices prior to starting other Work at the Site. Each prime contractor and Subcontractor identified in the SWPPP and SWPPP Revisions shall sign a copy of the storm water certification statement.

1.2 QUALITY ASSURANCE

Qualification requirements for the CONTRACTOR'S inspector, in accordance with applicable state and local laws, regulations, and permits.

- A. Regulatory Requirements: Comply with Laws and Regulations relative to environmental protection and restoration, including:
 1. Storm water permit applicable to the Work and Site.
 2. State and local erosion and sediment control guidelines and requirements,
 3. State and local storm water regulations and guidance.

1.3 SUBMITTALS

- A. Informational Submittals: Submit the following:
 1. Submit the following, in accordance with Paragraph 1.1.C and Article 1.4 of this Section.
 - a. SWPPP Revisions.
 - b. Co-permittee Agreement.
 - c. Storm Water Certification Statement.
 - d. Notice of Termination
 2. Approval to Discharge to Publicly-owned Treatment Works:
 - a. For storm water discharges associated with construction activity that are discharged to a publicly owned conveyance or treatment system, prior to commencing discharges, submit system owner's written approval for such discharges.
 3. Storm Water Site Plan Updates:

- a. Within three days after each storm water inspection, submit updated storm water site plan.

1.4 SWPPP REVISIONS

- A. CONTRACTOR shall prepare a SWPPP Revision in accordance with the Project's storm water permit when:
 1. There is a significant change in design, construction, operation, or maintenance of the Project that significantly affects the potential of discharging pollutants to Waters of the United States and has not otherwise been addressed in the SWPPP.
 2. SWPPP proves to be ineffective relative to:
 - a. eliminating or significantly minimizing pollutants from sources identified in the SWPPP required by the Project's storm water permit, or
 - b. achieving general objectives of controlling pollutants in storm water discharges from permitted construction activity.
 3. Prepare and submit SWPPP Revision identifying prime contractors and Subcontractor responsible for implementing part of the SWPPP.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 INSPECTIONS AND REPAIRS

- A. Perform Site inspections and assessments as required in applicable storm water permit and this Section. Inspections and assessments shall be done by CONTRACTOR's site superintendent or project manager, together with ENGINEER's RPR.
- B. Inspections:
 1. During the Work, relative to the storm water permit, inspections of the Site shall be performed:
 - a. Pre-Construction: After SWPPP controls are provided and prior to starting other Work at the Site.
 - b. During the Work: Every seven days until Notice of Termination is completed and submitted to authority having jurisdiction. When the Site is stabilized relative to storm water, erosion, and discharge of sediment, inspection required frequency during temporary shutdowns and seasonal shutdowns is not less than once per month until Notice of Termination is completed.
 - c. Prior to CONTRACTOR submitting the Notice of Termination.
 2. During each inspection, verify sediment control practices and record the approximate degree of sediment accumulation as percentage of acceptable

sediment storage volume; inspect erosion and sediment control practices and record maintenance performed; observe and record deficiencies relative to implementation of the SWPPP. RPR or ENGINEER will complete Storm Water Inspection Reports and CONTRACTOR shall record and submit the following.

- a. Storm Water Site Plan: On a copy of the Site plan included in the Contract Documents or other map of the Site acceptable to ENGINEER, indicate extent of all disturbed areas and drainage pathways. Indicate areas expected to undergo initial disturbance or significant site work within the next fourteen days.
 - b. Indicate on storm water site plan areas of Site that have undergone temporary or permanent stabilization.
 - c. Indicate on storm water site plan all disturbed areas that have not undergone active site Work during the previous 14 days.
- C. Maintain at the Site a copy of storm water site plans from each storm water inspection and submit each storm water site plan to ENGINEER and RPR. RPR will maintain at the Site a logbook with a copy of each Storm Water Inspection Report.
- D. Cooperate with representatives of authorities having jurisdiction during their periodic visits to the Site, and promptly furnish information requested by authorities having jurisdiction.
- E. Perform repairs to SWPPP controls, in accordance with applicable requirements and to satisfaction of ENGINEER, within two days of each inspection.

3.2 ATTACHMENTS

- A. The documents listed below, following this Section's "End of Section" designation, are part of this Specifications Section. Notice of Intent (NOI) form, Co-permittee Agreement form, and Notice of Termination (NOT) form are included with storm water permit.
1. Storm Water Inspection Report form (two pages).
 2. Storm Water Permit Certification form (one page).
 3. SWPPP Revision Form (one page).
 4. Storm Water Permit.
 5. Sediment and Erosion Control Permit.

++ END OF SECTION ++

STORM WATER INSPECTION REPORT

Owner: Site: Project: Contractor:

Date of Inspection: _____

Day of Week:

S	M	T	W	T	F	S

Sheet No. _____ of _____ Sheets

If pertinent to the Operation	
Weather	
Temperature	

This inspection and maintenance form is to be used when the Work is subject to a Storm Water General Permit for Construction Activity. Inspections shall be performed not less than once every seven calendar days; for sites that are stabilized and temporarily shut down inspections may be reduced to once per month. Each erosion and sediment control measure installed on the Site is to be inspected and the Contractor must complete all required maintenance within two calendar days from the date of inspection.

- Reason for this inspection:**
- ☐ Pre-construction Site assessment
 - ☐ Seven calendar day inspection
 - ☐ Monthly inspection (when Site is stabilized and shut down)
 - ☐ Post-construction inspection prior to Notice of Termination

Key for erosion and sediment control measures to be inspected: [Use the following designations in the table below] (1) mulch, (2) seed and mulch, (3) check dams, (4) hay bale/straw bales, (5) silt fence, (6) sediment trap, (7) turbidity curtains, (8) pipe slope drains, (9) drainage structure inlet protection, (10) rolled erosion control products, (11) soil stabilizers, (12) construction entrances, (13) pipe inlet/outlet protection, (14) water diversion structures, (15) sedimentation basins, (16) cofferdams, (17) Other _____.

ID	Location	Disturbance		Measure		Remarks (Evaluate integrity of measure, describe evidence of erosion)	Approximate Sediment Accumulation (% of Depth)	Maintenance Required? (Y or N) (If Yes, Describe Below)
		Existing? (Y or N)	Next 14 Days? (Y or N)	Code #	Temp or Perm? (T, P or NA)			
1								
2								
3								
4								
5								
6								
7								
8								

ID	Location	Disturbance		Measure		Remarks (Evaluate integrity of measure, describe evidence of erosion)	Approximate Sediment Accumulation (% of Depth)	Maintenance Required? (Y or N) (If Yes, Describe Below)
		Existing? (Y or N)	Next 14 Days? (Y or N)	Code #	Temp/Perm or N/A? (T, P or NA)			
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

DESCRIPTION OF REQUIRED MAINTENANCE AND ANY EXISTING DEFICIENCIES IN THE SWPPP:
Specify for each location using row ID number.

I certify under penalty of Law that this document and all attachments were prepared under my direction or supervision in accordance with a system to ensure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that false statements made herein may be punishable by Law.

Signature: _____ Prepared: _____ Copy to Contractor: _____
Resident Project Representative (Date) (Date)

Qualified Professional Name _____
(w/Firm Name, if Consultant)

STORM WATER PERMIT CERTIFICATION

Contract Number: _____ Project: _____

Owner: _____

Each Contractor and Subcontractor identified in the Storm Water Pollution Prevention Plan (SWPPP) must certify that they understand the permit conditions and their responsibilities. Every Contractor and Subcontractor performing an activity that involves soil disturbance shall sign this certification and submit it to the Engineer prior to performing the Work. This certification shall be signed by an owner, principal, president, secretary, or treasurer of the firm.

I certify under penalty of law that I understand and agree to comply with the terms and conditions of the SWPPP for the construction Site identified in such SWPPP as a condition of authorization to discharge storm water. I also understand that my firm and its employees and Subcontractors shall comply with the terms and conditions of Owner's general permit for storm water discharges from construction activities and that it is unlawful for any person to cause or contribute to a violation of water quality standards, Laws, or Regulations.

Firm: _____

Address: _____

City: _____ State _____ Zip _____

Name (Print) Signature Date

Title

STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REVISION

Owner:
Site:
Project:
Contractor:

Date of Inspection: _____

Sheet No. _____ of _____ Sheets

This form shall be used when revisions to the current Storm Water Pollution Prevention Plan (SWPPP) are required by the Storm Water General Permit for Construction Activity or the Contract Documents.

Reason for the Revision(s): Revisions were requested by State: ☐ Yes ☐ No

Describe the Revision(s) to the SWPPP: _____

I certify under penalty of Law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that false statements made herein may be punishable by Law.

Signature: _____ Prepared: _____ Submitted: _____

(Date)

(Date)

Copy to: ☐ Engineer ☐ Contractor _____

SECTION 01 41 27

EARTHMOVING PERMIT AND DUST CONTROL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes requirements for controlling fugitive dust emissions resulting from construction activities, including earthmoving, in coordination with Laws and Regulations.
2. CONTRACTOR shall obtain, pay for, and comply with permits required for earthmoving and dust control required because of dust-generating operations related to the Work, and shall develop and comply with provisions of dust control plan.
3. Obtain earthmoving permit from required jurisdiction.
4. Provide necessary labor, materials, equipment, tools, services, and incidentals to: apply sufficient dust suppressants; properly clean all track-out areas to driveways, roadways, and highways; and provide adequate physical stabilizations of soils to comply with earthmoving permits and accepted dust control plan.
5. Control fugitive dust generation from CONTRACTOR's operations including the following:
 - a. Construction areas.
 - b. Vehicle and equipment parking areas.
 - c. Material and equipment storage areas.
 - d. Field office area(s) and staging areas.
 - e. Haul and access roadways.
 - f. Track-out areas.
 - g. Other areas where CONTRACTOR will work, store materials or equipment, or park vehicles and equipment.
6. Do not cause or allow dust-generating operations, earthmoving operations, use of property, or other operations that result in fugitive dust emissions that exceed limits prescribed by authorities having jurisdiction.
7. Pay fines and civil penalties incurred by OWNER because of CONTRACTOR's actions or violations of earthmoving permits and dust control plan. OWNER may deduct as set-offs such amounts from payments due CONTRACTOR.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:

- 1 Dust Control Plan:

- a. Prepare and submit to ENGINEER and OWNER in accordance with Article 1.4 of this Section. Submit within the earlier of 30 days after the Contract Times commence running or prior to commencing earth-disturbing operations at the Site.
2. Earthmoving Permit:
 - a. Submit copy of permits obtained from authorities having jurisdiction, within seven days of CONTRACTOR's receipt of such permits. Do not commence earthmoving operations at the Site until required permits are obtained and submitted to ENGINEER.
3. Daily Logs and Reasonably-Available Control Measures (RACM) Records:
 - a. Submit upon request of OWNER or ENGINEER.
4. Field Quality Control Submittals:
 - a. When opacity monitoring is required, submit results not later than two days following completion of observations.

1.3 POSTING AND RECORDKEEPING

- A. Post copy of earthmoving permit and accepted dust control plan at conspicuous location at the Site.
- B. Recordkeeping:
 1. Maintain daily written log to record the actual application or implementation of reasonably-available control measures (RACM) described in the accepted dust control plan.
 2. Maintain the written log and supporting documentation at the Site, and submit copies to ENGINEER or OWNER upon request.
 3. Retain copies of dust control plan, RACM implementation records, and supporting documentations for not less than three years after Substantial Completion of the entire Project.

1.4 DUST CONTROL PLAN

- A. Prepare and submit to ENGINEER and OWNER a dust control plan that includes the following:
 1. Names, address, office and cellular telephone numbers, and e-mail address of person(s) responsible for preparing and overseeing implementation of dust control plan. Designate one person responsible for overseeing implementation of dust control plan for the Project.
 2. Name(s), address(es), office and cellular telephone numbers, and e-mail addresses of person(s) responsible for dust generating operations.
 3. Site plan delineating total area of land surface to be disturbed. Delineate each area of phased disturbances, when applicable.
 4. Total disturbed area in acres; earthmoving and dust-generating operations and activities to be performed at the Site; actual and potential sources of fugitive dust emissions; and delivery, transportation, and storage areas for the Site, including types of materials stored and appropriate size of material stockpiles.

5. Description of reasonably-available control measures (RACM) to be implemented during dust-generating operations at actual and potential sources of fugitive dust.
6. Description of dust suppressants to be used including product data and material safety data sheets (MSDS); method, frequency, and intensity of application; type, number, and capacity of application equipment; and certifications related to the suppressant's appropriate and safe use.
7. Description of specific surface treatment(s) or RACM proposed for controlling material deposition along paved surfaces (e.g., "track-out" areas) where unpaved Site surfaces or Site access points meet paved surfaces.
8. As contingency measure, designate and include description of not less than one alternative RACM for each actual and potential fugitive dust source.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Testing and Monitoring.
 1. Upon direction of OWNER or ENGINEER, obtain opacity observations for visible emissions of fugitive dust.
 2. Opacity Monitoring Method:
 - a. USEPA Method 9, Visual Determination of Opacity of Emissions from Stationary Sources (Emission Measurement Technical Information Center Test Method 009).
 3. Location and Frequency of Opacity Observations:
 - a. Obtain opacity observations from not less than six locations at downwind perimeter of the Site during construction operations.
 - b. Perform opacity monitoring at frequency required by applicable earthmoving/dust control permit, unless more-frequent monitoring is required by OWNER or ENGINEER.
 4. Qualifications: Opacity monitoring observations shall be by person trained and experienced with the opacity monitoring method specified.
 5. Prepare and submit to ENGINEER written report of results of opacity monitoring and observations.
 6. No additional compensation or addition to the Contract Times will be authorized for opacity observations.

+ + END OF SECTION + +

SECTION 01 42 00

REFERENCES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Section includes the following:
 - a. Definitions and terminology in general use in the Contract Documents.
 - b. Applicable codes.
 - c. Abbreviations in general use throughout the Contract Documents.
 - d. General requirements regarding reference standards, including a listing of standard-issuing organizations (and their acronyms) used in the Contract Documents.

1.2 DEFINITIONS AND TERMINOLOGY

- A. Definitions and terminology applicable to all the contract documents are included in the general conditions, as may be modified by the supplementary conditions.
- B. Additional terminology used in the Contract Documents includes the following:
 1. “Indicated” refers to graphic representations, notes, or schedules on the Drawings, or to other paragraphs, provisions, tables, or schedules in the Specifications and similar locations in the other Contract Documents. Terminology such as “shown”, “noted”, “scheduled”, and “specified” are used to help the user locate the reference without limitation on the location.
 2. “Installer”, “applicator”, or “erector” is CONTRACTOR, or another person or entity engaged by CONTRACTOR, either as an employee or Subcontractor, to perform a particular construction activity, including installation, erection, application, or similar Work. Installers shall be experienced in the Work that installer is engaged to perform.
 - a. The term “experienced”, when used in conjunction with the term “installer”, means having successfully completed not less than five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated and required; being familiar with Laws and Regulations; and having complied with requirements of

authorities having jurisdiction, and complying with requirements of the Supplier of the material or equipment being installed, unless other experience requirements specific to that element of the Work are indicated elsewhere in the Contract Documents.

3. Trades: Use of terms such as “carpentry” does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as “carpenter”, unless otherwise indicated in the Contract Documents or required by Laws or Regulations. Such terminology also does not imply that specified requirements apply exclusively to trade personnel of the corresponding generic name.

1.3 APPLICABLE CODES

- A. References in the Contract Documents to local code(s) shall mean the following:
 1. National Electric Code in effect at the location of the Project.
 2. NFPA 101, Life Safety Code.

1.4 ABBREVIATIONS

- A. Common abbreviations that may be found in the Contract Documents are indicated below, alphabetically by their written-out meaning:

alternating current	a-c
ampere	A
antemeridian	a.m.
Architectural Barriers Act	ABA
Americans with Disabilities Act	ADA
Americans with Disabilities Act Accessibility Guidelines	ADAAG
average	avg
biochemical oxygen demand	BOD
five-day biochemical oxygen demand	BOD5
brake horsepower	bhp
British thermal unit	Btu
building information model	BIM
carbonaceous biochemical oxygen demand	CBOD
five-day carbonaceous biochemical oxygen demand	CBOD5
chemical oxygen demand	COD
Centigrade (or Celsius)	C

chlorinated polyvinyl chloride	CPVC
chlorofluorocarbons	CFC
Code of Federal Regulations	CFR
computer-aided drafting and design	CADD, or CAD
cubic inch	cu in
cubic foot	cu ft
cubic yard	cu yd, or CY
cubic feet per minute	cfm
cubic feet per second	cfs
decibel	db
degree Centigrade (or Celsius) (Write)	degrees C, oC, or deg C
degrees Fahrenheit	degrees F, oF, or deg F
diameter	dia
direct current	d-c
dollars	\$
each	ea
efficiency	eff
Fahrenheit	F
feet	ft
feet per hour	fph, or ft/hr
feet per minute	fpm
feet per second	fps, or ft/min
figure	fig
flange	flg
foot-pound	ft-lb
gallon	gal
gallons per hour	gph, or gal/hr
gallons per minute	gpm
gallons per second	gps
gram	g
grams per liter	g/L
Hertz	Hz
horsepower	hp or HP
hour	hr
human-machine interface	HMI
inch	in.
inches of mercury	in. Hg
inches water gage	in. w.g.
inch-pound	in.-lb
inside diameter	ID

iron pipe size	IPS
thousand pounds	kips
thousand pounds per square inch	ksi
kilovolt-ampere	kva
kilowatt	kw
kilowatt-hour	kwhr or kwh
linear foot	lin ft or LF
liter	L
Leadership in Energy and Environmental Design (USGBC)	LEED
maximum	max
mercury	Hg
milligram	mg
milligrams per liter	mg/l or mg/L
milliliter	ml
millimeter	mm
million gallons per day	mgd or MGD
million gallon	MG
minimum	min
national pipe threads	NPT
net positive suction head	NPSH
net positive suction head available	NPSHA
net positive suction head required	NPSHR
nitrogen oxide (total concentration of mono-nitrogen oxides such as nitric oxide (NO) and nitrogen dioxide (NO ₂))	NO _x
nominal pipe size	NPS
number	no.
operator interface terminal	OIT
ounce	oz
ounce-force	ozf
outside diameter	OD
parts per hundred	pph
parts per million	ppm
parts per billion	ppb
polyvinyl chloride	PVC
post meridian	p.m.
pound	lb
pounds per square inch	psi
pounds per square inch absolute	psia
pounds per square inch gauge	psig

pounds per square foot	psf
process control system	PCS
programmable logic controller	PLC
revolutions per minute	rpm
second	sec
specific gravity	sp gr, or SG
square	sq
square foot	sq ft, sf, or ft ²
square inch	sq in., or in ²
square yard	sq yd, or SY
standard	std
standard cubic feet per minute	scfm
total dynamic head	TDH
totally-enclosed fan-cooled	TEFC
volt	V
volts alternating current	vac
volts direct current	vdc
volatile organic compounds	VOC

1.5 REFERENCE STANDARDS

- A. Copies of Standards: Each entity engaged in the Work shall be familiar with reference standards applicable to its construction activity. Copies of applicable reference standards are not bound with the Contract Documents. Where reference standards are needed for a construction activity, obtain copies of standards from the publication source.
- B. Abbreviations and Names: Where reference standards, specifications, codes, manuals, Laws or Regulations, or other published data of international, national, regional or local organizations are referred to in the Contract Documents, the organization issuing the standard may be referred to by their acronym or abbreviation only. The following acronyms or abbreviations that may appear in the Contract Documents shall have the meanings indicated below. Listing is alphabetical by acronym.

Standard	Title
AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACS	American Chemical Society
ADSC-IAFD	International Association of Foundation Drilling.

Standard	Title
AEIC	Association of Edison Illuminating Companies
AF&PA	American Forest and Paper Association
ABMA	American Bearing Manufacturers Association (formerly Anti-Friction Bearing Manufacturers Association (AFBMA))
AGMA	American Gear Manufacturers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AIChE	American Institute of Chemical Engineers
AISC	American Institute of Steel Construction
ISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standards Committee
AMA	Acoustical Materials Association
AMCA	Air Movement and Control Association
AMP	National Association of Architectural Metal Manufacturers, Architectural Metal Products Division
ANSI	American National Standards Institute
APA	The Engineered Wood Association
APHA	American Public Health Association
API	American Petroleum Institute
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ASQ	American Society for Quality
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWCI	Association of the Wall and Ceiling Industry
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BAAQMD	Bay Area Air Quality Management District
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association
CBMA	Certified Ballast Manufacturers Association

Standard	Title
CDA	Copper Development Association
CEMA	Conveyor Equipment Manufacturers Association
CGA	Compressed Gas Association
CISCA	Ceilings and Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CMAA	Crane Manufacturers Association of America
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DIN	Deutsches Institut für Normung eV (German Institute for Standardization)
DIPRA	Ductile Iron Pipe Research Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ETL	Intertek Testing Services, Inc. (formerly ETL Testing Laboratories, Inc.)
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FM	Factory Mutual (FM Global)
FRPI	Fiberglass Reinforced Plastics Institute
FS	Federal Specification
GA	Gypsum Association
GANA	Glass Association of North America
HEW	United States Department of Health, Education and Welfare
HI	Hydraulic Institute
HMI	Hoist Manufacturers Institute
HUD	United States Department of Housing and Urban Development
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFI	Industrial Fasteners Institute
IRI	Industrial Risk Insurers
ISA	Instrumentation, Systems, and Automation Society (formerly Instrument Society of America)
ISO	Insurance Services Office
ISO	International Organization for Standardization
LPI	Lightning Protection Institute

Standard	Title
MIA	Marble Institute of America
ML/SFA	Metal Lath/Steel Framing Association
MS	Military Specifications
MSS	Manufacturers' Standardization Society
MMA	Monorail Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators, Inc.
NARUC	National Association of Regulatory Utilities Commissioners
NBHA	National Builders Hardware Association
NBS	United States Department of Commerce, National Bureau of Standards
NCMA	National Concrete Masonry Association
NEC	National Electric Code
NELMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NHPMA	Northern Hardwood and Pine Manufacturers Association
NIST	United States Department of Commerce, National Institute of Standards and Technology
NLGA	National Lumber Grades Authority
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	National Sanitation Foundation
NSSGA	National Stone, Sand, and Gravel Association
NTMA	National Terrazzo and Mosaic Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PEI	Porcelain Enamel Institute
PFI	Pipe Fabrication Institute
PPI	Plastics Pipe Institute
PGMC	Primary Glass Manufacturers Council
PS	Product Standards Section, United States Department of Commerce

Standard	Title
RCSC	Research Council on Structural Connections (part of AISC)
RMA	Rubber Manufacturers Association
SAE	Society of Automotive Engineers
SCAQMD	Southern California Air Quality Management District
SCPRF	Structural Clay Products Research Foundation
SCTE	Society of Cable Telecommunications Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturing Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
SPI	Society of the Plastics Industry
SPIB	Southern Pine Inspection Bureau
SSPC	Society for Protective Coatings
SWI	Steel Window Institute
TCNA	Tile Council of North America
TEMA	Tubular Exchanger Manufacturers Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
UL	Underwriters Laboratories, Inc.
USAB	United States Access Board
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USGBC	United States Green Building Council
USGS	United States Geological Survey
USPHS	United States Public Health Service
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WCMA	Wood Component Manufacturers Association
WDMA	Window and Door Manufacturers Association
WEF	Water Environment Federation
WWEMA	Water and Wastewater Equipment Manufacturers Association
WWPA	Western Wood Products Association

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 43 00

QUALITY ASSURANCE

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section covers Quality Assurance and Quality Control requirements for this contract.
- B. The Contractor is responsible for controlling the quality of work, including work of its subcontractors, and suppliers and for assuring the quality specified in the Technical Specifications is achieved.
- C. Refer to the General Conditions Article 6 - Contractor's Responsibilities, paragraphs 6.01, 6.02, and 6.03.

1.2 SUMMARY:

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting 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 construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and control services required by, including but not limited to, Engineer, Owner, or authorities having jurisdiction, are not limited by provisions of this Section.
- C. Related Requirements:
 - 1. Divisions 01 through 46 Sections for specific test and inspection requirements.

1.3 REFERENCES:

- A. American Society for Testing and Materials (ASTM):
 - 1. E329: Standard Specification for Agencies Engaged in Construction Inspection and/or Testing

1.4 DEFINITIONS:

- A. 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.

- B. 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. Services do not include contract enforcement activities performed by Engineer.
- C. 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.
- D. Product Testing: Tests and inspections that are performed by a Nationally Recognized Testing Laboratory (NRTL), an (National Voluntary Laboratory Accreditation Program (NVLAP), or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. 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, 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).
- I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five (5) 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.

1.5 CONFLICTING REQUIREMENTS:

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision

before proceeding.

- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.6 SUBMITTALS:

- A. Shop Drawings: Provide plans, sections, dimensions, and elevations, indicating materials and size of proposed construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
- B. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- C. Qualification Data: For Contractor's quality-control personnel.
- D. 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.
- E. 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.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN:

- A. Quality Control Plan, General: Submit quality-control plan within thirty (30) days of Notice to Proceed. 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 full-time 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.
 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 accepted mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of accepted 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.

1.8 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, and telephone number 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 inspecting.

11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector, as applicable.
 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, and telephone number 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, and telephone number 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.
- D. Permits, Licenses, and Certificates: For Owner's records, 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.
- 1.9 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.
- 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, 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.
- 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 inspecting indicated, as documented according to ASTM E329; 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. Build site-assembled test assemblies and mockups using installers

who will perform same tasks for Project.

- d. When testing is complete, remove test specimens, assemblies; 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 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.
 - K. Codes and Standards: Refer to General Conditions Article 3 - Contract Documents: Intent, Amending, Reuse, paragraph 3.02 of the General Conditions.
 - L. Copies of applicable referenced standards are not included in the Contract Documents. Where copies of standards are needed by the Contractor for superintendence and quality control of the work, the Contractor shall obtain a copy or copies directly from the publication source and maintain at the jobsite, available to the Contractor's personnel, subcontractors, and Engineer
 - M. Quality of Materials: Unless otherwise specified, all materials and equipment furnished for permanent installation in the Work shall conform to applicable standards and specifications and shall be new, unused, and free from defects and imperfections, when installed or otherwise incorporated in the Work. The Contractor shall not use material and equipment for any purpose other than that intended or specified unless the Engineer authorizes such use.
 - N. Where so specified, products or workmanship shall also conform to the additional performance requirements included within the Contract Documents to establish a higher or more stringent standard or quality than that required by the referenced standard.
- 1.10 OFFSITE INSPECTION:
 - A. When the specifications require inspection of materials or equipment during the production, manufacturing, or fabricating process, or before shipment, such services shall be performed by the Owner's independent testing laboratory, or inspection organization acceptable to Engineer in conjunction with or by the Engineer.
 - B. The Contractor shall give appropriate written notice to the Engineer not less than thirty (30) days before offsite inspection services are required, and shall provide for the producer, manufacturer, or fabricator to furnish safe access and proper facilities and to cooperate with inspecting personnel in the performance of their duties.
- 1.11 MATERIALS AND EQUIPMENT:
 - A. The Contractor shall maintain control over procurement sources to ensure that materials and equipment conform to specified requirements in the Contract Documents.
 - B. The Contractor shall comply with manufacturer's printed instructions regarding all facets of materials and/or equipment movement, storage, installation, testing, startup, and operation. Should circumstances occur where the contract documents

are more stringent than the manufacturer's printed instructions, the Contractor shall comply with the specifications. In cases where the manufacturer's printed instructions are more stringent than the contract documents, the Contractor shall advise the Engineer of the disparity and conform to the manufacturer's printed instructions. In either case, the Contractor is to apply the more stringent specification or recommendation, unless accepted otherwise by the Engineer.

1.12 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 inspecting they are engaged to perform.
 - 2. The Contractor shall furnish a construction schedule and a minimum of 48 hour notice of readiness for testing and inspection of the work. The Engineer shall determine the exact time and location of field sampling and testing, and may require such additional sampling and testing to determine that materials and equipment conform with data previously furnished by Contractor and with the Contract Documents.
 - 3. The Contractor shall schedule the work to permit adequate time for testing and re- testing should test results not conform to the contract documents. Lack of testing or inspection which is attributable to insufficient notice by the Contractor or failure of the Contractor to cooperate, will be cause for rejection of the work.
 - 4. The Contractor shall deliver materials in sufficient quantities to the Owner's testing agency as may be required. Laboratory testing shall be performed within a reasonable time, consistent with the specified standards.
 - 5. The Contractor shall furnish material samples and cooperate in the field sampling and testing activities, interrupting the work when necessary. The Contractor shall furnish personnel, facilities and access to assist in the sampling and testing activities.
 - 6. 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 required to verify that the Work complies with requirements, whether specified or not.
 - 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. Monitor quality control over suppliers, manufacturers, products, services,

site conditions, and workmanship, to produce Work of specified quality.

3. Comply with manufacturers' instructions, including each step in sequence.
4. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
5. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
6. Perform Work by persons qualified to produce required and specified quality.
7. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.
8. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
9. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner
10. Notify testing agencies at least twenty-four (24) hours in advance of time when Work that requires testing or inspecting will be performed.
11. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
12. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
13. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Tolerances:

1. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
2. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
3. Adjust products to appropriate dimensions; position before securing products in place.

D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections.

E. 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.

- F. 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.
- G. 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 location 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 any duties of Contractor.
- H. Associated Services: Cooperate with agencies 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 inspecting. 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 inspecting equipment at Project site.
- I. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

- J. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. 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.

1.13 SPECIAL TESTS AND INSPECTIONS:

- A. Special Tests and Inspections: Owner will engage a qualified agency to conduct special tests and inspections required, as follows:
 - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 - 2. Notifying Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 - 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Engineer with copy to Contractor and to authorities having jurisdiction.
 - 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 - 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 - 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION:

- A. Clean substrate surfaces prior to applying next material or substance.

- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

3.3 QUALITY CONTROL:

- A. Quality control is the responsibility of the Contractor, and the Contractor shall maintain control over construction and installation processes to assure compliance with specified requirements.
- B. Certifications for personnel, procedures, and equipment associated with special processes (e.g., welding, cable splicing, surveying) shall be maintained by the Contractor, available for inspection by the Engineer. Copies shall be made available to the Engineer upon request.
- C. Means and methods of construction and installation processes are the responsibility of the Contractor, and at no time is it the intent of the Engineer to supersede or void that responsibility.

3.4 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.

3.5 REPAIR AND PROTECTION:

- A. General: On completion of testing, inspecting, 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 Section 01 73 29 Cutting and Patching.
- 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 ++

SECTION 01 45 29

TESTING LABORATORY SERVICES

PART 1 – GENERAL

1.1 SCOPE:

- A. This Section includes testing which the Owner may require, beyond that testing required of the manufacturer, to determine if materials provided for the Project meet the requirements of these Specifications.
- B. This work also includes all testing required by the Owner to verify work performed by the Contractor is in accordance with the requirements of these Specifications, i.e., concrete strength, slump testing, soil compaction, etc.
- C. This work does not include materials testing required in various sections of these Specifications to be performed by the manufacturer.
- D. The testing laboratory or laboratories will be selected by the Owner. The testing laboratory or laboratories will work for the Owner.

1.2 PAYMENT FOR TESTING SERVICES:

- A. Testing services will be directed by the owner and paid by the Contractor. Testing services to be completed by Owner selected testing provider.
- B. The cost of material testing described in various sections of these Specifications or as required in referenced standards to be provided by a material manufacturer, shall be included in the price bid for that item and shall not be paid for by the Owner.
- C. The cost of retesting any item that fails to meet the requirements of these Specifications shall be paid for by the Contractor. Retesting shall be performed by the testing laboratory working for the Owner.

1.3 LABORATORY DUTIES:

- A. Cooperate with the Owner, Engineer and Contractor.
- B. Provide qualified personnel promptly on notice.
- C. Perform specified inspections, sampling and testing of materials.
 - 1. Comply with specified standards, ASTM, other recognized authorities, and as specified.
 - 2. Ascertain compliance with requirements of the Contract Documents.
- D. Promptly notify the Engineer and Contractor of irregularity or deficiency of work which are observed during performance of services.
- E. Promptly submit three (3) copies of report of inspections and tests in addition to those additional copies required by the Contractor; one (1) copy to the Owner, one (1) copy

to the Engineer, and one (1) copy to the Contractor, with the following information included:

1. Date issued
 2. Project title and number
 3. Testing laboratory name and address
 4. Name and signature of inspector
 5. Date of inspection or sampling
 6. Record of temperature and weather
 7. Date of test
 8. Identification of product and Specification section
 9. Location of Project
 10. Type of inspection or test
 11. Results of test
 12. Observations regarding compliance with the Contract Documents
- F. Perform additional services as required.
- G. The laboratory is not authorized to release, revoke, alter or enlarge on requirements of the Contract Documents, or approve or accept any portion of the Work.

1.5 CONTRACTOR RESPONSIBILITIES:

- A. Cooperate with laboratory personnel; provide access to Work and/or manufacturer's requirements.
- B. Provide to the laboratory, representative samples, in required quantities, of materials to be tested.
- C. Furnish copies of mill test reports.
- D. Furnish required labor and facilities to:
 1. Provide access to Work to be tested;
 2. Obtain and handle samples at the site;
 3. Facilitate inspections and tests;
 4. Provide a clear, level and unobstructed location for placement of concrete curing box(es) adjacent to the work area as agreed upon with the testing laboratory and the Engineer. Provide power and lighting at the curing box location.
- E. Furnish climatically controlled curing box(es) for field storage of cast concrete cylinders or other samples. Multiple boxes shall be furnished when concrete placement activities are being performed at multiple locations across the project site. Curing box shall be manufactured and marketed for the specific purpose described

herein and shall meet standards ASTM C31, C192 and C511. Curing box shall be used to maintain temperature and humidity of the concrete cylinder specimens for 48 hours. Cure box shall feature a digital thermometer, heat/cool indicator lights; temperature set buttons and a capacity of 22 standard 6" x 12" cylinders. Use of field constructed curing boxes will not be acceptable.

- F. Notify the laboratory sufficiently in advance of operation to allow for the assignment of personnel and schedules of tests.
- G. Laboratory Tests: Where such inspection and testing are to be conducted by an independent laboratory agency, the sample(s) shall be selected by such laboratory or agency, or the Engineer, and shipped to the laboratory by the Contractor at Contractor's expense.
- H. Copies of all correspondence between the Contractor and testing agencies shall be provided to the Engineer.

1.5 QUALITY ASSURANCE:

- A. Testing shall be in accordance with all pertinent codes and regulations and with procedures and requirements of the American Society for Testing and Materials (ASTM).

1.6 PRODUCT HANDLING:

- A. Promptly process and distribute all required copies of test reports and related instructions to insure all necessary retesting or replacement of materials with the least possible delay in the progress of the Work.

1.7 FURNISHING MATERIALS:

- A. The Contractor shall be responsible for furnishing all materials necessary for testing.

1.8 CODE COMPLIANCE TESTING:

- A. Inspections and tests required by codes or ordinances or by a plan approval authority, and made by a legally constituted authority, shall be the responsibility of, and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

1.9 CONTRACTOR'S CONVENIENCE TESTING:

- A. Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

1.10 SCHEDULES FOR TESTING:

- A. Establishing Schedule
 - 1. The Contractor shall, by advance discussion with the testing laboratory selected by the Owner, determine the time required for the laboratory to perform its tests and to issue each of its findings, and make all arrangements for the testing laboratory to be on site to provide the required testing.

2. Provide all required time within the construction schedule.
- B. When changes of construction schedule are necessary during construction, coordinate all such changes of schedule with the testing laboratory as required.
- C. When the testing laboratory is ready to test according to the determined schedule, but is prevented from testing or taking specimens due to incompleteness of the Work, all extra costs for testing attributable to the delay will be back-charged to the Contractor and shall not be borne by the Owner.

1.11 TAKING SPECIMENS:

- A. Unless otherwise provided in the Contract Documents, all specimens and samples for tests will be taken by the testing laboratory or the Engineer.

1.12 TRANSPORTING SAMPLES:

- A. The Contractor shall be responsible for transporting all samples, except those taken by testing laboratory personnel, to the testing laboratory.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 45 53

CLEANING, TESTING, AND DISINFECTING HYDRAULIC STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes requirements for cleaning, testing, and disinfecting structures filled with fluid, such as tanks and flow conveyance channels. This Section does not cover manholes or utility chambers.
2. CONTRACTOR shall provide labor, material, tools, equipment, and incidentals as shown, specified, and required to clean, flush, disinfect, and test structures that will contain fluid.
2. The Work under this Section also includes providing all labor and materials required to prepare hydraulic structures for testing and disinfecting, conveying water to testing location, performing testing, and all labor and materials required to drain and dispose of water used for testing and disinfecting.

B. Hydraulic Structures Scheduled for Hydrostatic Testing: Clean, and test, the following:

Hydraulic Structure Number	Hydraulic Structure Service and Location
62-TX-01	Hydrofluorosilicic Acid Bulk Tank
62-TX-02	Hydrofluorosilicic Acid Day Tank
63-TX-01	Sodium Hypochlorite Bulk Tank - 01
63-TX-02	Sodium Hypochlorite Bulk Tank - 02
63-DT-01	Sodium Hypochlorite Day Tank
	Brine Tanks

E. Water for Testing:

1. Water for initial testing will be furnished by OWNER.
2. CONTRACTOR shall provide temporary piping, hoses, valves, backflow preventers, appurtenances, and services required for testing.
3. CONTRACTOR shall convey the water to testing location.
4. CONTRACTOR to coordinate with OWNER & ENGINEER for where water for testing may be withdrawn from and the maximum rate of flow.
5. CONTRACTOR shall provide on withdrawal piping, downstream of backflow preventer, flow meter and valve to control rate of flow. Flow meter shall be calibrated within the past 12 months. Operation of flow meter shall be confirmed at the Site and witnessed by ENGINEER. Submit to ENGINEER certification of calibration.

6. Cost of water for re-testing shall be paid by CONTRACTOR to OWNER at OWNER's standard rates.
- F. Provide chemicals required for disinfection and dechlorination.
- G. Not Included Under this Section:
 1. The following are specified under other Specifications Sections:
 - a. Field quality control for manholes associated with electrical systems is under Section 26 05 43.23, Manholes and Handholes for Electrical Systems.
 - b. Cleaning, testing and disinfecting of buried piping is under Section 33 05 05, Buried Piping Installation
 - c. Cleaning and testing of manholes for utility service is under Section 33 05 13, Manholes and Structures.
 - d. Cleaning, testing, and disinfecting of exposed piping is under Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 1. ACI 350.1, Tightness Testing of Environmental Engineering Concrete Structures, and Commentary.
 2. ANSI/AWWA C652, Disinfection of Water-Storage Facilities.
 3. APHA/AWWA/WEF, Standard Methods for the Examination of Water and Wastewater.
 4. NSF/ANSI 60, Drinking Water Treatment Chemicals – Health Effects.

1.3 TERMINOLOGY

- A. The following words or terms are not defined but, when used in this Section, have the following meaning:
 1. "Hydraulic structures" are tanks, channels, and other structures through which fluid is conveyed or that hold fluid. Hydraulic structures include structures open to the atmosphere and structures with closed tops, and structures that contain both fluid and gas. Hydraulic structures include wet wells, junction chambers, equalization tanks, storage tanks, treatment process tanks such as grit chambers, clarifiers, aeration tanks, filter beds, contact tanks, and other channels and tanks designated in this Section. Excluded are structures that are to be cleaned or tested under other Specifications Sections.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 1. Testing Laboratory:
 - a. Testing for bacteria and odor shall be by OWNER's laboratory.

2. Backflow Preventer Technician:
 - a. Backflow prevention technicians shall possess a valid certification as a backflow preventer technical issued by authority having jurisdiction.
- B. Regulatory Requirements:
 1. Backflow preventers shall be tested by certified backflow prevention technician within 12 months of the date backflow preventer is used on the Project.
 2. Requirements of Georgia EPD

1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Product Data:
 - a. Manufacturer's published data on chemicals used for disinfection and dechlorination.
 - b. Evidence of NSF/ANSI 60 compliance for chemicals used in disinfection and dechlorination.
 2. Procedure Submittals (including proposed plans for water conveyance, control, and disposal):
 - a. Cleaning procedures.
 - b. Hydrostatic testing procedures and equipment required, by hydraulic structure to be tested.
 - c. Air testing procedures and equipment required, by hydraulic structure to be tested.
 - d. Disinfection procedures and equipment required, by hydraulic structure to be tested.
- B. Informational Submittals: Submit the following:
 1. Certifications:
 - a. Certification of each backflow preventer proposed for use.
 - b. Calibration certification for each flow meter proposed for use.
 - c. Certification by CONTRACTOR and testing laboratory that tests were performed in compliance with referenced standards.
 2. Special Procedure Submittals:
 - a. Time schedule for each test required.
 - b. Procedure for disposal of chlorinated water, including proposed dechlorination chemical and methods proposed for use.
 - c. Not less than 7 days prior to scheduled test, submit written notification of intent to test each hydraulic structure. Do not commence testing without obtaining ENGINEER's acceptance of testing procedures, chemicals to be used, notification, and other required pre-test submittals.
 3. Field Quality Control Submittals:
 - a. Results of each test.

- b. Chain of custody documentation for samples obtained for bacteriological and odor testing.
- 4. Qualifications Statements:
 - a. Certified backflow preventer technician, when requested by ENGINEER.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Test Apparatus and Fluid Control Devices:
 - 1. Provide temporary pumping, hoses, piping, instrumentation, and other materials, equipment, and items necessary to perform cleaning, testing, and disinfecting of hydraulic structures.
 - 2. Provide and maintain temporary valves, plugs, bulkheads, and other fluid control devices suitable for the intended use and required cleaning, testing, and disinfecting.
 - 3. Do not use materials or items that will injure or damage the Work.
 - 4. Temporary backflow preventers shall be reduced pressure zone-type.

PART 3 – EXECUTION

3.1 CLEANING

- A. Cleaning Requirements:
 - 1. Prior to testing, remove all scaffolding, planking, tools, rags, dirt, debris, foreign matter, and material not part of the permanent structure.
 - 2. Thoroughly clean hydraulic structures' walls, floors, and operating equipment by sweeping, high-pressure wash, scrubbing, or other methods that will not injure the Work and existing facilities.
 - 3. Remove from each hydraulic structure all water, dirt, and foreign material accumulated during cleaning. Provide temporary pumps, piping, and facilities as required to discharge water from the cleaning operation in manner acceptable to ENGINEER and in accordance with Laws and Regulations.
 - 4. Do not proceed with testing until ENGINEER has accepted in the field results of cleaning.
 - 5. Comply with Section 01 74 05, Cleaning, and this Section.

3.2 TESTING AND DISINFECTION – GENERAL

- A. General Provisions Applicable to Cleaning and Testing of All Hydraulic Structures:
 - 1. Separately test each hydraulic structure.

2. Hydraulic structures shall be free of visible leakage. Repair leaks in manner in accordance with the Contract Documents.

3.3 HYDROSTATIC TESTING OF HYDRAULIC STRUCTURES

- A. Analysis of data from hydrostatic testing of hydraulic structures shall be by CONTRACTOR in accordance with ACI 350.1 and this Section. Provide materials, equipment, and labor to obtain test data.
- B. Prior to starting hydrostatic testing, perform the following:
 1. All elements of the hydraulic structure that will resist pressure exerted by retained fluid shall be in place and at specified strength. Concrete shall be fully cured.
 2. Do not backfill structure walls before testing. Refer to Paragraph 3.2.A of this Section regarding application of exterior coatings to hydraulic structures.
 3. Valves, gates, blind flanges, and items other than concrete that control the flow of or otherwise retain fluid in the hydraulic structure shall be watertight for the hydrostatic test.
 4. Repair defective concrete.
 5. Notify ENGINEER and OWNER prior to commencing filling hydraulic structure for hydrostatic testing. Minimum time between notice and starting to fill for hydrostatic testing shall be in accordance with Paragraph 1.5.B.2 of this Section.
 6. Do not perform hydrostatic testing during period when ambient temperature is below 33 degrees F.
 7. Hydraulic structures with interior, wetted concrete surfaces shall remain filled with water for an initial adsorption period of not less than 48 hours. Following this initial period, provide make-up water to fill the hydraulic structure to specified water surface test elevation.
- C. Required Water Surface Elevation for Hydrostatic Testing:
 1. Using the water source specified in this Section, fill hydraulic structures to specified water surface test elevation indicated in the following table:

Hydraulic Structure Service and Location	Water Surface Elevation for Testing
Hydrofluorosilicic Acid Bulk Tank	HWL shown in contract drawings
Hydrofluorosilicic Acid Day Tank	HWL shown in contract drawings
Sodium Hypochlorite Bulk Tank - 01	HWL shown in contract drawings
Sodium Hypochlorite Bulk Tank - 02	HWL shown in contract drawings
Sodium Hypochlorite Day Tank	HWL shown in contract

Cleaning, Testing and Disinfecting Hydraulic Structures

	drawings
Brine Tanks	HWL shown in contract drawings

D. Filling Hydraulic Structures with Water:

1. Fill the portion of the hydraulic structure to be tested at rate that does not exceed two vertical feet per hour.
2. When potable water is used for testing, during filling provide temporary backflow preventer at the point where water is withdrawn from potable water system.

E. When water has reached specified test elevation and specified wetting period has elapsed, inspect hydraulic structure's exposed surfaces for leakage. Before starting hydrostatic testing, repair apparent leakage or weeping. Leaking or weeping is defined as water moving through the wall as evident from holding a finger or object against the wet spot on the wall for 60 seconds and observing moving water or water buildup on the finger or object.

F. Test Duration: Hydrostatic test duration shall be determined by ENGINEER in accordance with ACI 350.1, and shall not be less than 24 hours.

G. Allowable Leakage:

1. Leakage during the test period for hydraulic structures with vertical walls is defined as the volume calculated using the difference in water surface elevations at the start and end of the test period adjusted by adding the volume of precipitation and subtracting the volume of evaporation measured during the test period.
2. Leakage during the test period for hydraulic structures with sloping walls is the quantity of water that must be supplied to the hydraulic structure or section thereof to maintain the water level within three inches of specified water surface test elevation during the hydrostatic test, plus the volume of water required to fill the hydraulic structure to specified water surface test elevation at conclusion of hydrostatic test, plus precipitation, minus evaporation.
3. For hydraulic structures with interior, wetted concrete surfaces that are not lined, allowable leakage is 0.075 percent of volume tested for each 24-hour period or portion thereof.
4. For hydraulic structures with interior wetted concrete surfaces lined with waterproof material, allowable leakage is 0.050 percent of volume tested for each 24-hour period or portion thereof.
5. No leakage is allowed for hydraulic structures with interior, wetted surfaces that do not include concrete.

H. Measurement Locations:

1. For hydraulic structures or portions thereof (when entire hydraulic structure is not tested as a whole) that are equal to or less than 1,000 square feet in

- water surface area, measure water level at not less than two locations approximately 180 degrees apart.
2. For hydraulic structures or portions thereof (when entire hydraulic structure is not tested as a whole) that are greater than 1,000 square feet in water surface area, measure water level at not less than four locations approximately 90 degrees apart.
 3. Each measurement location shall be marked and given distinct reference number. Mark reference point on face of wall above test water surface in manner that will prevent movement or deterioration of reference point mark during the test. Remove reference point mark upon completion of testing and acceptance of testing results by ENGINEER.
 4. Position the measurement locations to minimize effects of wave action and wind.
- I. Evaporation and Precipitation Measurement:
1. Evaporation and Precipitation Measurement Vessels:
 - a. In hydraulic structures open to atmosphere, a clear plastic, calibrated, open-topped container not less than 18-inch diameter and not less than 18 inches deep shall be provided at each measurement location.
 - b. Before starting test, partially fill each evaporation-precipitation measurement vessel and float the vessel in the hydraulic structure, held in position near each measurement location.
 - c. Calibration increments in container shall be 0.1-inch or less.
 2. Position evaporation-precipitation measurement vessels so that vessels are not shaded by hydraulic structure's walls, away from overhead items such as beams, pipes, and walkways.
- J. Obtaining Test Measurements:
1. Do not start hydrostatic tests when severe weather conditions, such as heavy precipitation, high winds, major changes in average daily temperature, and other severe conditions are predicted for duration of test period.
 2. Record the following measurements at each test location at start of test period and at 12-hour intervals thereafter:
 - a. Distance from reference point elevation to actual water surface.
 - b. Depth of water in evaporation-precipitation containers.
 - c. Temperature of test water at point 18 inches below water surface.
 - d. Temperature of water in evaporation-precipitation measurement vessels at mid-depth.
 3. If actual water surface in hydraulic structure is subject to wave action at measurement location, record as data the average water surface elevation of wave oscillations.
 4. Change in the water surface elevation at each measurement location shall be averaged and adjusted as follows:
 - a. Total change in hydraulic structure's water surface elevation shall be adjusted by average change in water surface elevation in evaporation-precipitation measurement vessels.

- b. Where averaged water temperature measurements vary by more than three degrees F from start to completion of test period, adjustment in test volume shall be determined by change of density of water resulting from change in the average water temperature.
- 5. Determination of Leakage:
 - a. Hydraulic Structures with Vertical Walls: Leakage volume shall be the drop in water surface elevation measured during the test, multiplied by water surface area of hydraulic structure tested.
 - b. Initial full volume shall include the volume of sloping tank bottoms, sump pits, and other features that contain water that is connected to the hydraulic structure during the hydrostatic test.
 - c. Allowable leakage shall be determined by multiplying the initial full volume by the daily leakage allowance and by the leakage test time period in days.
- K. Criteria for Acceptance:
 - 1. Hydrostatic test will pass if measured leakage is less than allowable leakage and no leaks or weeping is observed.
 - 2. If test becomes unreliable due to excessive precipitation, freezing, or other external factors, re-start and re-perform the test at no additional cost to OWNER.
 - 3. If hydrostatic test fails, the hydraulic structure may be re-tested immediately without repairs. If subsequent hydrostatic test fails, repair probable areas of leakage and repeat the hydrostatic test.
 - 4. Re-test hydraulic structure until it meets criteria specified for acceptance. Repair probable leakage areas before testing.
- L. Reuse and Disposal of Water Used in Hydrostatic Tests:
 - 1. Obtain ENGINEER's acceptance before water used in one hydrostatic test is pumped to a different hydraulic structure for reuse in subsequent test.
 - 2. If chlorine residual in test water exceeds 0.5 mg/L, dechlorinate water used for hydrostatic testing to remove chlorine residual before discharging water to storm water drainage routes. Dechlorinate water using sodium bisulfite or other dechlorination chemical acceptable to ENGINEER.
- M. Hydraulic structure shall not be backfilled or have exterior coating applied (such as dampproofing) until ENGINEER accepts hydrostatic test results.

3.5 TESTING OF APPURTENANT PIPING

- A. Test piping connected to hydraulic structures in accordance with the Contract Documents.

3.6 DISINFECTING HYDRAULIC STRUCTURES (NOT USED)

++ END OF SECTION ++

SECTION 01 51 05

TEMPORARY UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all temporary utilities and temporary facilities required for the Project, including the following:
 - a. Electricity.
 - b. Lighting.
 - c. Heating, cooling, ventilating, and temporary enclosures.
 - d. Water.
 - e. Sanitary facilities.
 - f. First-aid facilities.
 - g. Fire protection.
2. Make all arrangements with utility owners for temporary utilities and with others as appropriate for temporary facilities. Obtain required permits and approvals for temporary utilities and temporary facilities.
3. Pay all service costs for utilities and facilities indicated in this Section as CONTRACTOR's responsibility, including cost of electricity, water, fuel, and other utility services and temporary facilities required for the Work.
4. Continuously maintain adequate temporary utilities and temporary facilities for all purposes for the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities and temporary facilities through Substantial Completion and removal of temporary field offices and sheds unless otherwise approved in writing by ENGINEER.
5. Should OWNER occupy part of the Work prior to Substantial Completion of the entire Work, cost of utilities consumed via temporary utilities serving the portion occupied by OWNER will be shared proportionately by OWNER and CONTRACTOR as mutually agreed to by the parties.
6. Maintain, including cleaning, temporary utilities and temporary facilities, and continuously provide consumables as required.
7. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and the needs of the Project.

8. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.

1.2 REQUIREMENTS FOR TEMPORARY UTILITIES AND TEMPORARY FACILITIES

A. Electrical:

1. Provide temporary electrical service required for the Work, including continuous power for temporary field offices and sheds. Provide temporary outlets with circuit breaker protection and ground fault protection.
2. Furnish, locate and install area distribution boxes such that the individual trades may use their own construction type extension cords to obtain adequate power, and artificial lighting where required by inspectors and for safety.
3. Provide all temporary electrical services, wire, generators, etc. required for performance of the Work inclusive of maintaining existing facilities in service during required primary electrical service shutdowns.
4. Pay all bills for temporary power required for the performance of the Work where required during shutdowns, bypass pumping etc.
5. Use of Owner's existing standby generator facilities will not be allowed.

B. Lighting.

1. Provide lighting at the Site of not less than five foot-candles for open areas and not less than ten foot-candles for stairs and shops. Provide not less than one, 300-watt lamp every 15 feet in indoor work areas. Provide night security lighting of not less than five foot-candles within 50 feet of all parts of the Site during hours of darkness, controlled by photocell.
2. Do not work in areas with insufficient lighting. Where lighting is insufficient for the work activities to be performed, provide additional temporary lighting.
3. Provide temporary lighting sufficient for observation of the Work by ENGINEER and inspection by CONTRACTOR and authorities having jurisdiction. Where required by ENGINEER, provide additional temporary lighting.

C. Heating, Ventilating, and Enclosures.

1. Provide sufficient temporary heating, cooling, ventilating, and enclosures to ensure safe working conditions and prevent damage to existing facilities and the Work.
2. Except where otherwise specified, temporary heating shall maintain temperature of the space served between 50 degrees F and maximum design temperature of building or facility and its contents.

3. Maintain temperature of areas occupied by OWNER's personnel or electronic equipment, including offices, lunch rooms, locker rooms, toilet rooms, and rooms containing computers, microprocessors, and control equipment, between 65 degrees F and 80 degrees F with relative humidity less than 75 percent.
4. Required temperature range for storage areas and certain elements of the Work, including preparation of materials and surfaces, installation or application, and curing as applicable, shall be in accordance with the Contract Documents for the associated Work and the Supplier's recommended temperature range for storage, application, or installation, as appropriate.
5. Provide temporary ventilation sufficient to prevent accumulation in construction areas and areas occupied by OWNER of hazardous and nuisance levels or concentrations of dust and particulates, mist, fumes or vapors, odors, and gases, associated with construction.
6. Provide temporary enclosures and partitions required to maintain required temperature and humidity.

D. Water:

1. General:

- a. OWNER will provide a place of temporary connection for construction water at site. Obtain and install a meter from the Owner and pay for water used at Owner's current rate.
- b. Provide temporary water facilities approved by OWNER including piping, valves, , backflow preventers, pressure regulators, and other appurtenances. Provide freeze-protection as required.
- c. Continuously maintain adequate water flow and pressure for all purposes during the Project, until removal of temporary water systems.

2. Water for Construction Purposes:

- a. Provide water for Site maintenance and cleaning and, water necessary for construction activities, and water for disinfecting and testing of systems.
- b. Contractor may use existing hose bibbs for short-term wash-downs and intermittent use of water for work areas in the existing building. Obtain consent of ENGINEER and OWNER if connections to existing hose bibbs and similar existing connections will be used for more than one day at a time.

3. Water for Human Consumption and Sanitation:

- a. Provide potable water in accordance with Laws and Regulations for consumption by personnel at the Site, for field offices, and for sanitary facilities.

- b. When necessary, provide bottled, potable water for use and consumption by personnel at the Site, including CONTRACTOR, ENGINEER, and visitors to the Site.
- E. Sanitary Facilities.
 1. Prior to starting the Work, provide suitably-enclosed chemical or self-contained toilets for CONTRACTOR's employees, Subcontractors, Suppliers, ENGINEER, and visitors to the Site. Location of temporary toilets shall be acceptable to OWNER and ENGINEER.
 2. Refer to Paragraph 0.D. of this Section for requirements for water intended for human consumption during construction.
 3. Provide suitable temporary washing facilities for employees and visitors.
 4. Keep all facilities, regardless of type, in a clean and sanitary condition and comply with the requirements and regulations of the area in which the Work is performed.
- F. First-aid Facilities.
 1. Provide temporary first-aid stations at or immediately adjacent to the Site's work areas, and inside CONTRACTOR's temporary field office. Locations of first-aid stations shall be determined by CONTRACTOR's safety representative. Replenish supplies in first-aid stations as items are used, prior to expiration of items, and as necessary. Monitor and log inventory of supplies in first-aid stations in accordance with requirements for monitoring and logging safety equipment as indicated in Section 01 35 23, Safety Requirements.
 2. Provide list of emergency telephone numbers at each hardwired telephone at the Site. List shall be in accordance with the list of emergency contact information required in Section 01 35 23, Safety Requirements.
- G. Fire Protection.
 1. Provide temporary fire protection, including portable fire extinguishers rated not less than 2A or 5B in accordance with NFPA 10, Portable Fire Extinguishers, for each temporary building and for every 3,000 square feet of floor area under construction.
 2. Provide Class A (ordinary combustibles), Class B (combustible liquids and gases), and Class C (electrical equipment) fire extinguishers as necessary.
 3. Comply with NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations, and requirements of fire marshals and authorities having jurisdiction at the Site.

1.3 USE OF OWNER'S SYSTEM

- A. Existing Utility Systems: Do not use systems in existing buildings or structures for temporary utilities without OWNER's written permission and mutually acceptable

basis agreed upon by the parties for proportionate sharing of costs between OWNER and CONTRACTOR.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for temporary utilities and temporary facilities may be new or used, but shall be adequate for purposes intended and shall not create unsafe conditions, and shall comply with Laws and Regulations.
- B. Provide required materials, equipment, and facilities, including piping, cabling, controls, and appurtenances.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install temporary utilities and temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.
- B. Location of Temporary Utilities and Temporary Facilities:
 - 1. Locate temporary systems for proper function and service.
 - 2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility owners and others.
 - 3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.
- C. Modify and extend temporary systems as required by progress of the Work.

3.2 USE

- A. Maintain temporary systems to provide safe, continuous service as required.
- B. Properly supervise operation of temporary systems:
 - 1. Enforce compliance with Laws and Regulations.
 - 2. Enforce safe practices.
 - 3. Prevent abuse of services.
 - 4. Prevent nuisances and hazards caused by temporary systems and their use.
 - 5. Prevent damage to finishes.
 - 6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.

- C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient.

3.3 REMOVAL

- A. Completely remove temporary utilities, temporary facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to preconstruction condition.
- B. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner.
- C. Where permanent utilities and systems were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

+ + END OF SECTION + +

SECTION 01 55 13

ACCESS ROADS AND PARKING AREAS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide temporary construction roads, walks, parking areas, and appurtenances required during the Project for use by CONTRACTOR, other contractors employed on the Project, OWNER's, facility managers, and emergency vehicles.
2. Temporary roads and parking areas shall be designed and maintained by CONTRACTOR and shall be fully passable to vehicles in all weather conditions.

B. Use of Existing Access Roads:

1. CONTRACTOR is allowed to use OWNER's existing roads starting on the Effective Date of the Contract and satisfying other Contract requirements relative to starting the Work.
2. Prevent interference with traffic on existing roads and parking areas. Always keep access roads and entrances serving the Site clear and available to OWNER, facility manager, and their respective employees; emergency vehicles; and other contractors. Do not use access roads or Site entrances for parking or storage of materials or equipment.
3. CONTRACTOR shall indemnify and hold harmless OWNER and ENGINEER from expenses and losses caused by CONTRACTOR's operations over existing roads, drives, and parking areas.
4. Schedule deliveries to minimize use of driveways and Site entrances.

1.2 SITE ACCESS

A. Site Access:

1. CONTRACTOR access to the Site shall be via TDK Blvd

1.3 CONTRACTOR PARKING

A. CONTRACTOR employee vehicles shall park in construction staging area(s).

B. Park construction vehicles and equipment in work areas off permanent roads and parking areas, in areas of the Site designated for CONTRACTOR staging.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials for temporary roads and parking areas shall comply with the Contract Documents' requirements for permanent roads, drives, and parking areas.
- B. Traffic controls shall comply with requirements of authorities having jurisdiction. When such authority is the OWNER or facility manager, and no requirements are indicated, comply with the standard specifications of the state department of transportation in the area of the Project.

PART 3 – EXECUTION

3.1 TEMPORARY ROADS AND PARKING AREAS

- A. Temporary Roads and Parking in Same Areas as Permanent Pavement:
 - 1. Provide temporary roads and parking areas adequate to support and withstand traffic and construction loads during the Project. Locate temporary roads and parking areas in same location as permanent roads and parking areas. Extend temporary roads and parking areas, within construction limits indicated, as required for construction operations.
 - 2. Coordinate elevations of temporary roads and parking areas with permanent roads and parking areas.
 - 3. Prepare subgrade, subbase, and base for temporary roads and parking areas in accordance with the Contract Documents requirements for permanent roads, drives, and parking areas.
 - 4. Where required by subgrade conditions and construction loads and traffic, provide geosynthetic separation fabric as required on compacted subgrade for subbase support and separation of subbase and subgrade materials.
 - 5. Re-condition granular subbase of temporary roads and parking areas, including removing and properly disposing of granular material that has become intermixed with soil, re-grading, proof-rolling, compacting, and testing.

3.2 TRAFFIC CONTROLS

- A. Traffic Controls:
 - 1. Provide temporary traffic controls at intersections of temporary roads with each other and with parking areas, including intersections with other temporary roads, intersections with public roads, and intersections with permanent access roads at the Site.
 - 2. Provide temporary warning signs on permanent roads and drives and provide temporary "STOP" signs for traffic on temporary roads where required and at entrances to permanent pavement.
 - 3. Comply with requirements of authorities having jurisdiction. When such authority is the OWNER or facility manager, and no requirements are

indicated, comply with the standard specifications of the state department of transportation in the area of the Project

3.3 MAINTENANCE OF ROADS

A. General:

1. Maintain temporary roads and parking to continuously provide at the Site access for construction vehicles and trucks, OWNER and facility manager vehicles, deliveries for OWNER and facility manager, emergency vehicles, and parking areas for OWNER's and facility manager's personnel.
2. Public roads shall be passable at all times unless a road closure is allowed in writing by authority having jurisdiction.
3. When granular material of temporary roads and parking without hard surfacing become intermixed with soil or when temporary roads otherwise create a nuisance, remove intermixed granular-and-soil material, and replace with clean granular material as required.
4. Provide snow and ice removal for temporary roads and parking areas.

B. Cleaning and Dust Control:

1. Cleaning: Clean paved surfaces over which construction vehicles travel. Perform cleaning not less often than the frequency indicated in Section 01 74 05, Cleaning, or more frequently as directed by ENGINEER, by mechanical sweeping or other means acceptable to ENGINEER.
2. Clean the following surfaces:
 - a. Roads within limits of the Project.
 - b. Permanent roads at the Site between the Site entrance and the work areas, and between the Site entrance and construction parking and staging areas.
 - c. Public roads that require sweeping and cleaning due to construction operations.
3. Dust Control:
 - a. Control dust resulting from construction activities to prevent nuisances at the Site and in nearby areas.
 - b. Comply with Section 01 41 27, Earthmoving and Dust Control, and Section 01 57 00, Temporary Controls.

C. Protection of Underground Facilities: Comply with the General Conditions, as may be modified by the Supplementary Conditions, Section 01 71 33, Protection of the Work and Property, and other requirements of the Contract Documents.

3.4 REMOVALS AND RESTORATION

A. Removals:

1. Remove temporary roads, drives, walks, and parking areas that are not intended for, or acceptable for, integration into permanent pavement. Return areas of temporary roads, drives, walks, and parking to pre-construction condition unless otherwise required by the Contract Documents.

2. Remove temporary gates, fencing, and traffic controls associated with temporary roads and parking areas.
 3. Where areas of temporary roads and parking will be permanently landscaped, remove pavement, granular subbase, geosynthetic (where required by ENGINEER), soil, and other materials that do not comply with the Contract Documents regarding fill, subsoil, and landscaping.
 4. Remove and properly dispose of materials contaminated with oil, bitumen, and other petrochemical compounds resulting from CONTRACTOR's operations, and other substances that might impair growth of plants and lawns.
- B. Restoration:
1. Repair or replace paving, curbs, gutters, and sidewalks affected by temporary roads and parking, and restore to required conditions in accordance with authorities having jurisdiction.
 2. Restore to pre-construction conditions existing roads, walks, and parking areas damaged by CONTRACTOR, subject to approval of the owner of affected roads, drives, walks, and parking areas.

+ + END OF SECTION + +

SECTION 01 57 05

TEMPORARY CONTROLS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide and maintain methods, materials, equipment, and temporary construction as required for controlling environmental conditions at the Site and adjacent areas during construction.
2. Maintain controls until no longer required. Provide temporary controls at all times when CONTRACTOR is working at the Site.
3. Temporary controls include, but are not limited to, the following:
 - a. Erosion and sediment controls.
 - b. Noise controls.
 - c. Dust controls.
 - d. Pest and rodent controls.
 - e. Control of water, including storm water runoff.
 - f. Pollution controls.

B. Related Sections:

1. Section 01 41 26, Storm Water Pollution Prevention Plan and Permit.
2. Section 01 41 27, Earthmoving Permit and Dust Control.
3. Section 01 55 13 Access Roads and Parking Areas.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable provisions and recommendations of the following:

1. Procedural Submittals:
 - a. Proposed dust control measures, when submittal is requested by ENGINEER.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Plan for construction staging and maintenance of the Site relative to erosion and sediment controls. Indicate on a site plan approximate areas of planned disturbance of soils and soil cover over time during the Project. For areas not indicated in the Contract Documents as being disturbed and that CONTRACTOR proposes to disturb, Shop Drawing shall include proposed erosion and sediment control measures for the additional area.

- b. Location and details of temporary settlement basin(s).
 - 2. Product Data:
 - a. Silt fencing materials.
- B. Informational Submittals: Submit the following:
 - 1. Procedural Submittals:
 - a. Proposed dust control measures, when submittal is requested by ENGINEER.

PART 2 – PRODUCTS

2.1 MATERIALS FOR TEMPORARY EROSION AND SEDIMENT CONTROLS

- A. Materials for temporary erosion and sediment controls shall be as shown or indicated on the Drawings.

PART 3 – EXECUTION

3.1 NOISE CONTROL

- A. Noise Control – General:
 - 1. CONTRACTOR's vehicles and equipment shall minimize noise emissions to greatest degree practicable. When necessary, provide mufflers and silencers on construction equipment, and provide temporary sound barriers onsite when necessary.
 - 2. Noise levels shall comply with Laws and Regulations, including OSHA requirements and local ordinances.
 - 3. Noise emissions shall not interfere with the work of OWNER, facility manager, or others.

3.2 DUST CONTROL

- A. Dust Control – General:
 - 1. Control objectionable dust caused by CONTRACTOR's operation of vehicles and equipment, clearing, demolition, cleaning, and other actions. To minimize airborne dust, apply water or use other methods subject to acceptance of ENGINEER and approval of authorities having jurisdiction.
 - 2. CONTRACTOR shall prevent blowing and movement of dust from exposed soil surfaces and access roads to reduce onsite and off-Site damage, nuisances, and health hazards associated with dust emissions.
 - 3. Comply with Section 01 41 27, Earthmoving Permit and Dust Control.
- B. Dust Control Methods:

1. Dust control may be achieved by irrigation in which the dust-prone area of the Site shall be sprinkled with water until the surface is moist.
 2. Apply dust controls as frequently as required without creating nuisances such as excessive mud and ponding of water at the Site. Do not use water for dust control when water will cause hazardous or objectionable conditions such as ice, mud, ponds, and pollution.
 3. Provide dust control that is non-polluting and does not contribute to tracking-out of dirt and dust onto pavement.
- C. Removal of Dust and Dirt from Travelled Surfaces:
1. Remove dust and dirt from roadways, drives, parking areas, and other travelled surfaces not less than the frequency indicated in Section 01 74 05, Cleaning.
 2. Perform dust and dirt removals from travelled surfaces by mechanical sweeping or other method acceptable to ENGINEER.
- 3.3 PEST AND RODENT CONTROL
- A. Pest and Rodent Control – General:
1. Provide pest and rodent controls as required to prevent infestation of the Site and storage areas.
 2. Employ methods and use materials that do not adversely affect conditions at the Site or on adjoining properties.
 3. In accordance with Laws and Regulations, promptly and properly dispose of pests and rodents trapped or otherwise controlled.
- 3.4 WATER CONTROL
- A. Water Control – General:
1. Provide methods to control surface water and water from excavations and structures to prevent damage to the Work, the Site, and adjoining properties.
 2. Control fill, grading, and ditching to direct water away from excavations, pits, tunnels and other construction areas and to direct drainage to proper runoff courses to prevent erosion, damage, or nuisance. Avoid directing to adjoining properties runoff from the Site and construction operations.
- B. Equipment and Facilities for Water Control:
1. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
- C. Discharge and Disposal:
1. Dispose of storm water and ground water in manner to prevent flooding, erosion, and other damage to any and all parts of the Site and adjoining areas, and that complies with Laws and Regulations.
- 3.5 POLLUTION CONTROL

- A. Pollution Control – General:
 - 1. Provide means, methods, and facilities required to prevent contamination of soil, water, and atmosphere caused by discharge of noxious substances from or caused by construction operations.
 - 2. Equipment used during construction shall comply with Laws and Regulations.
 - 3. Comply with Section 01 35 43.13, Environmental Procedures for Hazardous Materials.
- B. Spills and Contamination:
 - 1. Provide equipment and personnel to perform emergency measures required to contain spills and to remove contaminated soils and liquids.
 - 2. Excavate contaminated material and properly dispose of off-Site and replace with suitable compacted fill and topsoil.
 - 3. Comply with Section 01 35 44, Spill Prevention Control and Countermeasures Plan, and OWNER's and facility manager's hazard control procedures as indicated in Section 01 35 23, Safety Requirements.
- C. Protection of Surface Waters and Ground Water:
 - 1. Provide and maintain special measures to prevent harmful substances from entering surface waters and ground water. Prevent disposal of wastes, effluents, chemicals, and other such substances in or adjacent to surface waters and open drainage routes, in sanitary sewers, or in storm sewers, and in ground water.
- D. Atmospheric Pollutants:
 - 1. Provide and maintain systems for controlling atmospheric pollutants related to the Work.
 - 2. Prevent toxic concentrations of chemicals and vapors.
 - 3. Prevent harmful dispersal of pollutants into atmosphere.
- E. Solid Waste:
 - 1. Provide and maintain systems for controlling and managing solid waste related to the Work.
 - 2. Prevent solid waste from becoming airborne, and from discharging to surface waters and drainage routes.
 - 3. Properly handle and dispose of solid waste.
 - 4. Comply with requirements for cleaning and disposal of debris in the General Conditions, as may be modified by the Supplementary Conditions, and Section 01 74 05, Cleaning.

3.6 EROSION AND SEDIMENT CONTROLS

- A. Installation and Maintenance of Erosion and Sediment Controls – General:
 - 1. General:
 - a. Provide temporary erosion and sediment controls as shown and indicated on the Drawings and as indicated elsewhere in the Contract Documents.

- Provide erosion and sediment controls as the Work progresses into previously undisturbed areas.
- b. Installation of erosion and sediment controls shall be in accordance with the applicable regulatory requirements indicated in Article 1.2 of this Section, unless more-stringent methods are otherwise shown or indicated in the Contract Documents.
 - c. Use necessary methods to successfully control erosion and sedimentation, including ecology-oriented construction practices, vegetative measures, and mechanical controls. Use best management practices (BMP) in accordance with Laws and Regulations, and regulatory requirements indicated in Article 1.2 of this Section, to control erosion and sedimentation during the Project.
 - d. Plan and execute construction, disturbances of soils and soil cover, and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation. Provide temporary measures for controlling erosion and sedimentation, as indicated in the Contract Documents and as required for the Project.
 - e. Where areas must be cleared for storage of materials or equipment, or for temporary facilities, provide measures for regulating drainage and controlling erosion and sedimentation, subject to the ENGINEER'S approval.
 - f. Provide erosion and sediment controls, including stabilization of soils, at the end of each workday.
- 2. Coordination:
 - a. Coordinate erosion and sediment controls with this Section's requirements on water control, and with Section 01 41 26, Storm Water Pollution Prevention Plan and Permit.
 - b. Coordinate temporary erosion and sediment controls with construction of permanent drainage facilities and other Work to the extent necessary for economical, effective, and continuous erosion and sediment controls.
 - 3. Before commencing activities that will disturb soil or soil cover at the Site, provide all erosion and sediment control measures required by the Contract Documents for the areas where soil or soil cover will be disturbed.
 - 4. In general, implement construction procedures associated with, or that may affect, erosion and sediment control to ensure minimum damage to the environment during construction. CONTRACTOR shall implement all additional measures required to comply with Laws and Regulations, and Section 01 41 26, Storm Water Pollution Prevention Plan and Permit.
 - 5. Vegetation Removal: Remove only those shrubs, grasses, and other vegetation that must be removed for construction. Protect remaining vegetation.
 - 6. Access Roads and Parking Areas: When possible, access roads and temporary roads and parking shall be located and constructed to avoid adverse effects on the environment. Provide measures to regulate drainage, avoid erosion and sedimentation, and minimize damage to vegetation.
 - 7. Earthwork and Temporary Controls:

- a. Perform excavation, fill, and related operations in accordance with Section 31 20 00, Earth Moving.
 - b. Control erosion to minimize transport of silt from the Site into existing waterways and surface waters. Such measures shall include, but are not limited to, using berms, silt fencing, baled straw silt barriers, gravel or crushed stone, mulching and soil stabilization, slope drains, and other methods. Apply such temporary measures to erodible materials exposed by activities associated with the construction of the Project.
 - c. Hold to a minimum the areas of bare soil exposed at one time.
 - d. Construct fills and waste areas by selectively placing fill and waste materials to eliminate surface silts and clays that will erode.
 - e. In performing earthwork, eliminate depressions that could serve as mosquito breeding pools.
 - f. CONTRACTOR shall provide special care in areas with steep slopes, where disturbance of vegetation shall be minimized to maintain soil stability.
8. Inspection and Maintenance:
- a. Periodically inspect areas of earthwork and areas where soil or soil cover are disturbed to detect evidence of the start of erosion and sedimentation; promptly implement corrective measures as required to control erosion and sedimentation. Continue inspections and corrective measures until soils are permanently stabilized and permanent vegetation has been established.
 - b. Inspect not less often than the frequency indicated in Section 01 41 26, Storm Water Pollution Prevention Plan and Permit.
 - c. Repair or replace damaged erosion and sediment controls within 24 hours of CONTRACTOR becoming aware of such damage.
 - d. Periodically remove silt and sediment that has accumulated in or behind sediment and erosion controls. Properly dispose of silt and sediment.
9. Duration of Erosion and Sediment Controls:
- a. Maintain erosion and sediment controls in effective working condition until the associated drainage area has been permanently stabilized.
 - b. Maintain erosion and sediment controls until the Site is restored and site improvements including landscaping, if any, are complete with underlying soils permanently stabilized.
10. Work Stoppage:
- a. If the Work is temporarily stopped or suspended for any reason, CONTRACTOR shall provide additional temporary controls necessary to prevent environmental damage to the Site and adjacent areas while the Work is stopped or suspended.
11. Failure to Provide Adequate Controls:
- a. In the event CONTRACTOR repeatedly fails to satisfactorily control erosion and sedimentation, OWNER reserves the right to employ outside assistance or to use OWNER's own forces for erosion and sediment control.

- b. Cost of such work by OWNER, plus engineering and inspection costs, will be deducted from amounts due CONTRACTOR, as set-offs in accordance with the Contract Documents.

B. Erosion and Sediment Control Permit:

- 1. Comply with permit requirements indicated in Section 01 41 24, Permit Requirements.

C. Silt Fencing:

- 1. Install and maintain silt fencing in a vertical plane, at the location(s) shown or indicated in the Contract Documents and where required.
- 2. Locations of Silt Fencing:
 - a. Where possible, install silt fencing along contour lines so that each given run of silt fencing is at the same elevation.
 - b. On slopes, install silt fencing at intervals that do not exceed the maximum intervals indicated in the following table:

Slope (percent)	Maximum Length of Slope Above Each Silt Fence (feet)
2 and less	150
2.1 to 5	100
5.1 to 10	50
10.1 to 20	25
20.1 to 25	20
25.1 to 40	15
40.1 to 50	10

- c. Provide silt fencing around perimeter of each stockpile of topsoil, general fill material, and excavated material. Install silt fencing before expected precipitation and maintain until stockpile is removed.
- d. Do not install silt fencing at the following types of locations:
 - 1) Area of concentrated storm water flows such as ditches, swales, or channels.
 - 2) Where rock or rocky soils prevent full and uniform anchoring of silt fencing.
 - 3) Across upstream or discharge ends of storm water piping or culverts.
- 3. Installation:
 - a. Securely fasten wire mesh to posts, and securely fasten filter cloth to wire mesh.
 - b. When two sections of filter cloth abut each other, fold over edges and overlap by not less than six inches and securely fasten to wire mesh.
 - c. Embed posts in the ground to the depth necessary for proper controls; embed posts to not less than 16 inches below ground.
 - d. Filter cloth and wire mesh shall extend not less than eight inches below ground and not less than 16 inches above ground.

- e. Remove sediment accumulated at silt fencing as required. Repair and reinstall silt fencing as required.
- 4. Maintenance:
 - a. Do not allow formation of concentrated storm water flows on slopes above silt fencing unless so shown or indicated in the Contract Documents. If unauthorized concentrated storm water flows occur, stabilize the slope via earthmoving and other stabilization measures as required to prevent flow of concentrated storm water flows toward silt fencing.
- D. Straw Bale Dike.
 - 1. Install straw bale dikes where shown or indicated, including in swales, along contours, and along toe of slopes.
 - 2. Install straw bales in shallow excavation as wide as the bale and approximately four to six inches below surrounding grade.
 - 3. Ends of straw bales shall tightly abut ends of adjacent straw bales.
 - 4. Securely install straw bales using two support posts per straw bale, driven into the ground not less than 1.5 to two feet below bottom of straw bale. Top of post shall be flush with top of straw bale. Angle first post for each straw bale toward the previously installed straw bale.
 - 5. Frequently inspect straw bales and repair or replace as required. Remove accumulated silt and debris from behind straw bales.
- E. Mulching and Soil Stabilization:
 - 1. Use mulching to temporarily stabilize exposed soil and fill material.
 - a. Immediately following final grading, provide mulch and stabilize with mats or netting, or sprayed soil stabilization emulsion with fiber additive.
 - b. Application of mulching for soil stabilization shall be as follows.
 - 1) Unrotted Straw or Salt Hay: 1.5 to two tons per acre.
 - 2) Soil stabilization emulsions, when used, shall be applied in accordance with manufacturer's instructions, and shall be applied with mulch or stabilization fibers.
 - 3) Wood-fiber or Paper-fiber Application: 1,500 lbs. per acre, installed by hydroseeding.
 - c. Where mats or netting are used:
 - 1) Cover entire area to be stabilized with mats or netting.
 - 2) Provide anchoring trenches at the top and bottom of slopes to receive mats or netting. Bury at least the top and bottom ends of mat or netting, four inches or more wide, at top and bottom of slope. Tamp trench full of soil. Four inches from trench, secure mat or netting with appropriate staples spaced at intervals of 10 inches.
 - 3) Overlap adjacent strips of mat or netting by not less than four inches.
- F. Protection of Storm Water Drainage Inlets and Catch Basins:

1. Protect each drainage inlet and catch basin that has the potential to receive storm water runoff from exposed soils and does not discharge into a storm water settlement basin.
2. Install inlet filter bags inside of drainage inlet or catch basin in accordance with manufacturer's instructions. Secure inlet filter bag with the structure's grate or by other acceptable means.
3. Inlet filter bags shall not pose any obstruction above the pre-construction elevation of the drainage inlet or catch basin grate requiring barricades or flashers.
4. When removing silt and sediment from inlet filter bag, do not dump filter bag's contents into the drainage inlet or catch basin.
5. Remove silt and sediment from inlet filter bag, or replace inlet filter bag, when inlet filter bag is not more than half full.

G. Temporary Settlement Basin:

1. For constructing embankments comply with requirements in Division 31 Sections on earthwork, embankments, excavation, and fill.
2. Overflow Weir and Discharge Pipe:
 - a. Install piping in accordance with manufacturer's instructions.
 - b. Install overflow weirs at elevations shown or indicated on the Drawings or approved Shop Drawings, as applicable, to avoid overtopping and overfilling of settlement basin without short-circuiting the settlement basin's hydraulic performance.
 - c. Wrap and secure geotextile material specified for silt fencing around discharge structures of temporary settlement basins
3. Crushed Stone and Riprap: Install in accordance with Division 31 Sections on earthwork, fill, and riprap. Provide in areas of temporary settlement basin subject to erosion, and at upstream and downstream ends of discharge piping.
4. Remove sediment when required based on accumulation of material.
5. When temporary settlement basin is no longer required, remove the temporary settlement basin discharge weir, discharge piping, and spillway, fill the temporary settlement basin to required grade in accordance with requirements of Division 31 Section on excavation and fill, and provide landscaping in accordance with Division 32 Sections on landscaping.

H. Filter Bag on Dewatering Pump Discharge:

1. Provide dewatering of excavations in compliance with Division 31 Sections on earthmoving, excavation, and fill.
2. Locate filter bags and temporary pump discharge lines to avoid interfering with the public, use of private property, and OWNER's and facility manager's operations. Relocate filter bags and appurtenances when required.
3. Filter bag discharge shall be directed to appropriate storm water drainage route. Do not discharge into roadways, driveways, access roads, parking areas, or overland. When temporary settlement basin is used, locate filter bags to discharge to temporary settlement basin when practicable.

4. Provide filter bag on discharge of each dewatering pump drawing from an excavation.
 5. Securely attach filter bag to pump discharge pipe or hose.
 6. Maintain, clean out, and replace filter bags as required.
- I. Temporary Stone Construction Entrance:
1. Where shown on the Drawings, and where construction vehicles will regularly transit to paved surfaces from unstabilized surfaces, provide temporary stone construction entrance. CONTRACTOR vehicles shall use temporary stone construction entrances.
 2. Provide temporary stone construction entrances of the width, length, and thickness shown or indicated on the Drawings. When not shown or indicated on the Drawings, temporary stone construction entrance shall be not less than 50 feet long, by 20 feet wide, by eight inches deep.
 3. Installation:
 - a. Ensure that subgrade under each temporary stone construction entrance is suitably dense for the intended purpose. Suitably prepare subgrade as required for temporary stone construction entrance.
 - b. Provide on subgrade a layer of geotextile separation fabric, installed in accordance with geotextile separation fabric manufacturer's recommendations for separation.
 - c. Provide stone on installed geotextile separation fabric. Grade the stone for passage of vehicles.
 4. Maintenance:
 - a. Maintain temporary stone construction entrance at not less than the minimum required thickness. Add stone as required to maintain thickness.
 - b. When upper layer of temporary stone construction entrance becomes contaminated with soil, remove the contaminated material and replace with clean stone.
 - c. Using water to wash down temporary construction entrance or paved areas onto which soil material has been tracked is unacceptable.

3.7 REMOVAL OF TEMPORARY CONTROLS

- A. Removals – General:
1. Upon completion of the Work, remove temporary controls and restore Site to specified condition; if condition is not specified, restore Site to pre-construction condition.
 2. After soils are permanently stabilized, remove from the Site temporary erosion and sediment controls.

+ + END OF SECTION + +

SECTION 01 57 33

SECURITY

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes general requirements for security at the Site, including accessing the Site, securing the Work, temporary fencing, and other requirements.
2. CONTRACTOR shall safely guard all the Work, the Project, materials, equipment, and property from loss, theft, damage, and vandalism until Substantial Completion, unless otherwise agreed upon by the parties.
3. CONTRACTOR's duty includes safely guarding OWNER's property in vicinity of the Work and Project, and other private property in the vicinity of the Project from injury and loss in connection with performance of the Project.
4. Employ watchmen as required to provide required security and prevent unauthorized entry.
5. Costs for security required under this Section shall be paid by CONTRACTOR.
6. Make no claim against OWNER for damage resulting from trespass.
7. Remedy damage to property of OWNER and others arising from failure to furnish adequate security.
8. Provide temporary fencing in accordance with the Contract Documents.
9. CONTRACTOR's security measures shall be at least equal to those usually provided by OWNER or facility manager to protect existing facilities during normal operation.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Temporary Fencing: Submit site plan drawings showing proposed locations and extent of temporary site security fencing and each breach therein.
2. Product Data:
 - a. Temporary Fencing: Manufacturer's literature, specifications, and installation instructions for temporary site security fencing proposed.

B. Informational Submittals: Submit the following:

1. Employee Information: Submit to OWNER the following; do not submit to ENGINEER:
 - a. Format of employee background data.
 - b. Background data for employees to whom identification badges will be furnished.
 - c. Updated listing of personnel to whom identification badges have been issued. Submit updated listing within 24 hours of a change in the list or change in an employee's Site access status.

1.3 CONTRACTOR'S SITE ACCESS AND SECURITY PROCEDURES

- A. Comply with Section 01 55 13, Access Roads and Parking Areas.
- B. Comply with OWNER's security procedures and access restrictions at the Site throughout the Project. Comply with the following:
 1. Personnel Identification and Background Checks:
 - a. All CONTRACTOR personnel, including Subcontractors, Suppliers, and others associated with the Project shall wear, in a visible location, at all times at the Site a durable, waterproof badge with wearer's photograph, name, signature, and, as applicable employee number; CONTRACTOR's name; employer (if other than CONTRACTOR), and Project name.
 - b. Prior to issuing badge, submit to OWNER copy of background data sheet for each person to whom badge may be issued for OWNER acceptance; do not issue badge without OWNER acceptance of background data for that person.
 - c. Submit for OWNER's acceptance the proposed format of employee background data sheet.
 2. General Provisions Regarding Personnel Identification:
 - a. Prerequisites to Issuance of Personnel Identification Badges:
 - 1) Do not issue personnel identification badge until the person receiving the badge is documented by CONTRACTOR as:
 - a) Being eligible to perform work in the jurisdiction where the Project is located.
 - b) Has received all required safety instructions, training, and equipment.
 - c) Is known to CONTRACTOR as being qualified to perform the Work to which the person will be assigned.
 - b. Listing of Personnel to Whom Badges are Issued:
 - 1) Maintain and continuously update a listing or log of all personnel to whom personnel identification badges have been issued.
 - 2) Listing or log shall indicate each person's full name, home address, personal telephone number, employer name, and employer address and telephone number.
 - 3) Submit copy of listing or to OWNER in accordance with Article 1.2 of this Section.

3. Vehicle Identification:
 - a. While on-Site, all CONTRACTOR vehicles, including employee vehicles, shall display vehicle identification tag.
 - b. Vehicle tag shall include the following information: Site name, CONTRACTOR name, contract designation, vehicle license plate number and state of registration, name and employer of vehicle owner, and vehicle owner contact telephone number.
4. Parking:
 - a. Do not park outside of designated CONTRACTOR parking area to be determined by Fayette County Plant Staff. Prepare and maintain parking area as required.
 - b. Personal vehicles are not allowed outside the contractor parking area.

PART 2 – PRODUCTS

2.1 TEMPORARY FENCING

- A. When security fencing or barriers are breached or temporarily removed for the Project, provide and maintain temporary security fencing equal to existing, unless otherwise specified, in manner satisfactory to ENGINEER and OWNER.
- A. Erect and maintain temporary fencing where shown on the drawings, and at locations where permanent security fencing or barriers are breached or temporarily removed for the Work.

PART 3 – EXECUTION

3.1 TEMPORARY FENCING

- A. Installation:
 1. Provide temporary fencing for site security so that integrity of site security is maintained throughout the Project.
 2. Install temporary fencing used for site security in accordance with the Contract Documents and fence manufacturer's instructions.
- B. Maintenance:
 1. Maintain temporary fencing throughout the Project.
 2. Repair damage to temporary fencing and replace fencing when required to preserve Site security.
- C. Removal:
 1. Remove temporary fencing when permanent site security fencing is in place and fully functional, or when otherwise directed or ENGINEER.

++ END OF SECTION ++

SECTION 01 61 00

COMMON PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes:
 - a. Common requirements for materials and equipment.
 - b. Compatibility of materials and equipment.

1.2 REQUIREMENTS FOR MATERIALS AND EQUIPMENT

- A. Unless otherwise indicated in the Contract Documents, furnish materials and equipment that:
1. Have not previously been incorporated into another project or facility; and
 2. Have not changed ownership after initial shipment from the manufacturer's factory or facility; and
 3. If stored since their manufacture or fabrication, have, while in storage, been properly maintained and serviced in accordance with the manufacturer's recommendations for long-term storage; submit documentation as required by ENGINEER that such maintenance and service has been performed; and
 4. That the item(s) have not been subject to degradation or deterioration since manufacture; and
 5. Are the current model(s) or type(s) furnished by the Supplier.
- B. To the extent possible, furnish from a single source those materials and equipment that are of the same generic kind.
- C. Furnish materials and equipment complete with accessories, trim, finish, fasteners, and other items shown, indicated, or required for a complete installation for the indicated use and performance.
- D. Standard Items: When available, and unless custom or nonstandard options are specified or indicated, furnish standard materials and equipment of types that have been produced and used successfully in similar situations on other projects.
- E. Visual Matching: Where required in the Contract Documents, furnish materials and equipment that match (as determined by ENGINEER) referenced existing construction, and mock-ups and Sample(s) approved by ENGINEER.

- F. Where the Contract Documents include the phrase “as selected” for color of materials or equipment, finish pattern, option, or similar phrase, provide materials and equipment selected by ENGINEER as follows:
1. Standard Range: Where the Contract Documents include the phrase “standard range of colors, patterns, textures” or similar wording, provide color, pattern, density, or texture selected by ENGINEER from manufacturer’s product line that does not include premium items.
 2. Full Range: Where the Contract Documents include the phrase “full range of colors, patterns, textures” or similar wording, ENGINEER will select color, pattern, density, or texture from manufacturer’s entire product line, including standard and premium items.

1.3 COMPATIBILITY

- A. Similar materials and equipment by the same Supplier shall be compatible with each other, unless otherwise indicated in the Contract Documents or approved by ENGINEER.
- B. Provide materials and equipment compatible with items previously selected or installed on the Project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 62 00

PRODUCT OPTIONS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. This Section includes:
 - a. CONTRACTOR's options for selecting materials and equipment.
 - b. Requirements for consideration of "or-equal" materials and equipment.

1.2 PRODUCT OPTIONS

- A. For materials and equipment specified only by reference standard or description, without reference to Supplier, furnish materials and equipment complying with such standard, by a Supplier or from a source that complies with the Contract Documents.
- B. For materials and equipment specified by naming one or more items or Suppliers, furnish the named materials and equipment that comply with the Contract Documents, unless an "or-equal" or substitute item is approved by ENGINEER.
- C. For materials and equipment specified by naming one or more items or Suppliers and the term, "or-equal", when CONTRACTOR proposes a material or equipment item or Supplier as an "or-equal", submit to ENGINEER a request for approval of an "or-equal" item or Supplier.

1.3 "OR-EQUAL" ITEMS

- A. Procedure:
 - 1. For proposed materials and equipment not named in the Contract Documents and considered as an "or-equal" in accordance with the General Conditions, CONTRACTOR shall request in writing ENGINEER's approval of the "or-equal".
 - 2. Request for approval of an "or-equal" item shall accompany the Shop Drawing or product data submittal for the proposed item
- B. Requests for approval of "or-equals" shall include:
 - 1. CONTRACTOR's written request that the proposed item be considered as an "or-equal" in accordance with the General Conditions, accompanied by CONTRACTOR's certifications required in the General Conditions.
 - 2. Documentation adequate to demonstrate to ENGINEER that proposed item does not require extensive revisions to the Contract Documents, that proposed

item is consistent with the Contract Documents, and that proposed item will produce results and performance required in the Contract Documents, and that proposed item is compatible with other portions of the Work.

3. Detailed comparison of significant qualities of proposed item with the materials and equipment and manufacturers named in the Contract Documents. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements shown or indicated.
4. Evidence that proposed item's manufacturer will furnish warranty equal to or better than that specified, if any.
5. List of similar installations for completed projects with project names and addresses, and names and address of design professionals and owners, when requested.
6. Samples, when requested by ENGINEER.
7. Other information requested by ENGINEER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 65 00

PRODUCT DELIVERY REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes the general requirements for preparing for shipping, delivering, and handling materials and equipment.
2. CONTRACTOR shall make all arrangements for transporting, delivering, and handling of materials and equipment required for prosecution and completion of the Work.
3. When required, move stored materials and equipment without additional compensation and without changes to the Contract Times.

1.2 SUBMITTALS

- A. Refer to individual Specification Sections for submittal requirements relative to delivering and handling materials and equipment.

1.3 PREPARING FOR SHIPMENT

- A. When practical, factory-assemble materials and equipment. Match mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable, protective coating.
- B. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate the associated purchase order number, bill of lading number, contents by name, OWNER's contract name and number, CONTRACTOR name, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.
- C. Protect materials and equipment from exposure to the elements and keep thoroughly dry and dust-free at all times. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Lubricate bearings and other items requiring lubrication in accordance with manufacturer's instructions.
- D. Do not ship materials and equipment until:
1. Related Shop Drawings, Samples, and other submittals have been approved or accepted (as applicable) by ENGINEER, including,

but not necessarily limited to, all Action Submittals associated with the materials and equipment being delivered.

2. Manufacturer's instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by ENGINEER in accordance with the Specifications.
3. Results of source quality control testing (factory testing), when required by the Contract Documents for the associated materials or equipment, have been reviewed and accepted by ENGINEER.
4. Facilities required for handling materials and equipment in accordance with manufacturer's instructions are in place and available.
5. Required storage facilities have been provided.

1.4 DELIVERY

A. Scheduling and Timing of Deliveries:

1. Arrange deliveries of materials and equipment in accordance with the accepted Progress Schedule and in ample time to facilitate inspection prior to installation.
2. Schedule deliveries to minimize space required for and duration of storage of materials and equipment at the Site or delivery location, as applicable.
3. Coordinate deliveries to avoid conflicting with the Work and conditions at Site, and to accommodate the following:
 - a. Work of subcontractors and OWNER.
 - b. Storage space limitations.
 - c. Availability of equipment and personnel for handling materials and equipment.
 - d. OWNER's use of premises.
4. Deliver materials and equipment to the Site during regular working hours.
5. Deliver materials and equipment to avoid delaying the Work and the Project, including work of other contractors, as applicable. Deliver anchor system materials, including anchor bolts to be embedded in concrete or masonry, in ample time to avoid delaying the Work.

B. Deliveries:

1. Shipments shall be delivered with CONTRACTOR's name, Subcontractor's name (if applicable), Site name, Project name, and contract designation (example: "ABC Construction Co., City of

Somewhere, Idaho, Wastewater Treatment Plant Primary Clarifier Improvements, Contract 25, General Construction”) clearly marked.

2. Site may be listed as the “ship to” or “delivery” address; but OWNER shall not be listed as recipient of shipment unless otherwise directed in writing by ENGINEER.
3. Provide CONTRACTOR’s telephone number to shipper; do not provide OWNER’s telephone number.
4. Arrange for deliveries while CONTRACTOR’s personnel are at the Site. CONTRACTOR shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when CONTRACTOR is not present will be refused by OWNER and/or ENGINEER, and CONTRACTOR shall be responsible for the associated delays and additional costs, if incurred.

C. Containers and Marking:

1. Have materials and equipment delivered in manufacturer’s original, unopened, labeled containers.
2. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.

D. Inspection of Deliveries:

1. Immediately upon delivery, inspect shipment to verify that:
 - a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) submittals.
 - b. Quantities are correct.
 - c. Materials and equipment are undamaged.
 - d. Containers and packages are intact and labels are legible.
 - e. Materials and equipment are properly protected.
2. Promptly remove damaged materials and equipment from the Site and expedite delivery of new, undamaged materials and equipment, and remedy incomplete or lost materials and equipment to furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.
3. Advise ENGINEER in writing when damaged, incomplete, or defective materials and equipment are delivered, and advise ENGINEER of the associated impact on the Progress Schedule.

1.5 HANDLING OF MATERIALS AND EQUIPMENT

Product Delivery Requirements

- A. Provide equipment and personnel necessary to handle materials and equipment, including those furnished by OWNER, by methods that prevent soiling or damaging materials and equipment and packaging.
- B. Provide additional protection during handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and surrounding surfaces.
- C. Handle materials and equipment by methods that prevent bending and overstressing.
- D. Lift heavy components only at designated lifting points.
- E. Handle materials and equipment in safe manner and as recommended by the manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during handling. Hand-carry or use suitable handling equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 66 00

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This Section includes general requirements for storing and protecting materials and equipment.

1.2 STORAGE

- A. Store and protect materials and equipment in accordance with manufacturer's recommendations and the Contract Documents.
- B. CONTRACTOR shall make all arrangements and provisions necessary for, and pay all costs for, storing materials and equipment. Excavated materials, construction equipment, and materials and equipment to be incorporated into the Work shall be placed to avoid injuring the Work and existing facilities and property, and so that free access is maintained at all times to all parts of the Work and to public utility installations in vicinity of the Work. Store materials and equipment neatly and compactly in locations that cause minimum inconvenience to OWNER, other contractors, public travel, and owners, tenants, and occupants of adjoining property. Arrange storage in manner to allow easy access for inspection.
- C. Areas available at the Site for storing materials and equipment are shown or indicated in the Contract Documents, or as approved by ENGINEER.
- D. Store materials and equipment to become OWNER's property to facilitate their inspection and ensure preservation of quality and fitness of the Work, including proper protection against damage by freezing, moisture, and high temperatures with ambient temperatures as high as 100 degrees F. Store in indoor, climate-controlled storage areas all materials and equipment subject to damage by moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to OWNER. When placing orders to Suppliers for equipment and controls containing computer chips, electronics, and solid-state devices, CONTRACTOR shall obtain, coordinate, and comply with specific temperature and humidity limitations on materials and equipment, because temperature inside cabinets and components stored in warm temperatures can approach 200 degrees F.
- E. CONTRACTOR shall be fully responsible for loss or damage (including theft) to stored materials and equipment.

Product Storage and Handling Requirements

- F. Do not open manufacturer's containers until time of installation, unless recommended by the manufacturer or otherwise specified in the Contract Documents.
- G. Do not store materials or equipment in structures being constructed unless approved by ENGINEER in writing.
- H. Do not use lawns or other private property for storage without written permission of the owner or other person in possession or control of such premises.

1.3 PROTECTION

- A. Equipment to be incorporated into the Work shall be boxed, crated, or otherwise completely enclosed and protected during shipping, handling, and storage, in accordance with Section 01 65 00, Product Delivery Requirements.
- B. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.
- C. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged or marred shall be repainted in their entirety in accordance with equipment manufacturer and paint manufacturer requirements, to the satisfaction of ENGINEER.
- D. Protect electrical equipment, controls, and instrumentation against moisture, water damage, heat, cold, and dust. Space heaters provided in equipment shall be connected and operating at all times until equipment is placed in operation and permanently connected.

1.4 UNCOVERED STORAGE

- A. The following types of materials may be stored outdoors without cover on supports so there is no contact with the ground:
 - 1. No materials shall be uncovered.

1.5 COVERED STORAGE

- A. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:
 - 1. Grout and mortar materials.
 - 2. Masonry units.
 - 3. Soil materials and granular materials such as aggregate.
 - 4. Chemical trench box.
 - 5. PVC and CPVC pipe.
- B. Tie down covers with rope, and slope covering to prevent accumulation of water.

- C. Store loose granular materials, with covering impervious to water, in well-drained area or on solid surfaces to prevent mixing with foreign matter.

1.6 FULLY PROTECTED STORAGE

- A. Unless otherwise approved by ENGINEER and OWNER, store all material and equipment not named in Articles 1.4 and 1.5 of this Section on supports in buildings or trailers that have concrete or wooden flooring, roof, and fully closed walls on all sides. Covering with visquine plastic sheeting or similar material in space without floor, roof, and walls is not acceptable. Comply with the following:
 - 1. Provide heated storage for materials and equipment that could be damaged by low temperatures or freezing.
 - 2. Provide air-conditioned storage for materials and equipment that could be damaged by high temperatures.
 - 3. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.
 - 4. Maintain humidity at levels recommended by manufacturers for electrical and electronic equipment.

1.7 MAINTENANCE OF STORAGE

- A. On scheduled basis, periodically inspect stored materials and equipment to ensure that:
 - 1. Condition and status of storage facilities is adequate to provide required storage conditions.
 - 2. Required environmental conditions are maintained on continuing basis.
 - 3. Materials and equipment exposed to elements are not adversely affected.
- B. Mechanical and electrical equipment requiring long-term storage shall have complete manufacturer's instructions for servicing each item, with notice of enclosed instructions shown on exterior of container or package.
 - 1. Comply with manufacturer's instructions on scheduled basis.
 - 2. Space heaters that are part of electrical equipment shall be connected and operated continuously until equipment is placed in service and permanently connected.

1.8 MICROPROCESSORS, PANELS, AND INSTRUMENTATION STORAGE

- A. Store panels, microprocessor-based equipment, electronics, and other devices subject to damage or decreased useful life because of temperatures below 40 degrees F or above 100 degrees F, relative humidity above 90

Product Storage and Handling Requirements

percent, or exposure to rain or exposure to blowing dust in climate-controlled storage space.

B. Requirements:

1. Storage shall be fully protected and climate controlled storage as specified in Article 1.6 of this section.
2. OWNER and ENGINEER have the right to inspect materials and equipment during normal working hours.
3. Placed inside each panel or device a desiccant, volatile corrosion inhibitor blocks (VCI), moisture indicator, and maximum-minimum indicating thermometer.
4. Check panels and equipment at least once per month. Replace desiccant, VCI, and moisture indicator as often as required, or every six months, whichever occurs first.
5. Certified record of daily maximum and minimum temperature and humidity in storage facility shall be available for inspection by OWNER and ENGINEER. Certified record of monthly inspection, noting maximum and minimum temperature for month, condition of desiccant, VCI, and moisture indicator, shall be available for inspection by OWNER and ENGINEER.

C. Costs for storing climate-sensitive materials and equipment shall be paid by CONTRACTOR. Replace panels and devices damaged during storage, or for which storage temperatures or humidity range has been exceeded, at no additional cost to OWNER. Delays resulting from such replacement are causes within CONTRACTOR's control.

D. Do not ship panels and equipment to the Site until conditions at the Site are suitable for installation, including slabs and floors, walls, roofs, and environmental controls. Failure to have the Site ready for installation shall not relieve CONTRACTOR from complying with the Contract Documents.

1.9 RECORDS

A. Keep up-to-date account of materials and equipment in storage to facilitate preparation of Applications for Payment, if the Contract Documents provide for payment for materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 71 23

FIELD ENGINEERING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes field engineering, surveying, and layouts by CONTRACTOR, and associated requirements. This Section supplements the General Conditions' provisions on reference points and other matters.
2. CONTRACTOR shall provide field engineering services, surveying and layout services, and professional services of the types indicated for the Project, including:
 - a. Furnishing civil, structural, and other professional engineering services specified or required to execute CONTRACTOR's construction methods.
 - b. Developing and making all detail surveys and measurements required for construction; including slope stakes, batter boards, and all other working lines, elevations, and cut sheets.
 - c. Providing materials required for benchmarks, control points, batter boards, grade stakes, structure and pipeline elevation stakes, and other items.
 - d. Keeping a transit, theodolite, or total station (i.e., theodolite with electronic distance measurement device); leveling instrument; and related implements such as survey rods and other measurement devices, at the Site at all times, and having a skilled instrument person available when necessary for laying out the Work.
 - e. Being solely responsible for all locations, dimensions and levels. No data other than Change Order, Work Change Directive, or Field Order shall justify departure from dimensions and levels required by the Contract Documents.
 - f. Rectifying all Work improperly installed because of not maintaining, not protecting, or removing without authorization established reference points, stakes, marks, and monuments.
 - g. Providing such facilities and assistance necessary for ENGINEER and Resident Project Representative (if any) or

Owner's Site Representative (if any) to check lines and grade points placed by CONTRACTOR. Do not perform excavation or embankment work until all cross-sectioning necessary for determining payment quantities for Unit Price Work have been completed and accepted by ENGINEER.

B. Coordination:

1. Review requirements of this and other Sections and coordinate installation of items to be installed with or before field engineering, surveying, and layout Work.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Certificates:
 - a. When requested by ENGINEER, submit certificate signed by professional engineer or professional surveyor, as applicable, certifying that elevations and locations of the Work comply with the Contract Documents. Explain each deviation, if any.
2. Field Engineering:
 - a. Submit daily reports as indicated in this Section.
 - b. When requested by ENGINEER, submit documentation verifying accuracy of field engineering.
3. Surveying:
 - a. Complete plan for performing survey work, submitted not less than 10 days prior to beginning survey Work.
 - b. Example of proposed survey field books to be maintained by CONTRACTOR's surveyor. Example shall have sufficient information and detail, including example calculations and notes, to demonstrate that field books will be organized and maintained in a professional manner in accordance with the Contract Documents.
 - c. Submit original field books within two days after completing survey Work.
 - d. Submit certified survey in accordance with this Section.
4. Qualifications Statements:
 - a. Field Engineer: Name, employer, and professional address. When requested by ENGINEER, submit qualifications, including resume'.
 - b. Surveyor: Name, employer, and professional address of firm, and resumes of each professional land surveyor and

crew chief that will be engaged in survey Work. Submit not less than 10 days prior to beginning survey Work. During the Project, submit resume for each new registered, licensed land surveyor and crew chief employed by or retained by CONTRACTOR not less than 10 days prior to starting on the survey Work.

1.3 CONTRACTOR'S ENGINEERS

A. Qualifications of Field Engineer:

1. Employ and retain at the Site a field engineer with experience and capability of performing all field engineering tasks required of CONTRACTOR, as indicated in this Article and elsewhere in the Contract Documents.
2. CONTRACTOR's field engineer shall possess not less than five years of experience performing duties similar in scope and extent to those required of CONTRACTOR's field engineer on this Project.

B. Responsibilities of Contractor's Field Engineer:

1. Daily Reports:
 - a. Prepare and maintaining daily reports of activity on the Contract. Submit reports to ENGINEER including the following information:
 - 1) Number of employees at the Site.
 - 2) Number employees at the Site for each Subcontractor.
 - 3) Breakdown of employees by trades.
 - 4) Major equipment and materials installed as part of the Work.
 - 5) Major construction equipment utilized.
 - 6) Location of areas in which construction was performed.
 - 7) Materials and equipment delivered to the Site or suitable, offsite storage location.
 - 8) Work performed, including field quality control and testing.
 - 9) Weather conditions.
 - 10) Safety concerns, events, and precautions taken.
 - 11) Delays encountered, extent of delay incurred, reasons for the delay, and measures that will be taken to rectify delays encountered.

- 12) Acknowledgement of specific instructions received from ENGINEER or OWNER.
 - b. Daily reports shall be signed and dated by responsible member of CONTRACTOR's staff, such as CONTRACTOR's project manager, field engineer, or superintendent, or foreman designated by CONTRACTOR as having authority to sign daily reports.
 - c. Submit = CONTRACTOR's daily reports in accordance with Section 01 31 26, Electronic Communication Protocols, by 9:00 a.m. the next working day after the day covered in the associated report.
 2. Check all formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping, other materials and equipment for compliance with the Contract Documents.
 3. Continually inspect the Work to ensure that the quality and quantities required by the Contract Documents are provided.
 4. Cooperate as required with ENGINEER and Resident Project Representative (if any) in observing the Work and performing field inspections.
 5. Check and coordinate the Work for conflicts and interferences, and immediately advise ENGINEER and Resident Project Representative, if any, of all discrepancies of which CONTRACTOR is aware.
 6. Maintain field office files and drawings, record documents, and coordinate field engineering services with Subcontractors and Suppliers as appropriate, and other prime contractors (if any).
 7. Prepare layout and coordination drawings for construction operations.
 8. Review and coordinate the Work with Shop Drawings and CONTRACTOR's other submittals approved or accepted, as applicable, by ENGINEER.
- C. Professionals Retained by Contractor (whether or not stationed at the Site):
1. Professional Services that are Not Delegated Professional Design of the Completed Work:
 - a. Where the Contract Documents require that CONTRACTOR retain a design professional for to carry out CONTRACTOR's responsibilities for construction means, methods, techniques, sequences and procedures (including temporary construction that will not remain as part of the completed Work), such services shall be performed by a registered professional of the discipline required for specific

service on the Project, with valid license in the same jurisdiction as the Site.

- b. OWNER and ENGINEER shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed by such design professionals.

1.4 CONTRACTOR'S SURVEYOR

A. Qualifications:

1. Employ or retain the services, as needed, at the Site a surveyor with experience and capability of performing surveying and layout tasks required in the Contract Documents and as required for the Work.
2. CONTRACTOR's surveyor shall possess not less than five years of experience performing duties similar in scope and extent to those required of CONTRACTOR's surveyor on this Project.
3. Surveyor shall be a professional land surveyor registered and licensed in the jurisdiction where the Project is located, or a professional engineer registered and licensed as a professional engineer in the jurisdiction where the Project is located and authorized under Laws and Regulations to practice surveying.

B. Responsibilities of Contractor's Surveyor:

1. Providing required surveying equipment, including transit, theodolite, or total station; level; stakes; and surveying accessories.
2. Establishing required lines and grades for constructing all facilities, structures, pipelines, and site improvements, including outdoor electrical equipment and feeders.
3. Preparing and maintaining professional-quality, accurate, well-organized, legible notes of all measurements and calculations made while surveying and laying out the Work.
4. Prior to backfilling operations, survey, locate, and record on a copy of the Contract Documents accurate representation of buried Work and Underground Facilities provided and encountered.
5. Locating on a site plan of the Site the actual location of above-ground Work to be indicated on record documents.
6. Complying with requirements of the Contract Documents relative to surveying and related Work, including requirements of this Section's Articles 1.5 and 3.1.

1.5 RECORDS

A. Records – General:

1. Maintain at the Site a complete and accurate log of control and survey Work as such Work progresses.
- B. Field Books and Records:
1. Survey data and records shall be in accordance with recognized professional surveying standards, Laws and Regulations, and prevailing standards of practice in the locality where the Site is located.
 2. Original field notes, computations, and other surveying data shall be recorded by CONTRACTOR's surveyor in CONTRACTOR-furnished hard-bound field books and shall be signed and sealed by CONTRACTOR's surveyor.
 3. Completeness and accuracy of survey Work, and completeness and accuracy of survey records, including field books, shall be responsibility of CONTRACTOR.
 4. Failure to organize and maintain survey records in an appropriate manner that allows reasonable and independent verification of calculations, and to allow identification of elevations, dimensions, and grades of the Work, shall be cause for rejecting the survey records, including field books.
 5. Illegible notes or data, and erasures on any page of field books, are unacceptable. Do not submit copied notes or data. Corrections by ruling or lining out errors will be unacceptable unless initialed by the surveyor. Violation of these requirements may require re-surveying the data questioned by ENGINEER.
- C. Certified Survey of Surface Structures:
1. Upon completion of foundation walls and major site improvements, prepare a certified survey, signed and sealed by professional surveyor, showing or indicating dimensions, locations, angles and elevations of construction and locations and elevations of Underground Facilities installed and encountered during the Work.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SURVEYING

A. Reference Points:

1. Refer the General Conditions, as may be modified by the Supplementary Conditions, for requirements regarding reference points.
2. OWNER's established reference points that are damaged or destroyed by CONTRACTOR will be re-established by OWNER at

CONTRACTOR's expense. OWNER may deduct from payments owed CONTRACTOR such amounts as set-offs in accordance with the Contract Documents.

3. From OWNER-established reference points, establish lines, grades, and elevations necessary to control the Work. Obtain measurements required for executing the Work to tolerances specified in the Contract Documents.
4. Establish, place, and replace as required, such additional stakes, markers, and other reference points necessary for control, intermediate checks, and guidance of construction operations.

B. Surveys to Determine Quantities for Payment:

1. For each application for progress payment, perform such surveys and computations necessary to determine quantities of Work performed or placed. Perform surveys necessary for ENGINEER to determine final quantities of Work in place.
2. Notify ENGINEER not less than 24 hours before performing survey services for determining quantities to be included in Application for Payment. Unless waived in writing by ENGINEER, perform quantity surveys in presence of ENGINEER or Resident Project Representative (if any).

C. Construction Surveying: Comply with the following:

1. Alignment Staking: Provide alignment stakes at 50-foot intervals on tangent, and at 25-foot intervals on curves.
2. Slope Staking: Provide slope staking at 50-foot intervals on tangent, and at 25-foot intervals on curves. Re-stake at every ten-foot difference in elevation.
3. Structure: Stake-out structures, including elevations, and check prior to and during construction.
4. Pipelines: Stake-out pipelines including elevations, and check prior to and during construction.
5. Roads, Drives, and Paved Areas: Stake-out roadway, driveway, and paved area elevations at 50-foot intervals on tangent, and at 25-foot intervals on curves.
6. Cross-sections: Provide original, intermediate, and final staking as required, for site work other locations as necessary for quantity surveys.
7. Easement Staking: Provide easement staking at 50-foot intervals on tangent, and at 25-foot intervals on curves. Also provide wooden lamps with flagging at maximum intervals of 100 feet.

8. Record Staking: Provide permanent stake at each blind flange and each utility cap provided for future connections. Stakes for record staking shall be material acceptable to ENGINEER.

D. Accuracy:

1. Establish CONTRACTOR's temporary survey references points for CONTRACTOR's use to not greater than second-order accuracy (e.g., 1:10000). Construction staking used as a guide for the Work shall be set at not greater than third-order accuracy (e.g., 1:5000). Basis on which such orders are established shall provide the absolute margin for error specified below.
2. Horizontal accuracy of easement staking shall be plus or minus 0.1 feet. Accuracy of other staking shall be plus or minus 0.04 feet horizontally and plus or minus 0.02 feet vertically.
3. Survey calculations shall include an error analysis sufficient to demonstrate required accuracy.

+ + END OF SECTION + +

SECTION 01 71 23.16

CONSTRUCTION SURVEYING

PART 1 – GENERAL

1.1 SCOPE:

- A. Construction surveying shall include all of the surveying work required to layout the Work and control the location of the finished Project. The Contractor shall have the full responsibility for constructing the Project to the correct horizontal and vertical alignment, as shown on the Drawings, as specified, or as directed by the Engineer. The Contractor shall assume all costs associated with rectifying work constructed in the wrong location.
- B. From the information shown on the Drawings and the information to be provided as indicated under Project Conditions below, the Contractor shall:
 - 1. Be responsible for setting reference points and/or offsets, establishment of baselines, and all other layout, staking, and all other surveying required for the construction of the Project.
 - 2. Safeguard all reference points, stakes, grade marks, horizontal and vertical control points, and shall bear the cost of re-establishing same if disturbed.
 - 3. Stake out the permanent and temporary easements or the limits of construction to ensure that the Work is not deviating from the indicated limits.
 - 4. Be responsible for all damage done to reference points, baselines, center lines and temporary bench marks, and shall be responsible for the cost of re-establishment of reference points, baselines, center lines and temporary bench marks as a result of the operations.
- C. Baselines shall be defined as the line to which the location of the Work is referenced, i.e., edge of pavement, road centerline, property line, right-of-way or survey line.
- D. Record Drawing surveys shall be performed in accordance with Section 01 78 39.

1.2 PROJECT CONDITIONS:

- A. The Drawings provide the location and/or coordinates of principal components of the Project. The alignment of some components of the Project may be indicated in the Specifications. The Engineer may order changes to the location of some of the components of the Project or provide clarification to questions regarding the correct alignment.
- B. The location and elevation of benchmarks are shown on Drawings.
- C. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.

1.3 QUALITY ASSURANCE:

- A. The Contractor shall furnish documentation, prepared by a surveyor currently registered in the State of Georgia, confirming that staking is being done to the horizontal and vertical alignment shown in the Contract Documents. This requires that the Contractor hire, at the Contractor's own expense, a currently registered surveyor, acceptable to the Owner, to provide ongoing construction staking or confirmation of such.
- B. Any deviations from the Drawings shall be confirmed by the Engineer prior to construction of that portion of the Project.
- C. Construction Verification Surveying
 - 1. The Engineer may verify the Contractor's reference points, centerlines and work performed. This verification activity in no way relieves the Contractor of the responsibility of installing reference points, centerlines, temporary benchmarks, verifying that the work has been performed accurately, and all other work covered by this Section.

1.4 SITE WORK:

- A. Staking Precision: The precision of construction staking shall match the precision of a component's location indicated on the Drawings. Staking of utilities shall be done in accordance with generally accepted practice for the type of utility.
- B. Written certification, by a licensed surveyor, that structure base grade and structure locations match the locations shown on the Drawings is required prior to beginning construction of the structure.
- C. Paved Surfaces: The Contractor shall establish a reference point for establishing and verifying the paving subgrade and finished grade elevations. Any variance with plan grades shall be identified by the Contractor and confirmed by the Engineer prior to constructing the road base.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 71 33

PROTECTION OF THE WORK AND PROPERTY

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes general requirements for safety and protection that augment the requirements of the General Conditions, as may be modified by the Supplementary Conditions. This Section also includes requirements for barricades and warning signals, and protection of trees and plants, existing structures, floors, roofs, installed items, and landscaping.
2. CONTRACTOR shall be responsible for taking all precautions, providing all programs, and taking all actions necessary to protect personnel health and safety, and to protect the Work and all public and private property and facilities from damage, as specified in the General Conditions, Supplementary Conditions, and the Specifications.
3. To prevent damage, injury, or loss, CONTRACTOR's actions shall include the following:
 - a. Provide measures for safety of personnel at the Site, including workers engaged in the Work, delivery personnel, testing and inspection personnel, personnel of authorities having jurisdiction, other visitors to the Site, the public, OWNER's personnel, facility manager's personnel (if different from OWNER), ENGINEER, and Resident Project Representative (if any).
 - b. Storing apparatus, materials, supplies, and equipment in an orderly, safe manner that does not unduly interfere with progress of the Work or work of other contractors, utility owners, and owners of transportation rights-of-way.
 - c. Providing suitable storage facilities for materials and equipment subject to damage or degradation by exposure to climate, temperature, theft, breakage, or other cause.
 - d. Placing upon the Work or any part thereof only loads consistent with the safety and integrity of that portion of the Work and existing construction.

- e. Frequently removing and disposing of refuse, rubbish, scrap materials, and debris caused by CONTRACTOR's operations so that, at all times, the Site is safe, orderly, and workmanlike in appearance.
 - f. Providing temporary barricades, fencing, and guard rails around the following: openings, scaffolding, temporary stairs and ramps, around excavations, for elevated walkways, and other areas that may present a fall-hazard or hazard to vehicles.
- 4. Do not, except after written consent from proper parties, enter or occupy privately-owned property or premises with personnel, tools, materials or equipment, except on lands and easements provided by OWNER.
 - 5. CONTRACTOR has full responsibility for preserving public and private property and facilities on and adjacent to the Site. Direct or indirect damage done by, or on account of, any act, omission, neglect, or misconduct by CONTRACTOR in executing the Work, shall be remedied by CONTRACTOR, at his expense, to condition equal to that existing before damage was done.
 - 6. Owner May Remedy:
 - a. Should CONTRACTOR fail to protect and safeguard property and the Work after requests from ENGINEER or OWNER, OWNER may implement measures to protect property and the Work.
 - b. Cost of such OWNER-implemented measures shall be paid by CONTRACTOR. OWNER may deduct from payments due CONTRACTOR such amounts as set-offs in accordance with the Contract Documents.
 - c. Such right, however, shall not result in any obligation by OWNER or ENGINEER to continuously monitor or have responsibility for protection of property and the Work, which responsibility is exclusively CONTRACTOR's.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 BARRICADES AND WARNING SIGNALS

A. Barricades and Warning Signals – General:

- 1. Where the Work is performed on or adjacent to roadway, access road or driveway, right-of-way, or public place:

- a. Provide temporary barricades, fences, lights, warning signs, danger signals, watchmen, and take other precautionary measures for protecting persons, property, and the Work.
 - b. Use appropriately colored and reflective barricades, or paint barricades accordingly, to be visible at night.
 - c. From sunset to sunrise, provide and maintain not less than one temporary light at each barricade.
 - d. Erect sufficient barricades to keep vehicles from being driven on or into Work under construction.
 - e. Furnish watchmen in sufficient numbers to protect the Work.
2. Provide temporary barricades to protect personnel and property for Work not in or adjacent to transportation routes and vehicular travel areas, including indoor work, in accordance with Laws and Regulations.
 3. CONTRACTOR's responsibility for maintaining temporary barricades, signs, lights, and for providing watchmen shall continue until the Work is substantially complete in accordance with the Contract Documents, unless other provision for security and protection is agreed to by the parties. After Substantial Completion, protect Work and property during periods when final Work or corrective Work is underway.

B. Temporary Fencing:

3.2 TREE AND PLANT PROTECTION

A. Tree and Plant Protection – General:

1. Protect existing trees, shrubs, and plants on or adjacent to the Site, shown or designated to remain in place, against unnecessary cutting, breaking, damage, or skinning of trunk, branches, bark, and roots.
2. Do not store materials or equipment or park construction equipment and vehicles within foliage drip lines.
3. In areas subject to traffic, provide temporary fencing or temporary barricades to protect trees and plants.
4. Open fires are not allowed onsite.
5. Within the limits of the Work, water trees and plants that are to remain to maintain their health during construction operations.
6. Cover exposed roots with burlap, and keep such burlap continuously wet. Cover exposed roots with earth as soon as possible. Protect root systems from mechanical damage and damage by erosion, flooding, runoff, and noxious materials in solution.

7. If branches or trunks are damaged, prune branches immediately and protect cut or damaged areas with emulsified asphalt compounded specifically for horticultural use, in manner acceptable to ENGINEER.
8. When directed by ENGINEER, remove and dispose of at location away from the Site damaged trees and plants that die or suffer permanent injury, and replace each damaged tree or plant with specimen of equal or better species and quality.

3.3 PROTECTION OF EXISTING STRUCTURES

A. Underground Facilities:

1. Underground Facilities known to OWNER and ENGINEER, except water, gas, sewer, electric, and communications services to individual buildings and properties, are shown. Information shown for Underground Facilities is the best available to OWNER and ENGINEER but, in accordance with the General Conditions, as may be modified by the Supplementary Conditions, is not guaranteed to be correct or complete.
2. CONTRACTOR shall explore ahead of trenching and excavating Work and shall sufficiently uncover Underground Facilities that will or may interfere with the Work to determine their location, to prevent damage to Underground Facilities, and to prevent service interruption to structures and properties served by Underground Facilities. If CONTRACTOR damages an Underground Facility, CONTRACTOR shall restore it to its pre-construction condition, in accordance with requirements of the owner of the damaged facility and the Contract Documents.
3. Necessary changes in the location of the Work may be directed by ENGINEER to avoid Underground Facilities not shown or indicated on the Contract Documents.
4. If permanent relocation of an existing Underground Facilities is required and is not otherwise shown or indicated in the Contract Documents, CONTRACTOR may be directed in writing to perform the required work. When such relocation Work results in a change in the Contract Price, Contract Times, the associated Contract modification procedures and payment for such Work shall be in accordance with the Contract Documents.

B. Surface Structures:

1. Surface structures are existing buildings, structures, and other facilities at or above ground surface, including their foundations and any extension below ground surface. Surface structures include, but are not limited to, buildings, tanks, walls, bridges, roads, dams, channels, open drainage routes, exposed piping and utilities, poles, exposed wires, posts, signs, markers, curbs, walks, fencing, and other facilities visible at or above ground surface.
 2. Existing surface facilities, including but not limited to guard rails, posts, guard cables, signs, poles, markers, curbs, and fencing, that are temporarily removed to facilitate the Work shall be replaced and restored to their pre-construction condition at CONTRACTOR's expense.
- C. Protection of Underground Facilities and Surface Structures:
1. CONTRACTOR shall sustain in their places and protect from direct or indirect injury all Underground Facilities and surface structures located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure or facility.
 2. Before proceeding with the Work of sustaining and supporting such structure or facility, CONTRACTOR shall satisfy ENGINEER that methods and procedures to be used have been approved by party owning same.
 3. CONTRACTOR shall bear all risks attending the presence or proximity of all Underground Facilities and surface structures within or adjacent to limits of the Work, in accordance with the Contract Documents.
 4. CONTRACTOR shall be responsible for damage and expense for direct or indirect injury, caused by CONTRACTOR's activities, to structures and facilities. CONTRACTOR shall promptly repair damage caused by CONTRACTOR's activities, to the satisfaction of owner of damaged structure or facility.
 5. Protection of Underground Facilities Under Roads and Parking Areas: Provide temporary, heavy-duty steel roadway plates to protect existing manholes, handholes, valve boxes, vaults, and other Underground Facilities near to or visible at the ground surface.

3.4 PROTECTION OF FLOORS AND ROOFS

A. Protection of Floors and Roofs – General:

1. Use proper protective covering when moving equipment, handling materials or other loads, when painting, handling mortar or grout, and when cleaning walls, ceilings, or structure contents.

2. Use metal pans to collect oil and cuttings from piping, conduits, and rod threading machines, and under metal cutting machines.
3. Do not load concrete floors less than 28 days old without written permission of ENGINEER. Do not load floors, roofs, or slabs in excess of design loading.
4. Do not load roofs without written permission of ENGINEER.
5. Restrict access to roofs, and keep CONTRACTOR personnel off existing roofs, except as required for the Work.
6. If access to roofs is required, roofing, parapets, openings, and all other construction on or adjacent to roof shall be protected with suitable plywood or other acceptable means.

3.5 PROTECTION OF INSTALLED MATERIALS, EQUIPMENT, AND LANDSCAPING

- A. Protect installed Work to prevent damage from subsequent operations. Remove protective items when no longer needed, prior to Substantial Completion of the Work.
- B. Control traffic to prevent damage to equipment, materials, and surfaces.
- C. Coverings:
 1. Provide temporary coverings to protect materials and equipment from damage.
 2. Cover projections, wall corners and jambs, sills, and soffits of openings, in areas used for traffic and for passage of materials and equipment in subsequent work.

+ + END OF SECTION + +

SECTION 01 73 19

INSTALLATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section describes general requirements for installing materials and equipment. Additional installation requirements are included in the various Specifications Sections in Divisions 02 through 49 and elsewhere in the Contract Documents.
2. CONTRACTOR shall provide all labor, materials, equipment, services, tools, and incidentals required to install materials and equipment.

1.2 QUALITY ASSURANCE

A. General:

1. Provide appropriate quality assurance for installing materials and equipment, and provide quality control over Suppliers, materials and equipment, services, Site conditions, and workmanship, to provide Work of the required quality.

B. Qualifications:

1. Installer:
 - a. Installers shall be experienced in the types of Work required, including, but not limited to, the requirements of Section 01 42 00, References, and the Division 02 through 49 Specifications where the particular element of the Work is specified.

C. Regulatory Requirements: Comply with the following:

1. 29 CFR 1910, OSHA.

PART 2 – PRODUCTS

2.1 EQUIPMENT DRIVE GUARDS

A. Equipment Drive Guards – General:

1. Unless otherwise shown or indicated, provide all-metal guards complying with 29 CFR 1910, Subpart O, with equipment driven by open shafts, belts, chains, pulleys, sheaves, or gears. Guards shall enclose drive and driven mechanism.

2. If material of guards are not otherwise specified, guards shall be galvanized sheet steel, galvanized woven wire, or expanded metal set in a frame of galvanized steel members, as appropriate.
3. Secure guards in position by steel braces or straps, securely fastened to frame of equipment, floor, or wall as required.
4. Fastenings shall allow removal of guards for servicing equipment.

2.2 MISCELLANEOUS MATERIALS

- A. Shims shall be Type 304L stainless steel, clean and free of slag.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:

1. Installation Instructions and Requirements:
 - a. Install materials and equipment in accordance with approved Shop Drawings and CONTRACTOR's other submittals approved by ENGINEER, the Contract Documents, and manufacturer's installation instructions. When manufacturer's installation instructions conflict with the Contract Documents, obtain interpretation or clarification from ENGINEER before proceeding.
 - b. Manufacturer's installation instructions include manufacturer's written instructions; drawings; illustrative, wiring and schematic diagrams; diagrams identifying external connections, terminal block numbers and internal wiring; and other such information pertaining to installation of materials and equipment. Included are all of manufacturer's printed installation instructions, including those that may be attached to equipment upon delivery.
2. Prior to installing materials and equipment, complete preparation of surfaces on which materials and equipment are to be installed. Prior to installing materials and equipment on new concrete, concrete shall achieve sufficient compressive strength to support the materials and equipment.
3. Maintain the work area in a broom-clean condition while installing materials and equipment.
4. Use proper tools to assemble materials and equipment. Do not deform or mar surface of shafts, nuts, and other parts.
5. Do not support rigging from building or structure without written permission of ENGINEER. CONTRACTOR is responsible for and shall repair damage to building or structure resulting from CONTRACTOR's operations, in accordance with Section 01 71 33, Protection of the Work and Property.
6. During installation, maintain materials and equipment in neutral position and do not exert undue stress on materials and equipment.

7. Tighten connections requiring gaskets evenly all around to ensure uniform stress over entire gasket.
8. Use only an oil bath heater to expand couplings, gears, and other mechanical components to be expanded for installation. Do not force or drive couplings, gears, and other mechanical components onto equipment shafts, or subject such items to open flame or torch.
9. Do not alter or repair materials and equipment and do not burn or weld materials and equipment unless required in the Contract Documents or allowed by ENGINEER.
10. Provide plugs in lubrication holes to prevent entry of foreign matter.

B. Setting and Erection:

1. Install materials and equipment plumb, level, true, and free of rack unless otherwise shown or indicated, and demonstrate plumbness and level to ENGINEER. Bring parts to proper bearing after installation and erection.
2. Anchorages:
 - a. Provide anchorage setting drawings in time to coordinate with fabrication of materials and equipment and the Work.
 - b. Anchorages shall comply with Section 05 05 33, Anchor Systems. Requests for approval of substitute materials or methods of anchorage shall be in accordance with the General Conditions, Supplementary Conditions, and Section 01 25 00, Substitution Procedures.
3. Shimming:
 - a. Wedging is not allowed.
 - b. During installation, use the minimum number of shims required for leveling the equipment.
 - c. Provide shims, filling pieces, keys, packing, grouting of the type required by the Contract Documents, and other materials and equipment necessary to properly align, level, and secure apparatus in place.
4. Installing Equipment onto Foundations:
 - a. Using experienced millwrights, carefully set and align equipment on foundations, after equipment soleplates or baseplates (as applicable) have been shimmed to true alignment at anchorages.
 - b. Set anchorages in place and tighten nuts against shims.
 - c. Check bedplates or wing feet of equipment after securing to foundations and, after confirming alignments, grout soleplates or baseplates (as applicable) in place in accordance with the Contract Documents.
5. Ream misaligned holes. Do not “force” bolts or keys.
6. Where applicable, properly align equipment with associated piping and utility connections, without exerting undue stress on connecting piping and utilities.

C. Alignment and Leveling:

1. Verify that all shafts, couplings, and sheaves are properly aligned and adjust to required tolerances.
2. Align couplings while equipment is free of external loads.

3. Check angular and parallel alignment and record actual alignment and submit to ENGINEER. Alignment shall be within tolerances specified in Contract Documents and as recommended by Supplier of the material or equipment item.
4. Use laser indicators or dial indicators for checking angular and parallel alignment. Using dial indicators requires that, during rotation of half-couplings in performing testing, dial indicator shall be maintained in same relative position, and dial indicator readings taken at same place on circumference of coupling.

D. Threaded Connections:

1. Apply a molybdenum disulfide, anti-seize compound to threads in mechanical connections such as bolts, studs, cap screws, tubing, and other threads, unless otherwise shown or indicated.

3.2 FIELD QUALITY CONTROL

A. Supplier's Services:

1. When specified, provide competent, qualified representatives of material or equipment Supplier to perform services required, including: supervising installation, checking the completed installation, adjusting, testing of materials and equipment, and where required instructing operations and maintenance personnel in the use and care of materials and equipment.

++ END OF SECTION ++

SECTION 01 73 24

CONNECTIONS TO EXISTING FACILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes requirements for connections to existing facilities. Requirements for tie-ins and shutdowns necessary to complete the Work are in Section 01 14 16, Coordination with Owner's Operations.
2. CONTRACTOR shall provide labor, materials, tools, equipment, and incidentals shown, specified, and required for performing connections to existing facilities.

B. Coordination:

1. Review installation procedures under other Sections and coordinate Work that will be performed with or before the Work specified in this Section.

C. Related Sections:

1. Section 01 14 16, Coordination with Owner's Operations.
2. Section 01 73 29, Cutting and Patching.

D. General:

1. Requirements for shutdowns, tie-ins, and other provisions on connections to existing facilities, are indicated in Section 01 14 16, Coordination with Owner's Operations.
2. Requirements for temporary pumping for connections to existing facilities are in Section 01 14 16, Coordination with Owner's Operations
3. Requirements for cutting and patching are in Section 01 73 29, Cutting and Patching.
4. To extent possible, materials, equipment, systems, piping, and appurtenances that will be placed into service upon completion of connection to existing facilities shall be checked, successfully tested, and in condition for operation prior to making connections to existing facilities, if valves, gates, or similar watertight and gastight isolation devices are not provided at the connection point.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes general requirements for cutting and patching Work.
2. CONTRACTOR shall perform cutting and coring, and rough and finish patching of holes and openings in existing construction.
3. Provide cutting, coring, fitting and patching, including attendant excavation and fill, required to complete the Work, and to:
 - a. remove and replace defective Work;
 - b. remove samples of installed Work as specified or required for testing;
 - c. remove construction required to perform required alterations or additions to existing construction;
 - d. uncover the Work for ENGINEER's observation of covered Work, testing or inspection by testing entities, or observation by authorities having jurisdiction;
 - e. connect to completed Work not performed in proper sequence;
 - f. remove or relocate existing utilities and piping that obstruct the Work in locations where connections are to be made;
 - g. make connections or alterations to existing or new facilities.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:

1. Cutting and Patching Request:
 - a. Submit written request to ENGINEER, well in advance of executing cutting or alteration that affects one or more of the following:
 - 1) Design function or intent of Project.
 - 2) Work of OWNER or other contractors.
 - 3) Structural value or integrity of an element of the Project.
 - 4) Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 5) Efficiency, operational life, maintenance, or safety of operational elements.
 - 6) Visual qualities of sight-exposed elements.
 - b. Request shall include:
 - 1) Identification of Project and Contract designation.
 - 2) Description of affected Work of CONTRACTOR and work of others (if any).
 - 3) Necessity for cutting.

- 4) Effect on work or operations of OWNER, other contractors (if any), and on structural or weatherproof integrity of Project.
 - 5) Description of proposed Work, describing: scope of cutting and patching; trades who will be executing the Work; materials and equipment to be used; extent of refinishing; schedule of operations; alternatives to cutting and patching, if any, and net effect on aesthetics following completion of finishing Work.
 - 7) Designation of entity responsible for cost of cutting and patching, when applicable.
 - 8) Written permission of other prime contractors (if any) whose work will or may be affected.
2. Recommendation Regarding Cutting and Patching:
 - a. Should conditions of work or schedule indicate a change of materials or methods, submit written recommendation to ENGINEER including:
 - 1) Conditions indicating change.
 - 2) Recommendations for alternative materials or methods.
 - 3) Items required with request for approval of substitute, in accordance with the substitution request requirements of the Contract Documents.
 3. Product Data:
 - a. Submit manufacturer's data for the protective compound to be applied to core-drilled surfaces and cut concrete surfaces.
 - b. When not required under other Sections, submit manufacturer's data on materials to be used for finishing around the cut or patched area.
 - c. Furnish submittals for patching materials under the associated Specifications Section.
- B. Informational Submittals: Submit the following:
1. Written Notification of Cutting and Patching:
 - a. Submit written indication designating the day and time that the construction associated with cutting and patching will be uncovered to allow for observation. Do not begin cutting or patching operations until submittal is accepted by ENGINEER.
 2. X-ray Investigations:
 - a. Proposed method of investigation. Submit and obtain ENGINEER's acceptance prior to performing X-ray inspections.
 - b. Report of X-ray evaluation of slabs, floors, and walls to be cut or core-drilled.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials - General:
1. Use materials that comply with the Contract Documents.

2. If not shown or indicated in the Contract Documents, use materials that are identical to existing materials affected by cutting and patching Work.
 3. For exposed surfaces, use materials that visually match existing adjacent surfaces to fullest extent possible. If identical materials are unavailable or cannot be used, use materials whose installed performance will equal or surpass that of existing materials.
 4. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using materials that do not void required or existing warranties.
- B. Compound Applied to Core-Drilled Surfaces and Cut Concrete Surfaces:
1. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with solvent-free, two-component, protective, epoxy resin coating.
 2. Color shall approximate the finish color of the existing surface to be coated.
 3. Product and Manufacturer: Provide one of the following:
 - a. Sikagard 62, by Sika Corporation.
 - b. Or equal.

PART 3 – EXECUTION

3.1 GENERAL

- A. Perform cutting and coring in such manner that limits extent of patching required.
- B. Structural Elements:
1. Do not cut or patch structural elements in manner that would change the element's structural load-carrying capacity as load deflection ratio.
- C. Operating Elements:
1. Do not cut or patch operating elements in manner that would reduce their capacity to perform as intended.
 2. Do not cut or patch operating elements or related components in manner that would increase maintenance requirements or decrease operational life or safety.
- D. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using methods that do not void required or existing warranties.

3.2 INSPECTION

- A. Examine surfaces to be cut or patched, and conditions under which cutting or patching will be performed before starting cutting or patching Work.
- B. Report unsatisfactory or questionable conditions to ENGINEER in writing. Do not proceed with cutting or patching Work until unsatisfactory conditions are corrected.

- C. Non-Destructive Investigation:
 - 1. In advance of cutting or coring through existing slabs or walls, use X-ray or other non-destructive methods accepted by ENGINEER to determine location of reinforcing steel, electrical conduits, and other items embedded in slabs or walls.
 - 2. Submit to ENGINEER written report of findings of evaluation.
 - 3. Perform X-ray investigation and submit results to ENGINEER sufficiently in advance of cutting Work to allow time to identify and implement alternatives, if changes to the Work are necessary because of conduit or other features in floor or wall.

3.3 PREPARATION

- A. Provide temporary support required to maintain structural integrity of facilities, to protect adjacent work from damage during cutting, and to support the element(s) to be cut.
- B. Protection of Existing Construction during Cutting and Patching:
 - 1. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project and facility that will be exposed during cutting and patching operations.
 - 2. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
 - 3. Do not cut existing pipe, conduit, ductwork, or other utilities serving facilities scheduled to be removed or relocated until provisions have been made to bypass them.

3.4 CORING

- A. Use core-drilling to make penetrations through concrete and masonry walls, slabs, or arches, unless otherwise accepted by ENGINEER in writing.
- B. Coring:
 - 1. Perform coring with non-impact rotary tool using diamond core-drills. Size holes for pipe, conduit, sleeves, equipment or mechanical seals, as required, to be installed through the penetration.
 - 2. Do not core-drill through electrical conduit or other utilities embedded in walls or slabs without approval of ENGINEER. To extent possible, avoid cutting reinforcing steel in slabs and walls.
- C. Protection:
 - 1. Protect existing equipment, utilities, and adjacent areas from water and other damage caused by or resulting from core-drilling operations.
 - 2. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with protective coating material

indicated in Paragraph 2.1.B of this Section. Apply protective coating in accordance with manufacturer's instructions.

D. Cleaning:

1. After core-drilling, vacuum or otherwise remove slurry and tailings from the work area.

3.5 CUTTING

A. Cutting – General:

1. Cut existing construction using methods least-likely to damage elements retained and adjoining construction and that provide proper surfaces to receive subsequent installation or repair.
2. In general, use hand tools or small power tools suitable for sawing or grinding. When possible, avoid using hammering and avoid chopping.
3. Cut holes and slots as small as possible, neatly to the size required, and with minimum disturbance of adjacent surfaces.
4. Prior to starting cutting, provide adequate bracing of area to be cut.
5. To avoid marring existing finished surfaces, cut or drill from exposed or finished side into concealed side.
6. Provide equipment of adequate size to remove the cut panel or "coupon".
7. Provide temporary covering over cut openings where not in use.

B. Cutting – Concrete and Masonry:

1. Cut through concrete and masonry using concrete wall saw with diamond saw blades.
2. On both of the element being cut, provide for control of slurry generated during sawing.
3. After cutting concrete and before installing subsequent construction on or through the opening, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Section. Apply protective coating in accordance with manufacturer's instructions.

3.6 PATCHING

A. Patching – General:

1. Patch construction by filling, repairing, refinishing, closing-up, and similar operations following performance of other Work.
2. Patch with durable seams that are as inconspicuous as possible. Provide materials and comply with installation requirements indicated in the Contract Documents.
3. Patch to provide airtight and watertight connections to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
4. Where feasible, test patched areas to demonstrate integrity of installation.

B. Restoration:

1. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in manner that eliminates evidence of patching and refinishing.
2. For continuous surfaces, refinish to nearest intersection.
3. For an assembly, refinish the entire unit that was patched.
4. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 CLEANING

- A. Cleaning and Restoration:
1. Clean areas and spaces where cutting, coring, or patching were performed.
 2. Clean piping, conduit, and similar constructions before applying paint or other finishing materials.
 3. Restore damaged coverings of pipe and other utilities to original condition.

++ END OF SECTION ++

SECTION 01 74 05

CLEANING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes requirements for keeping the Site free of accumulations of waste materials during construction (“progress cleaning”) and cleaning for Substantial Completion and prior to final inspection (collectively, “closeout cleaning”).
2. CONTRACTOR shall perform cleaning during the Project, including progress cleaning, upon completion of the Work, and as required by the General Conditions, as may be modified by the Supplementary Conditions, and this Section.
3. Maintain in a clean manner the Site, the Work, and areas adjacent to or affected by the Work.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. NFPA 241, Safeguarding Construction, Alteration, and Demolition Operations.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PROGRESS CLEANING

A. General:

1. Clean the Site, work areas, and other areas occupied by CONTRACTOR not less than weekly. Dispose of materials in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and the following:
 - a. Comply with NFPA 241 for removing combustible waste materials and debris.
 - b. Do not hold non-combustible materials at the Site more than three days if the temperature is expected to rise above 80 degrees F. When temperature is less than 80 degrees F, dispose of non-combustible materials within seven days of their generation.

- c. Provide suitable containers for storage of waste materials and debris.
 - d. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.
- B. Site:
 - 1. Keep outdoor, dust-generating areas wetted down or otherwise control dust emissions.
 - 2. Not less than weekly, brush-sweep roadways and paved areas at the Site that are used by construction vehicles or otherwise affected by construction activities.
 - 3. Comply with dust control requirements of Section 01 57 05, Temporary Controls, and Section 01 41 27, Earthmoving Permit and Dust Control.
- C. Work Areas:
 - 1. Clean areas where the Work is in progress to maintain the extent of cleanliness necessary for proper execution of the Work.
 - 2. Remove liquid spills promptly. Immediately report spills to OWNER, ENGINEER, and authorities having jurisdiction, in accordance with the Contract Documents and Laws and Regulations.
 - 3. Where dust would impair proper execution of the Work, broom-clean or vacuum entire work area, as appropriate.
 - 4. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- D. Installed Work:
 - 1. Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of material or equipment installed, using only cleaning agents and methods specifically recommended by material or equipment manufacturer. If manufacturer does not recommend specific cleaning agents or methods, use cleaning agents and methods that are not hazardous to health and property and that will not damage exposed surfaces.
- E. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until Substantial Completion.
- F. Cutting and Patching:
 - 1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, trailings and cuttings, and similar materials.
 - 2. Thoroughly clean piping, conduits, and similar features before applying patching material, paint, or other finishing materials. Restore damaged coverings on piping, ducting, and similar items to its pre-construction condition.

- G. Cleaning of Hydraulic Structures: Clean hydraulic structures that will contain fluid, such as tanks and channels, in accordance with this Section and Section 01 45 53, Cleaning, Testing, and Disinfecting Hydraulic Structures.
- H. Waste Disposal:
 - 1. Properly dispose of waste materials, surplus materials, debris, and rubbish off the Site.
 - 2. Do not burn or bury rubbish and waste materials at the Site.
 - 3. Do not discharge volatile or hazardous substances, such as mineral spirits, oil, or paint thinner, into storm sewers or sanitary sewers.
 - 4. Do not discharge wastes into surface waters or drainage routes.
 - 5. CONTRACTOR is solely responsible for complying with Laws and Regulations regarding storing, transporting, and disposing of waste generated by CONTRACTOR's operations or brought to the Site by CONTRACTOR.
- I. During handling and installation of materials and equipment, clean and protect construction in progress and adjoining materials and equipment already in place. Apply protective covering where required for protection from damage or deterioration, until Substantial Completion.
- J. Clean completed construction as frequently as necessary throughout the construction period.

3.2 CLOSEOUT CLEANING

- A. Complete the following prior to requesting inspection for Substantial Completion:
 - 1. Clean and remove from the Site rubbish, waste material, debris, and other foreign substances.
 - 2. Sweep paved areas broom-clean. Remove petrochemical spills, stains, and other foreign deposits.
 - 3. Hose-clean sidewalks and loading areas.
 - 4. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - 5. Leave surface waterways, drainage routes, storm sewers, and gutters open and clean.
 - 6. Repair pavement, roads, sod, and other areas affected by construction operations and restore to specified condition; if condition is not specified, restore to pre-construction condition.
 - 7. Clean exposed exterior and interior hard-surfaced finishes to dirt-free condition, free of spatter, grease, stains, fingerprints, films, and similar foreign substances.
 - 8. Clean, wax, and polish wood, vinyl, and painted floors.
 - 9. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, and similar spaces.
 - 10. In unoccupied spaces, sweep concrete floors broom-clean.

11. Clean transparent materials, including mirrors and glazing in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
 12. Remove non-permanent tags and labels.
 13. Surface Finishes:
 - a. Touch-up and otherwise repair and restore chipped, scratched, dented or otherwise marred surfaces to specified finish and match adjacent surfaces.
 - b. Do not paint over "UL" or similar labels, including mechanical and electrical nameplates.
 14. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint, and mortar droppings, and other foreign substances.
 15. Clean plumbing fixtures to sanitary condition, free of stains, including stains resulting from water exposure.
 16. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 17. Clean lighting fixtures, lamps, globes, and reflectors to function with full efficiency. Replace temporary lamps provided in permanent fixtures. Replace existing lighting fixture components that are burned out or noticeably dimmed from use during construction. Replace defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 18. Leave the Site clean, and in neat, orderly condition, satisfactory to OWNER and ENGINEER.
- B. Complete the following prior to requesting final inspection:
1. Following completion of the Work on the "punch list" of Work uncompleted at Substantial Completion, clean in accordance with Paragraph 3.2.A of this Section.

+ + END OF SECTION + +

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall comply with the requirements and procedures for construction waste management and disposal, including:
 - a. Minimizing construction waste and debris and reusing, salvaging, and recycling to specified extent.
2. Extent of required construction waste management and disposal includes:
 - a. Construction waste management disposal within the Project limits, as shown or indicated.

B. Coordination:

1. Coordinate salvaging, recycling, and disposing of waste as specified under this and other Sections.

C. Related Sections:

1. Section 01 31 13, Project Coordination

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from the Site and properly dispose of waste in facility such as permitted landfill or incinerator or other method acceptable to authorities having jurisdiction.
1. Except as otherwise specified, remove from the Site all waste and debris from the Work as it accumulates. Upon completion of the Work, remove materials, equipment, waste, and debris and leave the Site clean, neat, and orderly. Comply with the Contract Documents regarding cleaning and removal of trash, debris, and waste.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Disposal: Transport waste materials to proper location at site other than OWNER's property for disposal in accordance with Laws and Regulations.

++ END OF SECTION ++

SECTION 01 75 11

CHECKOUT AND STARTUP PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall initially start up and place equipment installed under the Contract into successful operation, in accordance with the equipment manufacturer's written instructions and as instructed by Supplier at the Site.
2. Provide all material, labor, tools, and equipment required to complete equipment checkout and start-up except as may be specifically noted otherwise.
3. Provide lubricants and other required operating fluids in sufficient quantity for equipment testing, start-up and initial operation until the CONTRACTOR has achieved Substantial Completion for the Project and the OWNER is able to begin full time continuous operation of the Project, unless otherwise shown or noted. OWNER will supply treatment chemicals for start-up.
4. Provide electricity, fuel, water, filters, and other expendables required for startup of equipment, unless otherwise specified. OWNER will pay for electricity.
5. General Activities Include:
 - a. Cleaning, as required under other provisions of the Contract Documents.
 - b. Removing temporary protective coatings.
 - c. Flushing and replacing lubricants, where required by manufacturer.
 - d. Lubrication.
 - e. Checking shaft and coupling alignments and resetting where required.
 - f. Checking and setting motor, pump, and other equipment rotation, safety interlocks, and belt tensions.
 - g. Checking and correcting (if necessary) leveling plates, grout, bearing plates, anchorage devices, fasteners, and alignment of piping, conduits, and ducts that may place stress on the connected equipment.

h. All adjustments required.

B. Coordination:

1. Coordinate checkout and start-up with other contractors, as necessary.
2. Do not start up system or subsystem for continuous operation until all components of that system or subsystem, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
3. OWNER will provide sufficient personnel to assist CONTRACTOR in starting up equipment, but responsibility for proper operation is CONTRACTOR's.
4. Supplier shall be present during checkout, start-up, and when equipment is initially started up and placed into operation, unless otherwise acceptable to ENGINEER.
5. Start-up of heating and air conditioning equipment and systems is dependent upon the time of year. Return to the Site at beginning of next heating or air conditioning season (as applicable) to recheck and start the appropriate systems.
6. Do not start up system, unit process, or equipment without submitting acceptable preliminary operations and maintenance manuals by CONTRACTOR, in accordance with Section 01 78 23, Operations and Maintenance Data.

C. OWNER's Assumption of Responsibility for Equipment and Systems:

1. OWNER will assume responsibility for the equipment upon Substantial Completion.
2. Prior to turning over to OWNER responsibility for operating and maintaining system or equipment:
 - a. Provide training of operations and maintenance personnel in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
 - b. Complete system field quality control testing in accordance with the Contract Documents.
 - c. Submit acceptable final operations and maintenance manuals in accordance with Section 01 78 23, Operations and Maintenance Data.
 - d. Obtain from ENGINEER final certificate of Substantial Completion for either entire Work or the portion being turned over to OWNER.

1.2 SUBMITTALS

- A. Closeout Submittals: Submit the following:
 - 1. Certifications:
 - a. Supplier's certification of installation in accordance with Paragraph 3.1.B of this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SERVICES OF SUPPLIER

- A. When specified, furnish services of competent, qualified representatives of material and equipment manufacturers as specified, including supervising installation, adjusting, checkout, start-up, and testing of materials and equipment.
- B. Certification:
 - 1. When services by Supplier are required at the Site, within 14 days after first test operation of equipment, submit to ENGINEER a letter from Supplier, on Supplier's letterhead, stating that materials and equipment are installed in accordance with Supplier's requirements and installation instructions, and in accordance with the Contract Documents.
 - 2. In lieu of Supplier letter, submit completed form attached to this Section.
 - 3. Include in the final operations and maintenance manual for the associated equipment a copy of the letter or completed form, as applicable.

3.2 MINIMUM START-UP REQUIREMENTS

- A. Bearings and Shafting:
 - 1. Inspect for cleanliness, and clean and remove foreign matter.
 - 2. Verify alignment.
 - 3. Replace defective bearings and those that operate in a rough or noisy manner.
 - 4. Grease as necessary, in accordance with manufacturer's recommendations.
- B. Drives:
 - 1. Adjust tension in V-belt drives and adjust vari-pitch sheaves and drives for proper equipment speed.
 - 2. Adjust drives for alignment of sheaves and V-belts.
 - 3. Clean and remove foreign matter before starting operation.

C. Motors:

1. Check each motor for comparison to amperage nameplate value.
2. Correct conditions that produce excessive current flow and conditions that exist due to equipment malfunction.

D. Pumps:

1. Check glands and seals for cleanliness and adjustment before running pump.
2. Inspect shaft sleeves for scoring.
3. Inspect mechanical faces, chambers, and seal rings, and replace if defective.
4. Verify that piping system is free of dirt and scale before circulating liquid through pump.

E. Valves:

1. Inspect manual and automatic control valves, and clean bonnets and stems.
2. Tighten packing glands to ensure no leakage, but allow valve stems to operate without galling.
3. Replace packing in valves to retain maximum adjustment after system is determined to be complete.
4. Replace packing on valves that continue to leak.
5. Remove and repair bonnets that leak.
6. After cleaning, coat packing gland threads and valve stems with surface preparation of "Molycote" or "Fel-Pro".

F. Verify that control valve seats are free of foreign matter and are properly positioned for intended service.

G. Pipe Joints and Other Connections:

1. Tighten flanges and other pipe joints after system has been placed in operation.
2. Replace gaskets that show signs of leakage after tightening.
3. Inspect all joints for leakage.
4. Promptly remake each joint that appears to be faulty; do not wait for rust or other corrosion to form.
5. Clean threads on both parts, and apply compound and remake joints.

H. After system has been placed in operation, clean strainers, drives, pockets, orifices, valve seats, and headers in fluid system to ensure freedom from foreign matter.

- I. Open steam traps and air vents, where used, and remove operating elements. Clean thoroughly, replace internal parts, and place back into operation.
- J. Remove rust, scale, and foreign matter from equipment and renew defaced surfaces.
- K. Set and calibrate draft gauges of air filters and other equipment.
- L. Inspect fan wheels for clearance and balance. Provide factory-authorized personnel for adjustment when needed.
- M. Check each electrical control circuit to verify that operation complies with the Contract Documents.
- N. Inspect each pressure gauge, thermometer, and other instruments for calibration. Replace items that are defaced, broken, or that read incorrectly.
- O. Repair damaged insulation.
- P. Excess Gasses and Fluids:
 - 1. Vent gasses trapped in systems.
 - 2. Verify that liquids are drained from all parts of gas or air systems.

3.3 ATTACHMENTS

- A. The attachment listed below, following the “End of Section” designation, is a part of this Specification Section.
 - 1. Supplier’s Installation Certification Form (one page).

+ + END OF SECTION + +

SUPPLIER'S INSTALLATION CERTIFICATION

Contract No. and Name: _____

Equipment Specification Section: _____

Equipment Name: _____

Contractor: _____

Manufacturer of Equipment: _____

The undersigned Supplier of the equipment described above hereby certifies that Supplier has checked the equipment installation and that the equipment, as specified in the Contract Documents, has been provided in accordance with the manufacturer's recommendations and the Contract Documents, and that the trial operation of the equipment has been satisfactory.

Comments: _____

Date

Supplier Name (print)

Signature of Supplier

Date

Contractor Name (print)

Signature of Contractor

SECTION 01 77 19
CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.1 GENERAL

- A. Scope:
 - 1. Section Includes.
 - a. Substantial Completion.
 - b. Final inspection.
 - c. Request for final payment.

1.2 SUBSTANTIAL COMPLETION

- A. Procedures for requesting and documenting Substantial Completion are in the General Conditions, as may be modified by the Supplementary Conditions.

1.3 FINAL INSPECTION

- A. Procedures for requesting and documenting the final inspection are in the General Conditions, as may be modified by the Supplementary Conditions.

1.4 REQUEST FOR FINAL PAYMENT

- A. Procedure:
 - 1. Submit request for final payment in accordance with the Agreement General Conditions, as may be modified by the Supplementary Conditions.
- B. Request for final payment shall include:
 - 1. Documents required for progress payments.
 - 2. Documents required in the General Conditions, as may be modified by the Supplementary Conditions.
 - 3. Releases or Waivers of Lien Rights:
 - a. When submitting releases or waivers of Lien rights, provide release or waiver by CONTRACTOR and each Subcontractor and Supplier that provided CONTRACTOR with labor, material, or equipment totaling \$1,000 or more.
 - b. Provide list of Subcontractors and Suppliers for which release or waiver of Lien is required.

- c. Each release or waiver of Lien shall be signed by an authorized representative of the entity submitting release or waiver to CONTRACTOR, and shall include Subcontractor's or Supplier's corporate seal, when applicable.
 - d. Release or waiver of Lien may be conditional upon receipt of final payment.
4. Refer to the General Conditions and Supplementary Conditions regarding final payment documentation requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 78 23

OPERATIONS AND MAINTENANCE DATA

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Submit operation and maintenance data, in accordance with this Section and in accordance with requirements elsewhere in the Contract Documents, as instructional and reference manuals by operations and maintenance personnel at the Site.
2. Required operation and maintenance data are listed in the Contract Documents. If not otherwise listed, at minimum, submit operation and maintenance data for:
 - a. All equipment and systems.
 - b. Valves, gates, actuators, and related accessories.
 - c. Instrumentation and control devices.
 - d. Electrical gear.
3. For each operation and maintenance manual, submit the following:
 - a. Preliminary Submittal: Printed and bound copy of and electronic copies of entire operation and maintenance manual, except for test data and service reports by Supplier.
 - b. Final Submittal: Printed and bound copy and electronic copies of complete operations and maintenance manual, including test data and service reports by Supplier, with electronic copies.

1.2 SUBMITTALS

A. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data
 - a. Submit the operations and maintenance data as required by the Contract Documents.

B. Quantity Required and Timing of Submittals:

1. Preliminary Submittal:
 - a. Electronic Copies: one copy provided to the ENGINEER, and Owner, exclusive of copies required by CONTRACTOR.

- b. Submit to ENGINEER by the earlier of: ninety days following approval of Shop Drawings and product data submittals, or thirty days prior to starting training of operations and maintenance personnel, or thirty days prior to field quality control testing at the Site.
- 2. Final Submittal: Provide final submittal prior to Substantial Completion, unless submittal is specified as required prior to an interim Milestone.
 - a. Printed Copies: one copy to be provided to OWNER.
 - b. Electronic Copies: one copy to be provided to the OWNER.

1.3 FORMAT OF PRINTED COPIES

A. Binding and Cover:

- 1. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy as required. Binders shall be minimum one-inch wide and maximum of three-inch wide. Binders for each copy of each volume shall be identical.
- 2. Binders shall be locking three-ring/"D"-ring type, or three-post type. Three-ring binders shall be riveted to back cover and include plastic sheet lifter (page guard) at front of each volume.
- 3. Do not overfill binders.
- 4. Covers shall be oil-, moisture-, and wear-resistant, including identifying information on cover and spine of each volume.
- 5. Provide the following information on cover of each volume:
 - a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - b. Name or type of material or equipment covered in the manual.
 - c. Volume number, if more than one volume is required, listed as "Volume ___ of ___", with appropriate volume-designating numbers filled in.
 - d. Name of Project and, if applicable, Contract name and number.
 - e. Name of building or structure, as applicable.
- 6. Provide the following information on spine of each volume:
 - a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".

- b. Name or type of material or equipment covered in the manual.
 - c. Volume number, if more than one volume is required, listed as “Volume ___ of ___”, with appropriate volume-designating numbers filled in.
 - d. Project name and building or structure name.
- B. Pages:
 - 1. Print pages in manual on 30-pound (minimum) paper, 8.5 inches by 11 inches in size.
 - 2. Reinforce binding holes in each individual sheet with plastic, cloth, or metal. When published, separately-bound booklets or pamphlets are part of the manual, reinforcing of pages within booklet or pamphlet is not required.
 - 3. Provide each page with binding margin at least one inch wide. Punch each page with holes suitable for the associated binding.
- C. Drawings:
 - 1. Bind into the manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing specified for pages.
 - 2. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Include no more than three drawing sheets per pocket.
- D. Copy Quality and Document Clarity:
 - 1. Contents shall be original-quality copies. Documents in the manual shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color. Manuals that contain copies that are unclear, not completely legible, off-center, skewed, or where text or drawings are cut by binding holes, are unacceptable. Pages that contain approval or date stamps, comments, or other markings that cover text or drawing are unacceptable. Faxed copies are unacceptable.
 - 2. Clearly mark in ink to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished or cross out inapplicable content. Using highlighters to so indicate options furnished is unacceptable.
- E. Organization:

1. Coordinate with ENGINEER and OWNER to develop comprehensive, practical, and consistent indexing system for operations and maintenance data. ENGINEER will review indexing system before operations and maintenance data is submitted.
2. Table of Contents:
 - a. Provide table of contents in each volume of each operations and maintenance manual.
 - b. In table of contents and at least once in each chapter or section, identify materials and equipment by their functional names. Thereafter, abbreviations and acronyms may be used if their meaning is clearly indicated in a table bound at or near beginning of each volume. Using material or equipment model or catalog designations for identification is unacceptable.
3. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

1.4 FORMAT OF ELECTRONIC COPIES

A. Electronic Copies of Operation and Maintenance Manuals:

1. Each electronic copy shall include all information included in the corresponding printed copy. Cover page shall include the following:
 - a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - b. Name or type of material or equipment covered in the manual.
 - c. Project name and building or structure name.
2. Include drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size.
3. Clearly mark to indicate all components of materials and equipment on catalog pages for ease of identification. In standard documents, indicate options furnished or cross out inapplicable content.
4. Coordinate with ENGINEER and OWNER to develop comprehensive practical, and consistent indexing system for operations and maintenance data. ENGINEER will review indexing system before operations and maintenance data is submitted.
5. Table of Contents:

- a. Provide table of contents in each operations and maintenance manual.
 - b. In table of contents and at least once in each chapter or section, identify materials and equipment by their functional names. Thereafter, abbreviations and acronyms may be used if their meaning is clearly indicated in a table included at or near beginning of each manual. Using material or equipment model or catalog designations for identification is unacceptable.
6. Submit each electronic copy on a separate compact disc (CD), unless another electronic data transfer method or format is acceptable to ENGINEER.
7. File Format:
 - a. Files shall be in “portable document format” (PDF). Files shall be electronically searchable; the use of scanned pages is to be minimized and is subject to ENGINEER approval.
 - b. Submit separate file for each separate document in the printed copy.
 - c. Within each file, provide bookmarks for the following:
 - 1) Each chapter and subsection listed in the corresponding printed copy document’s table of contents.
 - 2) Each figure.
 - 3) Each table.
 - 4) Each appendix.

B. Copies of Programming and Configuration Files:

1. Provide on CD copy of all software programming, such as programmable logic controller programs, prepared specifically for the Project. Third-party, licensed, commercially available software is excluded from requirements of this Article; submit copies of commercially-available, licensed, third-party software, where required, in accordance with the Contract Documents.
2. Submit on CD copies of system configuration prepared specifically for the Project, such as plant monitoring system and SCADA display configurations.
3. Submit programming and configuration files together with electronic copies of operation and maintenance data.

1.5 CONTENT

A. General:

1. Prepare each operations and maintenance manual specifically for the Project.
Include in each manual all pertinent instructions, as-built drawings as applicable, bills of materials, technical bulletins, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.
2. Completeness and Accuracy:
 - a. Operation and maintenance manuals that include language stating or implying that the manual's content may be insufficient or stating that the manual's content is not guaranteed to be complete and accurate are unacceptable.
 - b. Operations and maintenance manuals shall be complete and accurate.
 - c. Operation and maintenance manuals shall indicate the specific alternatives and features furnished, and the specific operation and maintenance provisions for the material or equipment furnished.
3. Submit complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.

B. Submit written explanations of all safety considerations relating to operation and maintenance procedures.

C. Submit complete, detailed, written preventive maintenance instructions including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:

1. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning. Include pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns.

2. Recommended schedule for each preventive maintenance task.
 3. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
 4. Table of alternative lubricants.
 5. Troubleshooting instructions.
 6. List of required maintenance tools and equipment.
- D. Submit complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:
1. Manufacturer's name, address, telephone number, fax number, and Internet website address.
 2. Manufacturer's local service representative's or local parts supplier's name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.
 3. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.
 4. For each part or piece include the following information:
 - a. Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
 - b. Part name or description.
 - c. Manufacturer's part number.
 - d. Quantity of each part used in each assembly.
 - e. Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.
- E. Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number) that will expedite the ordering process.
- F. Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.

- G. Submit manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. Avoid submitting catalog excerpts unless they are the only document available showing identification or description of particular component of the equipment. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.
- H. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.
- I. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.
- J. Programmable Logic Controllers: If programmable logic controllers are furnished under the Contract:
 - 1. Submit complete logic listings in ladder logic format.
 - 2. Format Requirements:
 - a. For ladder diagram logic, include complete cross-referencing of all logic elements. Annotate all elements with clearly understandable tags or descriptive labels.
 - 3. Submit complete programmable logic controller listing of all input/output address assignments, tag assignments, and pre-set constant values, with functional point descriptions.
 - 4. Submit complete manufacturer's programming manuals.
- K. Submit copy of warranty bond and service contract as applicable.
- L. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 78 36

WARRANTIES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This section describes general requirements for warranties required in the various Specifications.
2. Provisions on the Contract's correction period, CONTRACTOR'S general warranty and guarantee, and CONTRACTOR's warranty of title are in the General Conditions, as may be modified by the Supplementary Conditions.
3. This section includes general requirements for:
 - a. Suppliers' standard warranties.
 - b. Suppliers' special warranties.
 - c. Implied warranties.
 - d. Commencement and duration of warranties.

1.2 SUBMITTALS

A. General:

1. For each item of equipment furnished under the Contract, submit Supplier's standard warranty, regardless of whether such warranty or submittal thereof is required by the associated Specifications for that item. Submit such warranties for materials where such submittal is required in the Specifications for the material.
2. For each item of material or equipment where Supplier's special (or extended) warranty is required by the Contract Documents, submit appropriate special warranty that complies with the Contract Documents.
3. Supplier's warranties shall be specifically endorsed solely to OWNER by the entity issuing such warranty.
4. Submit Suppliers' standard warranties and special warranties as submittals in accordance with Schedule of Submittals accepted by ENGINEER.

1.3 SUPPLIERS' WARRANTIES FOR MATERIALS AND EQUIPMENT

A. Warranty Types:

1. Required by the General Conditions:
 - a. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, CONTRACTOR's general warranty and guarantee and requirements for the Contract's correction period.
 - b. Disclaimers and limitations in specific materials and equipment warranties do not limit CONTRACTOR's general warranty and guarantee, nor does such affect or limit CONTRACTOR's performance obligations under the correction period.
 2. Material or equipment manufacturer's standard warranty is pre-printed, written warranty published by item's manufacturer and specifically endorsed by manufacturer to OWNER.
 3. Special warranty is written warranty that either extends the duration of material or equipment manufacturer's standard warranty or provides other, increased rights to OWNER. Where the Contract Documents indicate specific requirements for warranties that differ from the manufacturer's standard warranty for that item, special warranty is implied.
- B. Requirements for Special Warranties:
1. Submit written special warranty document that contains appropriate provisions and identification, ready for execution by material or equipment manufacturer and OWNER. Submit draft warranty with submittals required prior to fabrication and shipment of the item from the Supplier's facility.
 2. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed by product manufacturer and other entities as appropriate.
 3. Specified Form: When specified forms for special warranties are included in the Contract Documents, prepare written document, properly executed by item manufacturer and OWNER, using the required form.
 4. Refer to the Specifications for content and requirements for submitting special warranties.

1.4 IMPLIED WARRANTIES

- A. Warranty of Title and Intellectual Property Rights:
1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.

2. Provisions on intellectual property rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.
- B. Warranty of Merchantability:
 1. Notwithstanding any other provision of the Contract to the contrary, implied warranties of merchantability required by Laws and Regulations apply to the materials and equipment incorporated into the Work.
- C. Warranty of Fitness-for-Purpose:
 1. When Supplier is aware of, or has reason to be aware of, specified materials or features of the Work that are contrary to the intended use, purpose, service, application, or environment in which the material or equipment item will be used, submit request for interpretation in accordance with Section 01 26 00, Contract Modification Procedures. Where appropriate, such request for interpretation shall indicate the apparent discrepancy and propose appropriate, alternative materials or equipment.

1.5 COMMENCEMENT AND DURATION OF WARRANTIES

- A. Commencement of Warranties:
 1. Contract correction period and CONTRACTOR's general warranty commence as indicated in the General Conditions, as may be modified by the Supplementary Conditions.
 2. Suppliers' general warranties and special warranties commence running on the date that the associated item is certified by ENGINEER as substantially complete. In no event shall special warranties commence running prior to ENGINEER's review and acceptance of special warranty submittal for the item.
 3. Implied warranties commence in accordance with Laws and Regulations.
- B. Duration of Warranties:
 1. Duration of correction period is in accordance with the General Conditions, as may be modified by the Supplementary Conditions.
 2. Duration of CONTRACTOR's general warranty and guarantee is in accordance with Laws and Regulations.
 3. Duration of Suppliers' general warranties is in accordance with the applicable general warranty document accepted by ENGINEER.
 4. Duration of required Suppliers' special warranties shall be in accordance with the requirements of the Contract Documents for the subject item.

5. Duration of implied warranties shall be in accordance with Laws and Regulations.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall maintain and submit to ENGINEER with record documents in accordance with the Specifications, General Conditions, and Supplementary Conditions.
- B. Maintenance of Record Documents:
 - 1. Maintain in CONTRACTOR's field office, in clean, dry, legible condition, complete sets of the following record documents: Drawings, Specifications, and Addenda; Shop Drawings, Samples, and other CONTRACTOR submittals, including records of test results, approved or accepted as applicable, by ENGINEER; Change Orders, Work Change Directives, Field Orders, photographic documentation, survey data, and all other documents pertinent to the Work.
 - 2. Provide files and racks for proper storage and easy access to record documents. File record documents in accordance with the edition of the Construction Specification Institute's "Master Format" used for organizing the Project Manual, unless otherwise accepted by ENGINEER.
 - 3. Make record documents available for inspection upon request of ENGINEER or OWNER.
 - 4. Do not use record documents for purpose other than serving as Project record. Do not remove record documents from CONTRACTOR's field office without ENGINEER's approval.
- C. Submittal of Record Documents:
 - 1. Submit to ENGINEER the following record documents:
 - a. Drawings.
 - b. Project Manual including Specifications and Addenda (bound).
 - 2. Prior to readiness for final payment, submit to ENGINEER one copy of final record documents. Submit complete record documents; do not make partial submittals.
 - 3. Submit record documents with transmittal letter on CONTRACTOR letterhead complying with letter of transmittal requirements in Section 01 33 00, Submittal Procedures.

4. Record documents submittal shall include notarized certification, with original signature of official authorized to execute legal agreements on behalf of CONTRACTOR, reading as follows:

“[Insert Contractor’s corporate name] has maintained and submitted record documentation in accordance with the General Conditions and Supplementary Conditions, Section 01 78 39, Project Record Documents, and other elements of Contract Documents, for the Trilith Elevated Water Storage Tank project . We certify that each record document submitted is complete, accurate, and legible relative to the Work performed under our Contract, and that the record documents comply with the requirements of the Contract Documents.

[Provide signature, print name, print signing party’s corporate title, and date]”

1.2 RECORDING CHANGES

A. General:

1. At the start of the Project, label each record document to be submitted as, “PROJECT RECORD” using legible, printed letters. Letters on record copy of the Drawings shall be two inches high.
2. Keep record documents current. Make entries on record documents within two working days of receipt of information required to record the change.
3. Do not permanently conceal the Work until required information has been recorded.
4. Accuracy of record documents shall be such that future searches for items shown on the record documents may rely reasonably on information obtained from ENGINEER-accepted record documents.
5. Marking of Entries:
 - a. Use erasable, colored pencils (not ink or indelible pencil) for marking changes, revisions, additions, and deletions to record documents.
 - b. Clearly describe the change by graphic line and make notations as required. Use straight-edge to mark straight lines. Writing shall be legible and sufficiently dark to allow scanning of record documents into legible electronic files.
 - c. Date all entries on record documents.

- d. Call attention to changes by drawing a “cloud” around the change(s) indicated.
- e. Mark initial revisions in red. In the event of overlapping changes, use different colors for subsequent changes.

B. Drawings:

- 1. Record changes on copy of the Drawings. Submittal of CONTRACTOR-originated or -produced drawings as a substitute for recording changes on the Drawings is unacceptable.
- 2. Record changes on plans, sections, schematics, and details as required for clarity, making reference dimensions and elevations (to Project datum) for complete record documentation.
- 3. Record actual construction including:
 - a. Depths of various elements of foundation relative to Project datum.
 - b. Horizontal and vertical location of Underground Facilities referenced to permanent surface improvements. For each Underground Facility, including pipe fittings, provide dimensions to at least two permanent, visible surface improvements.
 - c. Location of exposed utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
 - d. Changes in structural and architectural elements of the Work, including changes in reinforcing.
 - e. Field changes of dimensions, arrangements, and details.
 - f. Changes made in accordance with Change Orders, Work Change Directives, and Field Orders.
 - g. Changes in details on the Drawings. Submit additional details prepared by CONTRACTOR when required to document changes.
- 4. Recording Changes for Schematic Layouts:
 - a. In some cases on the Drawings, arrangements of conduits, circuits, piping, ducts, and similar items are shown schematically and are not intended to portray physical layout. For such cases, the final physical arrangement shall be determined by CONTRACTOR subject to acceptance by ENGINEER.
 - b. Record on record documents all revisions to schematics on Drawings, including: piping schematics, ducting schematics, process and instrumentation diagrams, control

and circuitry diagrams, electrical one-line diagrams, motor control center layouts, and other schematics when included in the Contract. Record actual locations of equipment, lighting fixtures, in-place grounding system, and other pertinent data.

- c. When dimensioned plans and dimensioned sections on the Drawings show the Work schematically, indicate on the record documents, by dimensions accurate to within one inch in the field, centerline location of items of Work such as conduit, piping, ducts, and similar items
 - 1) Clearly identify the Work item by accurate notations such as “cast iron drain”, “rigid electrical conduit”, “copper waterline”, and similar descriptions.
 - 2) Show by symbol or note the vertical location of Work item; for example, “embedded in slab”, “under slab”, “in ceiling plenum”, “exposed”, and similar designations. For piping not embedded, also provide elevation dimension relative to Project datum.
 - 3) Descriptions shall be sufficiently detailed to be related to Specifications.
- d. ENGINEER may furnish written waiver of requirements relative to schematic layouts shown on plans and sections when, in ENGINEER’s judgment, dimensioned layouts of Work shown schematically will serve no useful purpose. Do not rely on waiver(s) being issued.

5. Supplemental Drawings:

- a. In some cases, drawings produced during construction by ENGINEER or CONTRACTOR supplement the Drawings and shall be included with record documents submitted by CONTRACTOR. Supplemental record drawings shall include drawings provided with Change Orders, Work Change Directives, and Field Orders and that cannot be incorporated into the Drawings due to space limitations.
- b. Supplemental drawings provided with record drawings shall be integrated with the Drawings and include necessary cross-references between drawings. Supplemental record drawings shall be on sheets the same size as the Drawings.

- c. When supplemental drawings developed by CONTRACTOR using computer-aided drafting/design (CADD) software are to be included in record drawings, submit electronic files for such drawings in AutoCAD 2018 format as part of record drawing submittal. Submit electronic files on compact disc labeled, "Supplemental Record Drawings", together with CONTRACTOR name, Project name, and Contract name and number.

C. Specifications and Addenda:

- 1. Mark each Section to record:
 - a. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually provided.
 - b. Changes made by Addendum, Change Orders, Work Change Directives, and Field Orders.

1.3 ELECTRONIC FILES FURNISHED BY ENGINEER

- A. CADD files will be furnished by ENGINEER upon the following conditions:
 - 1. CONTRACTOR shall submit to ENGINEER a letter on CONTRACTOR letterhead requesting CADD files and providing specific definition(s) or description(s) of how files will be used, and specific description of benefits to OWNER (including credit proposal, if applicable) if the request is granted.
 - 2. CONTRACTOR shall execute ENGINEER's standard agreement for release of electronic files and shall abide by all provisions of the agreement for release of electronic files.
 - 3. Layering system incorporated in CADD files shall be maintained as transmitted by ENGINEER. CADD files transmitted by ENGINEER containing cross-referenced files shall not be bound by CONTRACTOR. Drawing cross-references and paths shall be maintained. If CONTRACTOR alters layers or cross-reference files, CONTRACTOR shall restore all layers and cross-references prior to submitting record documents to ENGINEER.
 - 4. CONTRACTOR shall submit record drawings to ENGINEER in same CADD format that files were furnished to CONTRACTOR.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 78 43

SPARE PARTS AND EXTRA MATERIALS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes administrative and procedural requirements for furnishing spare parts, extra materials, maintenance supplies, and special tools required for maintenance (collectively, “spare parts and extra materials”) required by the Contract Documents.
2. CONTRACTOR shall furnish spare parts, extra materials, and associated information, for materials and equipment furnished in accordance with the Contract Documents. Furnish such items in accordance with the requirements of this Section and the Specifications sections in which such items are indicated.
3. CONTRACTOR shall be fully responsible for loss and damage to spare parts and extra materials until such items are received by OWNER’s facility manager.
4. Promptly replace spare parts and extra materials furnished by OWNER to CONTRACTOR for use in remedying defective Work.

B. List of Spare Parts and Extra Materials:

1. With the Shop Drawings and product data submittals for each Specifications section, submit a complete listing of spare parts and extra materials required for maintenance for two years of operation, together with unit prices in current United States funds, and source(s) of supply for each.
2. Also include listing of spare parts and extra materials, with pricing and sources, in the operations and maintenance data submitted in accordance with Section 01 78 23, Operations and Maintenance Data.

1.2 SUBMITTALS

A. Maintenance Material Submittals: Submit the following:

1. Spare Parts and Extra Materials:
 - a. Furnish to OWNER in accordance with requirements of this Section, and the Specifications section in which the spare parts and extra materials are specified.
2. Transfer Documentation: For each delivery of spare parts and extra materials, submit to ENGINEER the following:
 - a. Submit, on CONTRACTOR’s letterhead, a letter of transmittal for spare parts and extra materials furnished under each Specifications section.

Letter of transmittal shall accompany spare parts and extra materials. Do not furnish letter of transmittal separate from associated spare parts and extra materials.

- b. Furnish three original, identical, signed letters of transmittal for each delivery of spare parts and extra materials furnished under each Specifications section. Upon delivery of specified quantities and types of spare parts and extra materials to OWNER, designated person from OWNER will countersign each original letter of transmittal indicating OWNER's receipt of spare parts and extra materials in the quantity, type, and quality required by the Contract Documents. OWNER will retain one fully-signed original, CONTRACTOR shall submit one fully-signed original to ENGINEER. CONTRACTOR shall retain one fully-signed original for CONTRACTOR's records.
- c. Letter of transmittal shall include the following:
 - 1) Information required for letters of transmittal in Section 01 33 00, Submittal Procedures.
 - 2) Transmittal shall list spare parts and extra materials furnished under each Specifications Section. List each individual part, material, equipment item, tool, and product and the associated quantity furnished.
 - 3) Include space for countersignature by OWNER as follows: space for signature, space for printed name, and date.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Packaging and Labeling of Spare Parts and Extra Materials:
 - 1. Furnish spare parts and extra materials in manufacturer's unopened cartons, boxes, crates, or other original, protective covering suitable for preventing corrosion and deterioration for maximum length of storage normally anticipated by manufacturer.
 - 2. Packaging of spare parts and extra materials shall be clearly marked and identified with name of manufacturer, applicable material or equipment, part number, part description, and part location in the equipment or system.
 - 3. Protect and package spare parts and extra materials for maximum shelf life normally anticipated by manufacturer.
- B. Storage Prior to Delivery to Owner:
 - 1. Prior to furnishing spare parts and extra materials to OWNER, store spare parts and extra materials in accordance with the Contract Documents and manufacturers' recommendations.
- C. Procedure for Delivery to Owner:
 - 1. Deliver spare parts and extra materials to OWNER's permanent storage rooms at the Site or area(s) at the Site designated by OWNER.
 - 2. When spare parts and extra materials are delivered, CONTRACTOR and OWNER will mutually inventory the spare parts and extra materials delivered

to verify compliance with the Contract Documents regarding quantity, part numbers, and quality.

3. Additional procedures for delivering spare parts and extra materials to OWNER, if required, will be developed by ENGINEER and complied with by CONTRACTOR.
4. CONTRACTOR shall reimburse OWNER for all costs and expenses incurred by OWNER, including professional services, for delivery of inadequate, incorrect, or defective spare parts and extra materials. OWNER may withhold such amounts from payments due CONTRACTOR via set-offs in accordance with the Contract Documents.

D. Delivery Time and Eligibility for Payment:

1. Deliver to OWNER spare parts and extra materials prior to date of Substantial Completion for materials and equipment associated therewith.
2. Do not deliver spare parts and extra materials before commencing startup for associated material or equipment.
2. Spare parts and extra materials are not eligible for payment until delivered to OWNER and CONTRACTOR's receipt of OWNER's countersignature on letter of transmittal.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 79 23

INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish services of Supplier's operation and maintenance training specialists to instruct OWNER's and facility manager's personnel in recommended operating and maintenance procedures for materials and equipment furnished, in accordance with the Contract Documents.
2. Supplier shall provide a combination of classroom and field training at the Site, unless otherwise required elsewhere in the Contract Documents.
3. OWNER or facility manager reserves the right to record training sessions on video for OWNER's later use in instructing OWNER's or facility manager's personnel.

B. Scheduling of Training Sessions:

1. General:
 - a. CONTRACTOR shall coordinate training services with start-up and initial operation of materials and equipment on days and times, and in manner, acceptable to OWNER, in accordance with the Contract Documents.
 - b. Training may be required outside of normal business hours to accommodate schedules of operations and maintenance personnel. Furnish training services at the required days and times at no additional cost to OWNER.
2. Prerequisites to Training:
 - a. Training of facility operations and maintenance personnel shall commence after preliminary operation and maintenance data has been submitted and accepted by ENGINEER, and Work required in Section 01 75 11, Checkout and Startup Procedures, is complete.
 - b. At option of OWNER or ENGINEER, training may be allowed to take place before, during, or after equipment startup.
3. Training Schedule Submittal:
 - a. Training Schedule Required: CONTRACTOR shall prepare and submit proposed training schedule for review and acceptance by ENGINEER and OWNER. Proposed training schedule shall show and indicate all training required in the Contract Documents, and shall demonstrate compliance with specified training requirements relative to number of

- hours of training for various elements of the Work, number of training sessions, and scheduling.
- c. Timing of Training Schedule Submittal: Submit initial training schedule not less than 30 days before scheduled start of first training session. Submit final training schedule, incorporating revisions in accordance with ENGINEER's comments, not later than 15 days prior to starting the first training session.
 - d. OWNER reserved the right to modify personnel availability for training in accordance with process or emergency needs at the facility.

1.2 QUALITY ASSURANCE

A. Qualifications:

- 1. Manufacturer's Instructors:
 - a. Shall be factory-trained by manufacturer of material or equipment.
 - b. Manufacturer's instructors shall be proficient and experienced in performing training of the type required.
 - c. Instructors shall be proficient in spoken and written English language.
 - d. Qualifications of instructors are subject to acceptance by ENGINEER. If ENGINEER does not accept qualifications of proposed instructor, furnish services of replacement instructor with acceptable qualifications.
- 2. Attendance is mandatory for the following:
 - a. CONTRACTOR's project manager.
 - b. CONTRACTOR's Site superintendent.
 - c. Project manager of Subcontractors responsible for furnishing materials and equipment for which training of operations and maintenance personnel is required.
 - d. Manufacturers and other Suppliers invited by CONTRACTOR.
 - f. ENGINEER.
 - g. Facility manager's staff responsible for training coordination, and staff responsible for scheduling operations and maintenance personnel.
- 3. If additional information must be developed to adequately cover agenda items, reconvene conference as soon as possible.
- 4. CONTRACTOR shall prepare minutes summarizing the discussions of conference, decisions made, and agreements and disagreements, and submit the minutes to each conference attendee.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

- 1. Training Schedule: Detailed schedule of training sessions, demonstrating compliance with number of training sessions, hours required in the Contract Documents, and complying with the Contract Times. Submit training schedule submittals in accordance with time frames specified in this Section.

- B. Informational Submittals: Submit the following:
1. Lesson Plan: Acceptable lesson plan for training on each material or equipment item, in accordance with Table 01 79 23-A and the Contract Documents. Lesson plan shall comply with requirements of this Section as may be supplemented by Specifications Sections where materials and equipment are specified. Include with lesson plan copy of handouts that will be used during training sessions. Furnish lesson plan submittals in accordance with time frames specified in this Section.
 2. Qualifications:
 - a. Credentials of manufacturer's proposed operations and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Section and shall include brief resume' and specific details of instructor's operating, maintenance, and training experience relative to the specific material and equipment for which instructor will provide training.
- C. Closeout Submittals: Submit the following:
1. Trainee sign-in sheets for each training session. Submit to OWNER's training coordinator with copy to ENGINEER.

1.4 LESSON PLAN

- A. Supplier's lesson plan shall describe specific instruction topics, system components for which training will be furnished, and training procedures. Handouts, if any, to be used in training shall be included with the lesson plan. Describe in lesson plan "hands-on" demonstrations planned for training sessions.
- B. Submit acceptable lesson plan not less than 14 days prior to starting associated training.
- C. Indicate in lesson plan estimated duration of each training segment.
- D. Lesson plan shall include the following:
1. Material and Equipment Overview (required for all types of operations and maintenance training):
 - a. Describe material and equipment's operating (process) function and performance objectives.
 - b. Describe material and equipment's fundamental operating principles and dynamics.
 - c. Identify equipment's mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem's interaction with other subsystems.
 - d. Identify all support materials and equipment associated with operation of subject equipment, such as air intake filters, valve actuators, motors, and other appurtenant items and equipment.

- e. Identify and describe safety precautions and potential hazards related to operation.
- f. Identify and describe in detail safety and control interlocks.
- 2. Operations Personnel Training:
 - a. Material and Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.
 - b. Operation:
 - 1) Describe operating principles and practices.
 - 2) Describe routine operating, startup, and shutdown procedures.
 - 3) Describe abnormal or emergency startup, operating, and shutdown procedures that may apply.
 - 4) Describe alarm conditions and responses to alarms.
 - 5) Describe routine monitoring and recordkeeping procedures.
 - 6) Describe recommended housekeeping procedures.
 - c. Troubleshooting:
 - 1) Describe how to determine if corrective maintenance or an operating parameter adjustment is required.
- 3. Mechanical Maintenance Training:
 - a. Material and Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.
 - b. Material and Equipment Preventive Maintenance:
 - 1) Describe preventative maintenance inspection procedures required to:
 - a) Inspect materials and equipment in operation.
 - b) Identify potential trouble symptoms and anticipate breakdowns.
 - c) Forecast maintenance requirements (predictive maintenance).
 - 2) Define recommended preventative maintenance intervals for each component.
 - 3) Describe lubricant and replacement part recommendations and limitations.
 - 4) Describe appropriate cleaning practices and recommend intervals.
 - 5) Identify and describe use of special tools required for maintenance of materials and equipment.
 - 6) Describe component removal, installation, and disassembly and assembly procedures.
 - 7) Perform “hands-on” demonstrations of preventive maintenance procedures.
 - 8) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
 - 9) Define recommended torquing, mounting, calibrating, and aligning procedures and settings, as appropriate.
 - 10) Describe recommended procedures to check and test equipment following corrective maintenance.
 - c. Equipment Troubleshooting:
 - 1) Define recommended systematic troubleshooting procedures.

- 2) Provide component-specific troubleshooting checklists.
 - 3) Describe applicable materials and equipment testing and diagnostic procedures to facilitate troubleshooting.
 - 4) Describe common corrective maintenance procedures with “hands-on” demonstrations.
4. Instrumentation/Controls and Electrical Maintenance Training:
 - a. Materials nad Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.
 - b. Preventative Maintenance and Troubleshooting of Instrumentation and Control Systems: In accordance with Section 40 90 09, Plant Monitoring and Control System Training. ENGINEER may grant waiver(s) to allow all training for a given system to be at the location of OWWNER’s training facility.
 - c. Preventative Maintenance and Troubleshooting of Other Electrical Systems: In accordance with requirements for Paragraph 1.4.D.3 of this Section.

1.5 TRAINING AIDS

- A. Manufacturer’s instructor shall incorporate training aids as appropriate to assist in the instruction. Furnish handouts of text, tables, graphs, and illustrations as required. Other appropriate training aids include:
 1. Audio-visual aids, such as videos, Microsoft PowerPoint presentations, overhead transparencies, posters, drawings, diagrams, catalog sheets, or other items.
 2. Equipment cutaways and samples, such as spare parts and damaged equipment.
 3. Tools, such as repair tools, customized tools, and measuring and calibrating instruments.
- B. Handouts:
 1. Manufacturer’s instructor shall distribute and use descriptive handouts during training. Customized handouts developed especially for training for the Project are encouraged.
 2. Photocopied handouts shall be good quality and completely legible.
 3. Handouts should be coordinated with the instruction, with frequent references made to the handouts.
 4. Provide not less than 15 copies of each handout for each training session.
- C. Audio-visual Equipment: Training provider shall provide audio-visual equipment required for training sessions. If suitable equipment is available at the Site, OWNER may make available OWNER’s audio-visual equipment; however, do not count on OWNER providing audio-visual equipment. Audio-visual equipment that training provider shall provide, as required, includes:
 1. Laptop computer, presentation software, and suitable projector.
 2. As required, extension cords and spare bulb for projector.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 TRAINING DELIVERY

A. Training Delivery – General:

1. Instructors shall be fully prepared for the training sessions. Training delivery shall be communicative, clear, and proceed according to lesson plan accepted by ENGINEER, with lesson content appropriate for trainees. If OWNER or ENGINEER deems that training delivery does not to comply with the Contract Documents, training shall be postponed, rescheduled, and re-performed in acceptable manner at no additional cost to OWNER.
2. Trainee Sign-in Sheets: In format acceptable to OWNER, furnish sign-in sheet for trainees for each session. Sign-in sheets shall include the Project name, equipment or system for which training was furnished, and type of training (e.g., operations, mechanical maintenance, instrumentation/controls maintenance, or other), and name of each trainee. Upon completion of training, submit copy of each sign-in sheet as indicated in Article 1.3 of this Section.

B. “Hands-on” Demonstrations:

1. Manufacturer’s instructor shall present “hands-on” demonstrations of operations and maintenance of materials and equipment for each training session, in accordance with lesson plan accepted by ENGINEER.
2. CONTRACTOR and manufacturer shall furnish tools necessary for demonstrations.

3.2 TRAINING SCHEDULE

- A. Manufacturer shall furnish not less than the hours of training and number of sessions indicated in Table 01 79 23-A of this Section. Travel time and expenses are responsibility of manufacturer and are excluded from required training time indicated in the Contract Documents.

B. Shifts and Training Sessions Required:

1. Operations at the Site take place 24 hours per day, divided into two shifts as follows: day, and night shift.
2. Training Sessions per Shift:
 - a. Operators: Maximum training per day is four hours; sessions longer than four hours shall be spread over multiple, preferably consecutive, days. Provide identical training sessions as follows:
 - 1) Two identical sessions during day shift, each session in a different week.
 - 2) One session during evening shift.

- 3) One session during night shift.
- b. Mechanical Maintenance: Provide two identical training sessions during day shift, each session in a separate week, for indicated equipment. Maximum training per day is four hours; sessions longer than four hours shall be spread over multiple, preferably consecutive, days.
- c. Instrument/Controls and Electrical Maintenance: Provide two identical training sessions during day shift, each session in a separate week, for indicated equipment. Maximum training per day is four hours; sessions longer than four hours will be spread over multiple, preferably consecutive, days.

+ + END OF SECTION + +

SECTION 02 41 00

DEMOLITION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified and required for demolition, removal, and disposal Work.
2. The Work under this Section includes, but is not necessarily limited to:
 - a. Demolition and removal of existing materials and equipment as shown or indicated in the Contract Documents. The Work includes demolition of structural concrete, foundations, walls, metals, masonry, attachments, appurtenances, piping, electrical and mechanical systems and equipment, paving, curbs, sidewalks, gutters, and similar existing facilities.
 - b. Demolition and removal of all Underground Facilities underneath, and above-grade piping and utilities in, the building(s) and structures shown or indicated for demolition, unless the Underground Facilities or above-grade facilities are shown or indicated as to remain.
 - c. Remove from slabs, foundations, walls, and footings that are to be demolished all utilities and appurtenances embedded in such construction.
3. Demolitions and removals specified under other Sections shall comply with requirements of this Section.
4. Perform demolition Work within areas shown or indicated.
5. Pay all costs associated with transporting and, as applicable, disposing of materials and equipment resulting from demolition.

B. Coordination:

1. Comply with Section 01 14 16, Coordination with Owner's Operations.
2. Review procedures under this and other Sections and coordinate the Work that will be performed with or before demolition and removals.

C. Related Sections:

1.2 QUALITY ASSURANCE

A. Qualifications:

1. Electrical Removals: Entity and personnel performing electrical removals shall be electrician legally qualified to perform electrical construction and electrical work in the jurisdiction where the Site is located.

2. Plumbing Removals: Entity and personnel performing plumbing removals shall be plumber legally qualified to perform plumbing construction and plumbing work in the jurisdiction where the Site is located.
- B. Regulatory Requirements:
1. Demolition, removal, and disposal Work shall be in accordance with 29 CFR 1926.850 through 29 CFR 1926.860 (Subpart T - Demolition), and all other Laws and Regulations.
 2. Comply with requirements of authorities having jurisdiction.

1.3 SUBMITTALS

- A. Informational Submittals: Submit the following:
1. Procedure Submittals:
 - a. Demolition and Removal Plan: Not less than ten days prior to starting demolition Work, submit acceptable plan for demolition and removal Work, including:
 - 1) Plan for coordinating shut-offs, capping, temporary services, and continuing utility services.
 - 2) Other proposed procedures as applicable.
 - 3) Equipment proposed for use in demolition operations.
 - 4) Recycling/disposal facility(ies) proposed, including facility owner, facility name, location, and processes. Include copy of appropriate permits and licenses, and compliance status.
 - 5) Planned demolition operating sequences.
 - 6) Detailed schedule of demolition Work in accordance with the accepted Process Schedule.
 2. Notification of Intended Demolition Start: Submit in accordance with Paragraph 3.1.A of this Section.
 3. Qualifications Statements:
 - a. Name and qualifications of entity performing electrical removals, including copy of licenses required by authorities having jurisdiction.
 - b. Name and qualifications of entity performing plumbing removals, including copy of licenses required by authorities having jurisdiction.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION

- A. Notification:
1. At least 48 hours prior to commencing demolition or removal, notify Engineer in writing of planned start of demolition Work. Do not start removals without permission of Engineer.

- B. Protection of Surrounding Areas and Facilities:
 - 1. Perform demolition and removal Work in manner that prevents damage and injury to property, structures, occupants, the public, and facilities. Do not interfere with use of, and free and safe access to and from, structures and properties.
 - 2. Closing or obstructing of roads, drives, sidewalks, and passageways adjacent to the Work is not allowed unless indicated otherwise in the Contract Documents. Conduct the Work with minimum interference to vehicular and pedestrian traffic.
 - 3. Provide temporary barriers, lighting, sidewalk sheds, and other necessary protection.
 - 4. Repair damage to facilities that are to remain.
- C. Existing Utilities: In addition to requirements of the General Conditions, Supplementary Conditions, and Division 01 Specifications, do the following:
 - 1. Should uncharted or incorrectly charted Underground Facilities be encountered, Contractor responsibilities shall be in accordance with the General Conditions as may be modified by the Supplementary Conditions. Cooperate with utility owners in keeping adjacent services and facilities in operation.
 - 2. Sanitary Sewer: Before proceeding with demolition, locate and cap all sewer lines and service laterals discharging from the building or structure being demolished.
 - 3. Storm Water: Existing storm water system shall remain in place until demolitions of existing building or structure is completed. Upon completing demolition, cut and cap storm sewer laterals at locations shown on the Drawings. Remove existing storm water piping and related structures between points of cutting, and backfill, restore to grade, and stabilize the area over the removed facilities.
 - 4. Water Piping: Before proceeding with demolition, locate and cap all potable and non-potable waterlines and service laterals serving the building or structure being demolished.
 - 5. Other Utilities: Before proceeding with demolition, locate and cap as required all other utilities, such as fuel and gas; heating, ventilating, and air conditioning; electric; and communications; and service laterals serving the building or structure being demolished.
 - 6. Shutdown of utility services shall be coordinated by Contractor, assisted by Owner as required relative to contacting utility owners.

3.2 DEMOLITION – GENERAL

- A. Locate construction equipment used for demolition Work and remove demolished materials and equipment to avoid imposing excessive loading on supporting and adjacent walls, floors, framing, facilities, and Underground Facilities.
- B. Pollution Controls:

1. Use water sprinkling, temporary enclosures, and other suitable methods to limit emissions of dust and dirt to lowest practical level. Comply with Section 01 57 05, Temporary Controls, and Laws and Regulations.
 2. Do not use water when water may create hazardous or objectionable conditions such as icing, flooding, or pollution.
 3. Clean adjacent structures, facilities, properties, and improvements of dust, dirt, and debris caused by demolition Work, in accordance with the General Conditions and Section 01 74 05, Cleaning.
- C. Explosives:
1. Do not bring explosives to the Site or use explosives without written consent of Owner and authorities having jurisdiction. Obtaining such written consent will not relieve Contractor of responsibility for injury or damage caused by Contractor's blasting operations.
 2. Perform blasting, when permitted, in compliance with Laws and Regulations, and blasting plan accepted by Engineer.
- D. Comply with Section 01 73 29, Cutting and Patching.
- E. Building or Structure Demolition:
1. Unless otherwise approved by Engineer, proceed with demolition from top of building or structure to the ground. Complete demolition Work above each floor or tier before disturbing supporting members of lower levels.
 2. Demolish concrete and masonry in small sections.
 3. Remove structural framing members and lower to ground using hoists, cranes, or other suitable methods. Do not throw or drop to the ground.
 4. Break up and remove foundations and slabs-on-grade unless otherwise shown or indicated as remaining in place.
- F. Demolition of Site Improvements:
1. Pavement, Sidewalks, Curbs, and Gutters: Demolition of asphalt or concrete pavement, sidewalks, curbs, and gutters, as applicable, shall terminate at cut edges. Edges shall be linear and have a vertical cut face.
 2. Manholes, Vaults, Chambers, and Handholes: Remove to the limits shown or indicated on the Drawings.
 3. Underground Facilities Other than Manholes, Vaults, Chambers, and Handholes: Remove to the extent shown or indicated on the Drawings. Unless otherwise shown or indicated, cap ends of piping to remain in place in accordance with the "Mechanical Removals" Article in this Section.
 4. Landscaping: Comply with Section 33 11 00, Clearing and Grubbing.
- G. Salvage and Ownership:
1. Refer to Section 01 11 13, Summary of Work, for requirements on salvage, ownership, and handling of equipment and materials removed during demolition and removal Work.
 2. Materials and equipment to remain Owner's property shall be carefully removed and appropriately handled by Contractor to avoid damage and

invalidation of warranties in effect, and shall be cleaned and stored at the Site (or other site specified in the Contract Documents) at place designated by Engineer or Owner.

- H. Finishing of Surfaces Exposed by Removals: Unless otherwise shown or indicated in the Contract Documents, surfaces of walls, floors, ceilings, and other areas exposed by removals, and that will remain as finished surfaces, shall be repaired and re-finished with materials that match existing adjacent surface, or as otherwise approved by Engineer.

3.3 STRUCTURAL REMOVALS

- A. Remove structures to lines and grades shown or indicated, unless otherwise directed by Engineer. Where limits are not shown or indicated, limits shall be four inches outside item to be installed. Removals beyond limits shown or indicated shall be at Contractor's expense and such excess removals shall be reconstructed to satisfaction of Engineer without additional cost to Owner.
- B. Recycling and Reuse of Demolition Materials:
 - 1. All concrete, brick, tile, masonry, roofing materials, reinforcing steel, structural metals, miscellaneous metals, plaster, wire mesh, and other items contained in or upon building or structure to be demolished shall be removed, transported, and disposed of away from the Site, unless otherwise approved by Engineer.
 - 2. Do not use demolished materials as fill or backfill adjacent to structures, in pipeline trenches, or as subbase under structures or pavement.
- C. After removing concrete and masonry walls or portions thereof, slabs, and similar construction that ties in to the Work or to existing construction, neatly repair the junction point to leave exposed only finished edges and finished surfaces.
- D. Where parts of existing structures are to remain in service following demolition, remove the portions shown or indicated for removal, repair damage, and leave the building or structure in proper condition for the intended use.
 - 1. Remove concrete and masonry to the lines shown or indicated by sawing, drilling, chipping, and other suitable methods. Leave the resulting surfaces true and even, with sharp, straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended.
 - 2. Do not damage reinforcing bars beyond the area of concrete and masonry removal. Do not saw-cut beyond the area to be removed.
 - 3. Reinforcing bars that are exposed at surfaces of removed concrete and masonry that will not be covered with new concrete or masonry shall be removed to 1.5 inches below the final surface. Repair the resulting hole, with repair mortar for concrete and grout for masonry, to be flush with the surface.
 - 4. Where existing reinforcing bars are shown or indicated to extend into new construction, remove existing concrete so that reinforcing bars are clean and undamaged.

- E. Where equipment or material anchored to concrete or masonry are removed and anchors are not to be re-used, remove the anchors to not less than 1.5 inches beneath surface of concrete or masonry member. Repair the resulting hole, using repair mortar for concrete and grout for masonry, to be flush with the surface. Alternately, when the anchor is stainless steel, the anchor may be cut flush with the surface of the concrete or masonry, when so approved by Engineer.
- E. Jambs, sills and heads of windows, passageways, doors, or other openings (as applicable) cut-in to the Work or to existing construction shall be dressed with masonry, concrete, or metal to provide smooth, finished appearance.
- F. Where anchoring materials, including bolts, nuts, hangers, welds, and reinforcing steel, are required to attach the Work to existing construction, provide such materials under this Section, unless specified elsewhere in the Contract Documents.

3.4 MECHANICAL REMOVALS

- A. Mechanical demolition and removal Work includes dismantling and removing existing piping, ductwork, pumps, equipment, tanks, and appurtenances as shown, indicated, and required for completion of the Work. Mechanical removals include cutting and capping as required, except that cutting of existing piping and ductwork to make connections is included under Section 01 14 16, Coordination with Owner's Operations; Section 01 73 29, Cutting and Patching; and applicable Sections of Division 40, Process Integration.
- B. Demolition and Removals of Piping, Ductwork, and Similar Items:
 - 1. Purge piping and tanks (as applicable) of chemicals or fuel (as applicable) and make safe for removal and capping. Remove to the extent shown or indicated existing process, water, waste and vent, chemical, gas, fuel, and other piping. Remove piping to the nearest solid piping support, and provide caps on ends of remaining piping. Where piping to be demolished passes through existing walls to remain, cut off and cap pipe on each side of the wall.
 - 2. Caps, Closures, Blind Flanges, and Plugs:
 - a. Provide closure pieces, such as blind flanges and caps, where shown or required to complete the Work.
 - b. Where used in this Section, the term "cap" means the appropriate type closure for the piping or ductwork being closed, including caps, blind flanges, and other closures.
 - c. Caps shall be compatible with the piping or ductwork to which the cap is attached, fluid-tight and gastight, and appropriate for the fluid or gas conveyed in the pipe or duct.
 - d. Unless otherwise shown or indicated, caps shall be mechanically fastened, fused, or welded to pipe or duct. Plug piping with means other than specified in this Section only when so shown or indicated in the Contractor Documents or when allowed by Engineer.

3. When Underground Facilities are altered or removed, properly cut and cap piping left in place, unless otherwise shown or indicated.
 4. Remove waste and vent piping, and ductwork to extent shown and cap as required. Where demolished vent piping, stacks, and ductwork passes through existing roofing, patch the roof with the same or similar materials. Completed patch shall be watertight and comply with roofing manufacturer's recommendations.
 5. Modifications to potable water piping and other plumbing and heating system work shall comply with Laws and Regulations. All portions of potable water system that have been modified or opened shall be hydrostatically tested and disinfected in accordance with the Contract Documents, and Laws and Regulations. Hydrostatically test other, normally-pressurized, plumbing piping and heating piping.
- C. Equipment Demolition and Removals:
1. To the extent shown or indicated, remove existing process equipment; pumps; storage tanks; hoisting and conveying equipment; heating, ventilating, and air conditioning equipment; generators; and other equipment.
 2. Where required, disassemble equipment to avoid imposing excessive loading on supporting walls, floors, framing, facilities, and Underground Facilities. Disassemble equipment as required for access through and egress from building or structure. Disassembly shall comply with Laws and Regulations. Provide required means to remove equipment from building or structure.
 3. Remove control panels, operator stations, and instruments associated with equipment being removed, unless shown or indicated otherwise.
 4. Remove equipment supports as applicable, anchorages, base, grout, and piping. Remove anchorage systems in accordance with the "Structural Removals" Article in this Section. Remove small-diameter piping back to header unless otherwise indicated.
 5. Remove access platforms, ladders, and stairs related to equipment being removed, unless otherwise shown or indicated.

3.5 ELECTRICAL REMOVALS

- A. Electrical demolition Work includes removing existing transformers, distribution switchboards, control panels, motors, starters, conduit and raceways, cabling, poles and overhead cabling, panelboards, lighting fixtures, switches, and miscellaneous electrical equipment, as shown, specified, or required.
- B. Remove existing electrical equipment and fixtures to avoid damaging systems to remain, to keep existing systems in operation, and to maintain integrity of grounding systems.
- C. Remove or modify motor control centers and switchgear as shown or indicated. Modified openings shall be cut square and dressed smooth to dimensions required for installation of equipment.

- D. Disconnect and remove motors, control panels, and other electrical gear where shown or indicated. Motors, microprocessors and electronics, other electrical gear to be reused shall be stored in accordance with Section 01 66 00, Product Storage and Handling Requirements.
- E. Cables in conduits to be removed shall be removed back to the power source or control panel, unless otherwise shown or indicated. Verify the function of each cable before disconnecting and removing.
- F. Conduits, raceways, and cabling shall be removed where shown or indicated. Abandoned conduits concealed in floor, ceiling slabs, or in walls shall be cut flush with the slab or wall (as applicable) at point of entrance, suitably capped, and the area repaired in a flush, smooth manner acceptable to Engineer. Exposed conduits, junction boxes, other electrical appurtenances, and their supports shall be disassembled and removed. Repair all areas of the Work to prevent rusting on exposed surfaces.
- G. Conduits in Underground Facilities not scheduled for reuse shall be suitably capped watertight where each enters building or structure to remain.
- H. Where shown or indicated, remove direct burial cable. Openings in buildings for entrance of direct burial cable shall be patched with repair mortar or other material approved by Engineer for this purpose, and made watertight.
- I. Existing poles and overhead cables shall be removed or abandoned as shown and specified. Existing substation(s) and poles owned by electric utility will be removed by the electric utility. Completely remove from the Site poles not owned by electric utility and shown or indicated for removal. Make necessary arrangements with electric utility for removal of utility company's transformers and metering equipment after new electrical system has been installed and energized.
- J. Lighting fixtures, wall switches, receptacles, starters, and other miscellaneous electrical equipment, not designated as remaining as Owner's property, shall be removed and properly disposed off-Site as required.

3.6 DISPOSAL OF DEMOLITION DEBRIS

- A. Remove from the Site all debris, waste, rubbish, and material resulting from demolition operations and equipment used in demolition Work. Comply with the General Conditions, Supplementary Conditions, and Section 01 74 05, Cleaning.
- B. Transportation and Disposal:
 - 1. Non-hazardous Material: Properly transport and dispose of non-hazardous demolition debris at appropriate landfill or other suitable location, in accordance with Laws and Regulations. Non-hazardous material does not contain Asbestos, PCBs, Petroleum, Hazardous Waste, Radioactive Material, or other material designated as hazardous in Laws and Regulations.

2. Hazardous Material: When handling and disposal of hazardous materials is included in the Work, properly transport and dispose of hazardous materials in accordance with the Contract Documents and Laws and Regulations.
- C. Submit to Engineer information required in this Section on proposed facility(ies) where demolition material will be recycled. Upon request, Engineer or Owner, shall be allowed to visit recycling facility(ies) to verify adequacy and compliance status. During such visits, recycling facility operator shall cooperate and assist Engineer and Owner.

+ + END OF SECTION + +

SECTION 03 00 05

CONCRETE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete, reinforcing, and related materials.
2. The Work includes:
 - a. Providing concrete consisting of portland cement, fine and coarse aggregates, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured.
 - b. Fabricating and placing reinforcing, including ties and supports.
 - c. Design, erection, and removal of formwork.
 - d. Building into the concrete all sleeves, frames, anchorage devices, inserts, and other items required to be embedded in concrete.
 - e. Providing openings in concrete as required to accommodate Work under this and other Sections.

B. Coordination:

1. Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work.

C. Classifications of Concrete:

1. Class "A" concrete shall be steel-reinforced and includes all concrete unless otherwise shown or indicated.
2. Class "B" concrete shall be placed without forms or with simple forms, with little or no reinforcing and includes the following:
 - a. Concrete fill.
 - b. Duct banks.
 - c. Unreinforced encasements.
 - d. Curbs and gutters.
 - e. Sidewalks.
 - f. Thrust blocks.

B. Related Sections:

1. Section 05 05 33, Anchor Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ACI 224R, Control of Cracking in Concrete Structures.
2. ACI 301, Specifications for Structural Concrete for Buildings.
3. ACI 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
4. ACI 305R, Specification for Hot Weather Concreting.
5. ACI 306R, Cold Weather Concreting.
6. ACI 309R, Guide for Consolidation of Concrete.
7. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
8. ACI 347, Guide to Formwork for Concrete.
9. ACI SP-66, ACI Detailing Manual.
10. ASTM A1064/ASTM 1064M, Standard Specification for Steel Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
11. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
12. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.
13. ASTM C33/C33M, Specification for Concrete Aggregates.
14. ASTM C39/C39M, Test Method for Compressive Strength of Cylindrical Concrete Specimens.
15. ASTM C42/C42M, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
16. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
17. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
18. ASTM C143/C143M, Test Method for Slump of Hydraulic-Cement Concrete.
19. ASTM C150/C150M, Specification for Portland Cement.
20. ASTM C595/C595M, Standard Specification for Blended Hydraulic Cements
21. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
22. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
23. ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
24. ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
25. ASTM C494/C494M, Specification for Chemical Admixtures for Concrete.
26. ASTM C579, Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
27. ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
28. ASTM D1752, Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
29. ASTM E96/E96M, Test Methods for Water Vapor Transmission of Materials
30. ASTM E154, Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

31. CRD-C 572, U. S. Army Corps of Engineers Specification for Polyvinylchloride Waterstops.
32. CRSI 1MSP, Manual of Standard Practice.

1.3 QUALITY ASSURANCE

A. Laboratory Trial Batch:

1. Employ independent testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.
2. Each concrete mix design specified shall be verified by laboratory trial batch, unless indicated otherwise.
3. Perform the following testing on each trial batch:
 - a. Aggregate gradation for fine and coarse aggregates.
 - b. Slump.
 - c. Air content.
 - d. Compressive strength based on three cylinders each tested at seven days and at 28 days.
4. Submit for each trial batch the following information:
 - a. Project identification name and number (if applicable).
 - b. Date of test report.
 - c. Complete identification of aggregate source of supply.
 - d. Tests of aggregates for compliance with the Contract Documents.
 - e. Scale weight of each aggregate.
 - f. Absorbed water in each aggregate.
 - g. Brand, type, and composition of cementitious materials.
 - h. Brand, type, and amount of each admixture.
 - i. Amounts of water used in trial mixes.
 - j. Proportions of each material per cubic yard.
 - k. Gross weight and yield per cubic yard of trial mixtures.
 - l. Measured slump.
 - m. Measured air content.
 - n. Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28-day test, and for each design mix.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. List of concrete materials and concrete mix designs proposed for use. Include results of tests performed to qualify the materials and to establish the mix designs. Do not start laboratory trial batch testing until this submittal is approved by ENGINEER.
 - b. Laboratory Trial Batch Reports: Submit laboratory test reports for concrete cylinders, materials, and mix design tests.

- c. Concrete placement drawings showing the location and type of all joints.
 - d. Drawings for fabricating, bending, and placing concrete reinforcing. Comply with ACI SP-66. For walls and masonry construction, provide elevations to a minimum scale of 1/4-inch to one foot. Show bar schedules, stirrup spacing, adhesive dowels, splice lengths, diagrams of bent bars, arrangements, and assemblies, as required for fabricating and placing concrete reinforcing.
 - 2. Product Data:
 - a. Manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
 - 3. Samples:
 - a. Samples: Submit samples of materials as specified and as otherwise requested by ENGINEER, including names, sources, and descriptions.
- B. Informational Submittals: Submit the following:
- 1. Site Quality Control Submittals:
 - a. Report of testing results for testing of field concrete cylinders for each required time period. Submit within 24 hours after completion of associated test. Test report shall include results of all testing required at time of sampling.
- ### 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING
- A. Transportation, Delivery, and Handling:
- 1. Deliver concrete reinforcing products to Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings on approved Shop Drawings.
 - 2. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.
 - 3. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
 - 4. Deliver grout materials from manufacturers in unopened containers that bear intact manufacturer labeling.
- B. Storage:
- 1. Store formwork materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective, waterproof covering. Provide for adequate air circulation or ventilation under cover.
 - 2. Store concrete reinforcing materials to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground. Space framework or blocking supports to prevent excessive deformation of stored materials.

3. Store concrete joint materials on platforms or in enclosures or covered to prevent contact with ground and exposure to weather and direct sunlight.
4. For storage of concrete materials, provide bins or platforms with hard, clean surfaces.

PART 2 – PRODUCTS

2.1 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I/II, or ASTM C595, Type IL.
Type IL cement shall meet the following requirements:
 - a) Type IL cement shall have moderate sulfate resistance (MS) per ASTM C595.
 - b) Type IL cement shall have a maximum heat of hydration no more than 80 (cal/g) or 335 (KJ/kg) per ASTM 595.
 - c) Type IL cement Tricalcium Aluminate content shall not exceed 8%.
- B. Aggregates: All aggregates shall comply with ASTM C33/C33M.
 1. Fine Aggregate: Clean, sharp, natural silica sand free of loam, clay, lumps, and other deleterious substances. Dune sand, bank run sand, and manufactured sand are unacceptable.
 2. Coarse Aggregate:
 - a. Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter.
 - b. Coarse aggregate shall comply with the following:
 - 1) Crushed stone, processed from natural rock or stone.
 - 2) Washed gravel, either natural or crushed. Slag, pit gravel, and bank-run gravel are not allowed.
 - c. Coarse Aggregate Size: ASTM C33/C33M, Nos. 57 or 67, unless otherwise approved by ENGINEER.
- C. Water: Clean, potable.
- D. Admixtures:
 1. Air-Entraining Admixture: ASTM C260.
 2. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 3. Water Reducing and Set-Adjusting Admixtures: ASTM C494/C494M, Types D and E.
 4. High Range Water-Reducing Admixture: ASTM C494/C494M, Type F/G.
 5. Use only admixtures that have been tested and approved in the mix designs.
 6. Do not use calcium chloride or admixtures containing chloride ions.
- E. Cementitious Materials:
 - a. Fly Ash ASTM C618, Class F, content in cementitious material up to 25% by weight.

- b. Slag ASTM C989, Grade 120, content in cementitious material up to 25% by weight.

2.2 CONCRETE MIX

- A. General:
 - 1. Normal weight: 150 pounds per cubic foot.
 - 2. Use air-entraining admixture in all concrete. Provide not less than four percent, nor more than eight percent, entrained air for concrete exposed to freezing and thawing, and provide from three to five percent entrained air for other concrete.
- B. Proportioning and Design of Class “A” Concrete Mix:
 - 1. Minimum compressive strength at 28 days: 4,500 psi.
 - 2. Maximum water-cement ratio by weight: 0.42.
 - 3. Minimum cement content: 564 pounds per cubic yard.
- C. Proportioning and Design of Class “B” Concrete Mix:
 - 1. Minimum compressive strength at 28 days: 3,000 psi.
 - 2. Maximum water-cement ratio by weight: 0.50.
 - 3. Minimum cement content: 517 pounds per cubic yard.
- D. Slump Limits:
 - 1. Proportion and design mixes to result in concrete slump at point of placement of not less than one inch and not more than four inches.
 - 2. When using high-range water reducers, slump prior to addition of admixture shall not exceed three inches. Slump after adding admixture shall not exceed eight inches at point of placement.
- E. Adjustment of Concrete Mixes:
 - 1. Concrete mix design adjustments may be requested by CONTRACTOR when warranted by characteristics of materials, Site conditions, weather, test results, or other, similar circumstances.
 - 2. Submit for ENGINEER’s approval laboratory test data for adjusted concrete mix designs, including compressive strength test results.
 - 3. Implement adjusted mix designs only after ENGINEER’s approval.
 - 4. Adjustments to concrete mix designs shall not result in additional costs to OWNER.

2.3 FORM MATERIALS

- A. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection. CONTRACTOR shall be responsible for designing the formwork system to resist all applied loads including pressures from fluid concrete and construction loads.

- B. Smooth Form Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces in accordance with ACI 301.
- C. Unexposed Concrete Surfaces: Material to suit project conditions.
- D. Provide 3/4-inch chamfer at all external corners. Chamfer is not required at re-entrant corners unless otherwise shown or indicated.
- E. Form Ties:
 - 1. Provide factory-fabricated, removable, or snap-off metal form ties, that prevent form deflection and prevent spalling of concrete surfaces upon removal. Materials used for tying forms are subject to approval of ENGINEER.
 - 2. Unless otherwise shown or indicated, provide ties so that portion remaining within concrete after removal of exterior parts is at least 1.5 inches from outer surface of concrete. Unless otherwise shown or indicated, provide form ties that, upon removal, will leave a uniform, circular hole not larger than one-inch diameter in the concrete surface.
 - 3. Ties for exterior walls, below-grade walls, and walls subject to hydrostatic pressure shall be provided with waterstops.
 - 4. Wire ties are unacceptable.

2.4 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed bars.
- B. Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete: ASTM A1064/ASTM A1064M.
- C. Provide supports for reinforcing including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing in place.
 - 1. Use wire bar-type supports complying with CRSI MSP1 recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.
 - 2. For slabs on grade, use precast concrete blocks, four inches square minimum with compressive strength equal to or greater than the surrounding concrete, or supports with sand plates or horizontal runners where base materials will not support chair legs.
 - 3. For all concrete surfaces where legs of supports are in contact with forms, provide supports having either hot-dip galvanized, plastic-protected, or stainless steel legs in accordance with CRSI MSP1.
 - 4. Provide precast concrete supports over waterproof membranes.
- D. Adhesive Dowels:
 - 1. Dowels:
 - a. Dowel reinforcing bars shall comply with ASTM A615, Grade 60.
 - 2. Adhesive:

- a. For requirements for adhesive, refer to Section 05 05 33, Anchor Systems.

2.5 RELATED MATERIALS

A. Waterstops:

1. PVC Waterstops:
 - a. Manufacturers: Provide products of one of the following:
 - 1) W.R. Meadows, Inc.
 - 2) Greenstreak Plastic Products Company.
 - 3) Or approved equal.
 - b. Waterstops shall comply with CRD-C 572. Do not use reclaimed or scrap material.
 - c. Minimum Thickness: 3/8-inch.
 - d. Provide waterstops with minimum of seven ribs equally spaced at each end on each side with the first rib located at the edge. Each rib shall be minimum 1/8-inch in height.
 - e. Construction Joints: Waterstops shall be six-inch wide flat-strip type.
 - f. Expansion Joints: Waterstops shall be nine-inch wide centerbulb type.
2. Hydrophilic Waterstops:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Duroseal Gasket, by BBZ USA, Inc.
 - 2) Adeka Ultraseal MC-2010M, by Asahi Denka Kogyo K.K.
 - 3) Hydrotite, by Greenstreak Plastic Products Company.
 - 4) Or approved equal.
 - b. Hydrophilic waterstop materials shall be bentonite-free and shall expand by minimum of 80 percent of dry volume in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.
 - c. Waterstop material shall be composed of resins and polymers that absorb water and cause a completely reversible and repeatable increase in volume.
 - d. Waterstop material shall be dimensionally stable after repeated wet-dry cycles with no deterioration of swelling potential.
 - e. Select material in accordance with manufacturer's recommendations for type of liquid to be contained.
 - f. Minimum cross-sectional dimensions: 3/16-inch by 3/4-inch.
 - g. Location of hydrophilic waterstops shall be as shown or indicated on the Drawings, or where approved by ENGINEER.
 - h. Hydrophilic Sealant: Shall adhere firmly to concrete, metal, and PVC in dry or damp condition and be indefinitely elastic when cured.
 - 1) Products and Manufacturers: Provide one of the following:
 - a) Duroseal Paste, by BBZ USA, Inc.
 - b) Adeka Ultraseal P-201, by Asahi Denka Kogyo K.K.
 - c) Hydrotite, by Greenstreak Plastic Products Company.
 - d) Or approved equal.
3. Special Waterstops

- a. Performed Adhesive Waterstops:
 - 1) Use rope type performed plastic waterstop meeting requirements of Federal Specification SS-S-210A.
 - 2) Cross sectional area: approximately one (1) square inch
 - 3) Use Synko Flex by Synko Flex Products, or equal.
- 4. Retrofit Waterstop:
 - a. Polyvinyl chloride or thermoplastic vulcanizate waterstop used between existing concrete and new concrete: Minimum of 3/8-inch thick, ribbed, 4-inch nominal width, 3-inch minimum height, T or L shaped.
 - b. Provide epoxy gel bed below retrofit waterstop.
 - c. Attach waterstop to existing concrete with stainless steel expansion anchors or concrete screws and stainless-steel batten bar with minimum dimensions of 1 1/2-inch by 3/16-inch.
 - d. Product and Manufacturer: Provide one of the following:
 - 1) Sika Greenstreak 581.
 - 2) Earth Shield JP 320L.
 - 3) Or approved equal.
- B. Vapor Retarder:
 - 1. Products and Manufacturers: Provide one of the following:
 - a. Stego Wrap 10-mil Vapor Retarder, by Stego Industries LLC.
 - b. Griffolyn 10-mil, by Reef Industries.
 - c. Moistop Ultra, by Fortifiber Industries.
 - d. Or approved equal.
 - 2. Vapor retarder membrane shall comply with the following.
 - a. Water Vapor Transmission Rate, ASTM E96/E96M: 0.04 perms or lower.
 - b. Water Vapor Retarder, ASTM E1745: Meets or exceeds Class C.
 - c. Thickness of Retarder (plastic), ACI 302 1R: Not less than 10 mils.
 - d. Provide accessories by same manufacturer as vapor retarder.
- C. Membrane-Forming Curing Compound: ASTM C309, Type I.
- D. Epoxy Bonding Agent:
 - 1. Two-component epoxy resin bonding agent.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sikadur 32, Hi-Mod LPL, by Sika Corporation.
 - b. Eucopoxy LPL, by the Euclid Chemical Company.
 - c. Or approved equal.
- E. Epoxy-Cement Bonding Agent:
 - 1. Three-component blended epoxy resin-cement bonding agent.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sika Armatec 110 EpoCem, by Sika Corporation.

- b. Duralprep A.C., by Euclid Chemical Company.
 - c. Or approved equal.
- F. Preformed Expansion Joint Filler:
 - 1. Provide preformed expansion joint filler complying with ASTM D1752, Type I (sponge rubber) or Type II (cork).
- G. Joint Sealant and Accessories:
 - 1. For joint sealants and accessories used on isolation joints, control joints, and expansion joints, refer to Section 07 92 00, Joint Sealants.

2.6 GROUT

- A. Non-shrink Grout:
 - 1. Pre-packaged, non-metallic, cementitious grout requiring only the addition of water at the Site.
 - 2. Minimum 28-day Compressive Strength: 7,000 psi.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. Hi-Flow Grout by Euclid Chemical Company.
 - b. Masterflow 928 by Master Builders, Inc.
 - c. Five Star Grout by Five Star Products, Inc.
 - d. Or approved equal.
- B. Epoxy Grout:
 - 1. Pre-packaged, non-shrink, non-metallic, 100 percent solids, solvent-free, moisture-insensitive, three-component epoxy grouting system.
 - 2. Minimum Seven-day Compressive Strength: 14,000 psi, when tested in accordance with ASTM C579.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. E3-G, by Euclid Chemical Company.
 - b. Sikaflow 648, by Sika Corporation.
 - c. HP Epoxy Grout, by Five Star Products, Inc.
 - d. Or approved equal.
- C. Grout Fill:
 - 1. Grout mix shall consist of cement, fine and coarse aggregates, water, and admixtures complying with requirements specified in this Section for similar materials in concrete.
 - 2. Proportion and mix grout fill as follows:
 - a. Minimum Cement Content: 564 pounds per cubic yard.
 - b. Maximum Water-Cement Ratio: 0.45.
 - c. Maximum Coarse Aggregate size: 1/2-inch, unless otherwise indicated.
 - d. Minimum 28-day Compressive Strength: 4,000 psi.

PART 3 – EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the substrate and the conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 FORMWORK

- A. Construct formwork in accordance with ACI 347 such that concrete members and structures are of correct size, shape, alignment, elevation, and position.
- B. Provide openings in formwork to accommodate the Work of other trades. Accurately place and securely support items required to be built into formwork.
- C. Clean and adjust forms prior to placing concrete. Apply form release agents or wet forms as required. Re-tighten forms during and after concrete placing, when required, to eliminate cement paste leaks.
- D. Removing Formwork:
 - 1. Comply with ACI 301 and ACI 347, except as otherwise indicated in the Contract Documents.
 - 2. Do not remove formwork and shoring until supported concrete members have acquired minimum of 90 percent of specified compressive strength. Results of suitable quality control tests of field-cured specimens may be submitted to ENGINEER for review as evidence that concrete has attained sufficient strength for removal of supporting formwork and shoring prior to removal times indicated in the Contract Documents.
 - 3. Removal time for formwork is subject to ENGINEER's acceptance.
 - 4. Repair form tie-holes following in accordance with ACI 301.

3.3 REINFORCING, JOINTS, AND EMBEDDED ITEMS

- A. Comply with the applicable recommendations of Laws and Regulations and standards referenced in this Section, including CRSI MSP1, for details and methods of placing and supporting reinforcing.
- B. Clean reinforcing to remove loose rust and mill scale, earth, ice, and other materials which act to reduce or destroy bond between reinforcing material and concrete.
- C. Position, support, and secure reinforcing against displacement during formwork construction and concrete placing. Locate and support reinforcing by means of metal chairs, runners, bolsters, spacers, and hangers, as required.
 - 1. Place reinforcing to obtain minimum concrete coverages as shown on the Drawings and as required in ACI 318. Arrange, space, and securely tie bars

- and bar supports together with 16-gage wire to hold reinforcing accurately in position during concrete placing. Set with ties so that twisted ends are directed away from exposed concrete surfaces.
2. Do not secure reinforcing to formwork using wire, nails or other ferrous metal. Metal supports subject to corrosion shall not be in contact with formed or exposed concrete surfaces.
- D. Provide sufficient strength on supports required to carry reinforcing. Do not place reinforcing more than two inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- E. Splices: Provide standard reinforcing splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown or indicated for minimum lap of spliced bars, as shown on Drawings.
- F. Install welded wire reinforcement in lengths as long as practical, lapping adjoining sections a minimum of one full mesh.
- G. Do not place concrete until reinforcing is inspected and ENGINEER indicates that conditions are acceptable for placing concrete. Concrete placed in violation of this paragraph will be rejected. Notify ENGINEER in writing at least two working days prior to proposed concrete placement.
- H. Joints:
1. Provide construction, isolation, expansion, and control joints as indicated or required. Locate construction joints so as to not impair the strength and appearance of the structure. Place isolation and control joints in slabs-on-grade to stabilize differential settlement and random cracking.
 2. In walls, locate joints at a maximum spacing of 40 feet and approximately 12 feet from corners.
 3. In foundation slabs and slabs-on-grade, locate joints at intervals of approximately 40 feet.
 4. In mats and structural slabs and beams, locate joints in compliance with ACI 224R.
 5. Locations of joints shall be in accordance with the Contract Documents and as approved by ENGINEER in the Shop Drawings.
 6. Where construction joints are indicated to be roughened, intentionally roughen surfaces of previously-placed concrete to amplitude of 1/4-inch.
- I. Installation of Embedded Items: Set and build into the Work anchorage devices and embedded items required for other Work that is attached to, or supported by, cast-in-place concrete. Use setting diagrams, templates, and instructions provided under other Sections and, when applicable, other contracts for locating and setting. Refer to Paragraph 1.1.B of this Section. Do not embed in concrete uncoated aluminum

items. Where aluminum items are in contact with concrete surfaces, coat aluminum to prevent direct contact with concrete.

J. Adhesive Dowels:

1. Adhesive dowels shall be reinforcing bar dowels set in an adhesive in hole drilled into hardened concrete. Comply with adhesive system manufacturer's installation instructions regarding hole diameter, drilling method, embedment depth required to fully develop required tensile strength, and hole cleaning and preparation instructions. Unless more-stringent standards are required by adhesive system manufacturer, comply with the following.
2. Drill holes to adhesive system manufacturer's recommended diameter and depth to develop required tensile strength. Holes shall not be more than 1/4-inch greater than nominal bar diameter, and hole depth shall not be less than twelve times nominal bar diameter. Hammer-drill holes. Cored holes are not allowed.
3. Embedment depths shall be based on concrete compressive strength of 4,000 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.
4. Determine location of existing reinforcing steel in vicinity of proposed holes prior to drilling. Adjust location of holes to be drilled to avoid drilling through or damaging existing reinforcing bars only when approved by ENGINEER.
5. Before setting adhesive dowel, hole shall be free of dust and debris using method recommended by adhesive system manufacturer. Hole shall be brushed, with manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
6. Inject adhesive into hole through injection system mixing nozzle and necessary extension tubes, placed to bottom of hole. Withdraw discharge end as adhesive is placed, but keep end of tube immersed to prevent forming air pockets. Fill hole to depth that ensures that excess material is expelled from hole during dowel placement.
7. Twist dowels during insertion into partially-filled hole to guarantee full wetting of bar surface with adhesive. Insert bar slowly to avoid developing air pockets.

3.4 CONCRETE PLACING

- A. Site Mixing: Use drum-type batch machine mixer, mixing not less than 1.5 minutes for one cubic yard or smaller capacity. Increase required mixing time by minimum of 15 seconds for each additional cubic yard or fraction thereof.
- B. Ready-Mixed Concrete: Comply with ASTM C94/C94M.
- C. Concrete Placing:
 1. Place concrete in a continuous operation within planned joints or sections in accordance with ACI 304R.

2. Do not begin placing concrete until work of other trades affecting concrete is completed.
 3. Wet concrete and subgrade surfaces to saturated surface dry condition immediately prior to placing concrete.
 4. Deposit concrete as near its final location as practical to avoid segregation due to re-handling or flowing.
 5. Avoid separation of the concrete mixture during transportation and placing. Concrete shall not free-fall for distance greater than four feet during placing.
 6. Complete concrete placing within 90 minutes of addition of water to the dry ingredients.
- D. Consolidate placed concrete in accordance with ACI 309R using mechanical vibrating equipment supplemented with hand rodding and tamping, such that concrete is worked around placing and other embedded items and into all parts of formwork. Insert and withdraw vibrators vertically at uniformly-spaced locations. Do not use vibrators to transport concrete within the formwork. Vibration of formwork or placing is not allowed.
- E. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing.
1. In hot weather comply with ACI 305R.
 2. In cold weather comply with ACI 306R.

3.5 QUALITY OF CONCRETE WORK

- A. Make concrete solid, compact, smooth, and free of laitance, cracks, and cold joints.
- B. Concrete for liquid-retaining structures and concrete in contact with earth, water, or exposed directly to the elements shall be watertight.
- C. Cut out and properly replace to extent directed by ENGINEER, or repair to satisfaction of ENGINEER, surfaces that contain cracks or voids, are unduly rough, or are in defective in any way. Patches or plastering are unacceptable.
- D. Repair, removal and replacement of defective concrete directed by ENGINEER shall be at no additional cost to OWNER.

3.6 CURING

- A. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by using moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until formwork is removed. Provide protection, as required, to prevent damage to exposed concrete surfaces. Total curing period shall not be less than seven days. Curing methods and materials shall be compatible with scheduled finishes.

3.7 FINISHING

A. Slab Finish:

1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently. Use a wood float only. Check and level surface plane to a tolerance not exceeding 1/4-inch in ten feet when tested with a ten foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float the surface to a uniform, smooth, granular texture. Slab surfaces shall receive a float finish. Provide additional trowel finishing as required in this Section.
2. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over the surface.
3. Consolidate concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten-foot straightedge. Grind smooth surface defects that would telegraph through applied floor covering system.
4. Use trowel finish for the following:
 - a. Interior exposed slabs, unless otherwise shown or indicated.
 - b. Apply non-slip broom finish, after troweling, to exterior concrete slab and elsewhere as shown.

B. Apply chemical floor hardener to exposed interior concrete floor areas when cured and dry, in accordance with hardener manufacturer's instructions.

C. Formed Finish:

1. Provide smooth form concrete finish at exposed surfaces. Use largest practical form panel sizes to minimize form joints. Exposed surfaces include interior water-contacting surfaces of tanks, whether or not directly visible. All surfaces shall be considered as exposed, unless buried or covered with permanent structural or architectural material. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/8-inch in height. Where surface will be coated or will receive further treatment, remove all fins flush with concrete surface.
2. Provide rough form finish at all unexposed surfaces. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/2-inch in height.

3.8 GROUT PLACING

A. Place grout as shown and indicated, and in accordance with grout manufacturer's instructions and recommendations. If grout manufacturer's instructions conflict with

- the Contract Documents, notify ENGINEER and not proceed until obtaining ENGINEER's clarification.
- B. Dry-packing is not allowed, unless otherwise indicated.
 - C. Manufacturers of proprietary grout materials shall make available upon 72 hours notice the services of qualified, full-time, factory-trained employee to aid in ensuring proper use of grout materials at the Site.
 - D. Placing grout shall comply with temperature and weather limitations described in Article 3.4 of this Section.

3.9 FIELD QUALITY CONTROL

- A. Site Testing Services:
 - 1. CONTRACTOR shall employ independent testing laboratory to perform field quality control testing for concrete. ENGINEER will direct where samples are obtained.
 - 2. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.
 - 3. CONTRACTOR shall provide curing and necessary cylinder storage.
- B. Quality Control Testing During Construction:
 - 1. Perform sampling and testing for field quality control during concrete placing, as follows:
 - a. Sampling Fresh Concrete: ASTM C172.
 - b. Slump: ASTM C143/C143M; one test for each concrete load at point of discharge.
 - c. Concrete Temperature: ASTM C1064/C1064M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.
 - d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.
 - e. Unit Weight: ASTM C138/C138M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
 - f. Compression Test Specimens:
 - 1) In accordance with ASTM C31/C31M, make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by ENGINEER.
 - 2) Cast, store, and cure specimens in accordance with ASTM C31/C31M.
 - g. Compressive Strength Tests:
 - 1) In accordance with ASTM C39/C39M; one specimen tested at seven days, and three specimens tested at 28 days.

- 2) Concrete that does not comply with strength requirements will be considered as defective Work.
- h. Submit test results from certified by testing laboratory to ENGINEER within 24 hours of completion of test.
- i. When there is evidence that strength of in-place concrete does not comply with the Contract Documents, CONTRACTOR shall employ the services of concrete testing laboratory to obtain cores from hardened concrete for compressive strength determination. Cores and tests shall comply with ASTM C42/C42M and the following:
 - 1) Testing of Adhesive Dowels: OWNER will employ testing agency to perform field quality control testing of drilled dowel installations. After adhesive system manufacturer's recommended curing period and prior to placing connecting reinforcing, proof-test for pullout ten percent of adhesive dowels installed. Adhesive dowels shall be tensioned to 60 percent of specified yield strength. Where dowels are located less than six bar diameters from edge of concrete, ENGINEER will determine tensile load required for test. If one or more dowels fail, retest all dowels installed for the Work. Dowels that fail shall be reinstalled and retested at CONTRACTOR's expense.

+ + END OF SECTION + +

SECTION 05 05 33

ANCHOR SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all professional services, labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install anchor systems.
 - 2. This Section includes all anchor systems required for the Work, but not specified under other Sections.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before anchor systems Work.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ACI 318, Building Code Requirements for Structural Concrete.
 - 2. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.
 - 3. ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
 - 4. ANSI B212.15, Cutting Tools - Carbide-tipped Masonry Drills And Blanks For Carbide-tipped Masonry Drills.
 - 5. ANSI/MSS SP-58, Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.
 - 6. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - 7. ASTM A276, Specification for Stainless Steel Bars and Shapes.
 - 8. ASTM A493, Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
 - 9. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
 - 10. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - 11. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - 12. ASTM C307, Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.

13. ASTM C881/C881M, Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
14. ASTM D695, Test Method for Compressive Properties of Rigid Plastics.
15. ASTM D790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
16. ASTM E329, Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
17. ASTM E488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.
18. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
19. ASTM F594, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
20. ASTM F1554, Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
21. FS A-A-1922A, Shield, Expansion (Caulking Anchors, Single Lead).
22. FS A-A-1923A, Concrete Expansion Anchors.
23. FS A-A-1925A, Shield, Expansion (Nail Anchors).
24. FS A-A-55614, Shield, Expansion (non-drilling expansion anchors).
25. ICC-ES AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
26. ICC-ES AC58, Acceptance Criteria for Adhesive Anchors in Masonry Elements.
27. ICC-ES AC60, Acceptance Criteria for Anchors in Unreinforced Masonry Elements.
28. ICC-ES AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
29. ICC-ES AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
30. ISO 3506-1, Mechanical Properties of Corrosion-Resistant Stainless Steel Fasteners -- Part 1: Bolts, Screws and Studs.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Testing Laboratory: Shall comply with ASTM E329 and shall be experienced in tension testing of post-installed anchoring systems.
2. Professional Engineer:
 - a. CONTRACTOR or delegated system manufacturer shall retain a registered professional engineer legally qualified to practice in the same state as the Site.
 - b. Responsibilities include:
 - 1) Reviewing anchor system performance and design criteria stated in the Contract Documents.
 - 2) Preparing written requests for clarifications or interpretations of

- performance or design criteria for submittal to ENGINEER by CONTRACTOR.
- 3) Preparing or supervising preparation of design calculations and related Shop Drawings.
 - 4) Signing and sealing all design calculations and Shop Drawings.
 - 5) Certifying that:
 - a) Design of anchor systems has been performed in accordance with performance and design criteria stated in the Contract Documents, and
 - b) Design conforms to all applicable local, state, and federal Laws and Regulations, and to prevailing standards of practice.
4. Post-installed Anchor Installer:
- a. Mechanical and Adhesive anchors, except as noted in 1.3.A.4.b: Installer shall be experienced and trained by post-installed anchor system manufacturer in proper installation of manufacturer's products. Product installation training by distributors or manufacturer's representatives is unacceptable unless the person furnishing the training is qualified as a trainer by the anchor manufacturer.
 - b. Adhesive Anchors: Installation of horizontal or vertically inclined adhesive anchors shall be performed by personnel certified under an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Anchors Installer Certification Program, or equivalent. Description of equivalent programs shall be submitted for ENGINEER's approval and acceptance by the building official having jurisdiction.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Listing of all anchor systems products intended for use in the Work including product type, intended location in the Project, and embedded lengths.
 2. Product Data:
 - a. Manufacturer's specifications, load tables, dimension diagrams, acceptable base material conditions, acceptable drilling methods, and acceptable bored hole conditions.
 - b. Copies of valid ICC ES reports that presents load-carrying capacities and installation requirements for anchor systems.
- B. Delegated Design Submittals:
1. Design Data: Submit the following:
 - a. Design Calculations for delegated anchor systems. Structural calculations shall include all specified performance criteria. The magnitude of delegated system/anchorage reactions to supporting

structure shall be clearly noted. Design calculations shall be signed, sealed and dated by CONTRACTOR's professional engineer registered in the state of Georgia.

C. Informational Submittals: Submit the following:

1. Certificates:
 - a. For each type of anchor bolt or threaded rod, submit copies of laboratory test reports and other data required to demonstrate compliance with the Contract Documents.
 - 1) Reports shall demonstrate compliance with ductile steel element definition of ACI 350, Appendix D, or ACI 318 Chapter 17.
 - b. Post-installed anchor system manufacturer's certification that installer received training in the proper installation of manufacturer's products required for the Work.
 - c. For each required adhesive anchor installer, submit ACI/CRSI Adhesive Anchor Installer Certification.
2. Manufacturer's Instructions:
 - a. Installation instructions for each anchor system product proposed for use, including bore hole cleaning procedures and adhesive injection, cure and gel time tables, and temperature ranges (storage, installation and in-service).
3. Field Quality Control Submittals:
 - a. Submit results of field quality control testing and inspections performed by testing laboratory.

1.5 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:

1. Keep materials dry during delivery and storage.
2. Store adhesive materials within manufacturer's recommended storage temperature range.
3. Protect anchor systems from damage at the Site. Protect products from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. General:

1. At locations where conditions dictate that Work specified in other Sections is to be of corrosion resistant materials, provide associated anchor systems of stainless-steel materials, unless other corrosion-resistant anchor system material is specified. Provide anchor systems of stainless-steel materials where stainless steel materials are required in the Contract Documents.
2. Stainless Steel Nuts:

- a. For anchor bolts and adhesive anchors, provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts for stainless steel anchors used for anchoring equipment, gates, and weirs, and other locations, if any, where the attachment will require future removal for operation or maintenance. Provide lock washer or double nuts on each anchorage device provided for equipment, as required by equipment manufacturer.
- b. For other locations, provide for each anchorage device a nut as specified or as required by anchor manufacturer. When ASTM A194/A194M, Grade 8S (Nitronic 60) nuts are not required for anchor bolts and adhesive anchors as specified in this Section, provide anti-seizing compound where stainless steel rods are used with stainless steel nuts of the same type.

B. Design Criteria

1. Size, Length, and Load-carrying Capacity: Comply with the Contract Documents. When size, length or load-carrying capacity of anchor system is not otherwise shown or indicated, provide the following:
 - a. Anchor Bolts: Provide size, length, and capacity required to carry design load based on values and requirements of Paragraph 3.2.A of this Section. For conditions outside limits of critical edge distance and spacing in Paragraph 3.2.A of this Section, minimum anchor bolt embedment as shown or indicated in Paragraph 3.2.A of this Section apply and capacity shall be based on requirements of Laws and Regulations, including applicable building codes.
 - b. Adhesive Anchors, Expansion Anchors, or Concrete Inserts: Provide size, length, type, and capacity required to carry design load. Anchor capacity shall be based on the procedures required by the building code in effect at the Site. Where Evaluation Service Reports issued by the ICC Evaluation Service are required in this Section, anchor capacities shall be based on design procedure required in the applicable ICC Evaluation Service Report.
 - 1) General: Determine capacity considering reductions due to installation and inspection procedures, embedment length, strength of base fastening materials, spacing, and edge distance, as indicated in the manufacturer's design guidelines. For capacity determination, concrete shall be assumed to be in the cracked condition, unless calculations demonstrate that the anchor system will be installed in an area that is not expected to crack under any and all conditions of design loading.
 - 2) Concrete Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of the greater of the following: required to develop tensile strength of anchor, or a minimum

- embedment of 10 anchor diameters; and minimum anchor spacing and edge distance of 12 anchor diameters.
 - 3) Concrete Masonry Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.
 - 4) Concrete Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of six anchor diameters, and minimum anchor spacing and edge distance of seven anchor diameters.
 - 5) Concrete Masonry Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.
 - 6) Concrete Undercut Anchors: Unless otherwise shown or indicated in the Contract Documents, or approved by ENGINEER, provide minimum anchor spacing and edge distance as tabulated in anchor manufacturer's instructions.
2. Delegated Design: When anchor systems are used for supporting materials, equipment, or systems delegated to CONTRACTOR, Subcontractor, or Supplier, provide anchor system suitable for loads indicated in delegated design documents and consistent with the design intent expressed in the Contract Documents. Anchor system shall be designed by a professional engineer, retained by CONTRACTOR, Subcontractor, or Supplier, registered in the same state as the Site, with proper consideration of concrete strength, spacing and edge distance.
- a. Design Loads. Comply with the Contract Documents. When design load of supported material, equipment, or system is not otherwise shown or indicated, provide the following:
 - 1) Equipment Anchors: Use design load recommended by equipment manufacturer. When equipment can be filled with fluid, use loads that incorporate equipment load and load imposed by fluid.
 - 2) Pipe Hangers and Supports: Use full weight of pipe, and fluid contained in pipe that are tributary to the support plus the full weight of valves and accessories located between the hanger or support being anchored and the next hanger or support.
 - 3) Hangers and Supports for Electrical Systems, and HVAC, Plumbing, and Fire Suppression Systems and Piping: Use the full weight of supported system that is tributary to the support plus the full weight of accessories located between the hanger or support being anchored and the next hanger or support. When piping or equipment is to be filled with fluid, anchor systems shall be sized to support such loads in addition to the weight of the equipment, piping, or system, as applicable.

C. Application:

1. Anchor Bolts:
 - a. Where anchor bolt is shown or indicated, use cast-in-place anchor bolt unless another anchor type is approved by ENGINEER.
 - b. Provide anchor bolts as shown or indicated, or as required to secure structural element to appropriate anchor surface.
2. Concrete Adhesive Anchors:
 - a. Use where adhesive anchors are shown or indicated for installation in concrete.
 - b. Suitable for use where subject to vibration.
 - c. Suitable for use in exterior locations or locations subject to freezing.
 - d. Suitable for use in submerged, intermittently submerged, or buried locations.
 - e. Do not use in overhead applications, unless otherwise shown or approved by ENGINEER.
 - f. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.
3. Concrete Masonry Adhesive Anchors:
 - a. Use where adhesive anchors are shown or indicated for installation in grout-filled or hollow masonry units.
 - b. Suitable for use where subject to vibration.
 - c. Suitable for use in exterior locations or locations subject to freezing.
 - d. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.
4. Concrete Wedge Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation in concrete.
 - b. Do not use where subject to vibration.
 - c. Do not use in exterior locations or locations subject to freezing.
 - d. Do not use in submerged, intermittently submerged, or buried locations.
 - e. Suitable for use in overhead applications.
5. Grout-filled Concrete Masonry Wedge Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation on the interior face of grout-filled unit masonry.
 - b. Do not use where subject to vibration.
 - c. Do not use in exterior locations or locations subject to freezing.
6. Hollow Concrete Masonry Sleeve Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation in hollow concrete unit masonry or solid brick.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use where subject to vibration.
 - d. Do not use in exterior locations or locations subject to freezing.

7. Drop-in Expansion Anchors:
 - a. Use drop-in expansion anchors installed in concrete where light-duty anchors are required to support piping or conduit two-inch diameter or smaller.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use where subject to vibration.
 - d. Do not use at submerged, intermittently submerged, or buried locations.
 - e. Do not use in exterior locations or locations subject to freezing.
 - f. Suitable for use in overhead applications.
8. Concrete Undercut Anchors:
 - a. Use where undercut anchors are shown or indicated for installation in concrete.
 - b. Suitable for use where subject to vibration.
 - c. Do not use in submerged, intermittently submerged, or buried locations.
 - d. Do not use in exterior locations or locations subject to freezing.
 - e. Suitable for use in overhead applications.
9. Concrete Inserts:
 - a. Use only where shown or indicated in the Contract Documents.
 - b. Allowed for use to support pipe hangers and pipe supports for pipe size and loading recommended by the concrete insert manufacturer.
10. Drive-In Expansion Anchors:
 - a. Use drive-in expansion anchors installed in concrete, precast concrete, grouted masonry units, or brick, where light-duty anchors are required to support piping or conduit one-inch diameter and smaller.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use in overhead applications.
11. For Use in Precast Concrete Planks:
 - a. To support piping or conduit two-inch diameter and smaller, use low-profile drop-in anchors, hollow concrete masonry adhesive anchors, or through-bolts.
 - b. For piping greater than two-inch diameter, or to support safety-related systems, use through-bolts. Each through-bolt shall consist of threaded rod, nuts, washers, and bearing plate.

2.2 MATERIALS

A. Anchor Bolts:

1. Interior Dry Non-corrosive Locations: Provide straight threaded carbon steel rods complying with ASTM F1554, Grade 36, with heavy hex nuts complying with ASTM A563 Grade A, unless otherwise shown or indicated on the Drawings. Hooked anchor bolts are unacceptable.
 2. Exterior, Buried, Submerged Locations, or When Exposed to Wastewater: Provide stainless steel straight threaded rods complying with ASTM F593, AISI Type 316, Condition A, with ASTM F594, AISI Type 316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required. Other AISI types may be used when approved by ENGINEER. Hooked bolts are unacceptable.
 - a. Stainless steel straight threaded rod shall comply with ductility requirements of ACI 350 Appendix D or ACI 318 Chapter 17.
 3. Equipment: Provide anchor bolts complying with material requirements of this Section and equipment manufacturer's requirements relative to size, embedment length, and anchor bolt projection. Anchor bolts shall be straight threaded rods with washers and nuts as specified in this Section. Hooked bolts are unacceptable.
 4. Anchoring of Structural Elements: Provide anchor bolts of size, material, and strength shown or indicated in the Contract Documents.
- B. Concrete Adhesive Anchors:
1. General:
 - a. Adhesive anchors shall consist of threaded rods anchored into hardened concrete using an adhesive system.
 2. Products and Manufacturers: Provide one of the following:
 - a. HIT-RE 500-V3 Injection Epoxy Adhesive Anchoring System, by Hilti Fastening Systems, Inc.
 - b. HIT-HY 200-A and HIT-HY 200-R Adhesive Anchoring System, by Hilti Fastening Systems, Inc
 - c. SET-XP Adhesive anchoring system, by Simpson Strong-Tie Company, Inc.
 - d. Or approved equal.
 3. Adhesive:
 - a. Adhesive system shall use two-component adhesive mix.
 - b. Epoxy adhesives shall comply with physical requirements of ASTM C881/C881M, Type IV, Grade 2 and 3, class A, B and C, except gel times.
 - b. Adhesives shall have a current evaluation report by ICC Evaluation Service for use in both cracked and uncracked concrete with seismic recognition for SDC A through F as tested and assessed in accordance with ICC-ES AC308, which incorporates the requirements of ACI 355.4-11
 4. Anchor:
 - a. Provide continuously-threaded, AISI Type 316 stainless steel adhesive anchor rod. Threaded rods shall comply with the concrete adhesive

anchor manufacturer's specifications as included in the ICC Service Evaluation Report for the anchor submitted. Nuts shall have specified proof load stresses equal to or greater than the minimum tensile strength of the stainless steel threaded rod used. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

- b. Stainless steel threaded rod shall comply with ductility requirements of ACI 350 Appendix D or ACI 318 Chapter 17.

C. Concrete Masonry Adhesive Anchors:

- 1. General:
 - a. Grout-filled concrete masonry adhesive anchors shall consist of threaded rods anchored into grout-filled concrete block masonry using an adhesive system.
 - b. Hollow concrete masonry adhesive anchors shall consist of threaded rods with a cylindrical mesh steel or plastic screen tube anchored into hollow concrete block masonry using an adhesive system.
- 2. Products and Manufacturers: Provide one of the following:
 - a. HIT-HY 270 Hybrid Adhesive Anchor System, by Hilti Fastening Systems, Inc.
 - b. Acrylic-Tie Adhesive, by Simpson Strong-Tie Company, Inc.
 - c. Or approved equal.
- 3. Adhesive:
 - a. Adhesive system shall use two-component adhesive mix.
 - b. Adhesives shall have current ICC Evaluation Service Report for use in grout-filled concrete masonry, tested and assessed in accordance with ICC-ES AC 58 and ICC-ES AC 60.
- 4. Anchor:
 - a. Provide stainless steel adhesive anchor rod complying with ASTM F593, AISI Type 316, Condition CW, with ASTM F594, AISI Type 316 stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.
- 5. Mesh Screen Tube (for hollow masonry applications):
 - a. Provide with mesh size, length, and diameter as specified by adhesive anchor manufacturer.

D. Concrete Wedge Expansion Anchors:

- 1. General:
 - a. Concrete wedge expansion anchors shall consist of stud, wedge, nut, and washer.
- 2. Products and Manufacturers: Provide one of the following:
 - a. Kwik Bolt TZ Wedge Anchor, by Hilti Fastening Systems, Inc.
 - b. Strong Bolt 2 Wedge Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or approved equal.

3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4. Provide concrete wedge expansion anchors suitable for use in cracked and uncracked concrete in accordance with ACI 318 Chapter 17 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete wedge anchors in accordance with ACI 355.2 prequalification tests.
 4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 5. Other Locations: Provide expansion anchors complete with nuts and washers, AISI Type 316 stainless steel anchor body, in accordance with ASTM A276 or ASTM A493.
 6. Anchor shall comply with ductility requirements of ACI 350 Appendix D or ACI 318 Chapter 17.
 7. Concrete wedge expansion anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete with seismic recognition in seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.
- E. Grout-filled Masonry Wedge Expansion Anchors:
1. General:
 - a. Grout-filled masonry wedge expansion anchors shall each consist of stud, wedge, nut, and washer.
 2. Product and Manufacturers: Provide one of the following:
 - a. Kwik-Bolt 3 Expansion Anchors, by Hilti Fastening Systems, Inc.
 - b. Wedge-All Wedge Anchors, by Simpson Strong-Tie Company, Inc.
 - c. Or approved equal.
 3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4. Anchors shall be non-bottom bearing type with single-piece steel expansion clip providing 360-degree contact with base material and shall not require oversized holes for installation.
 4. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 5. Grout-filled masonry wedge expansion anchors shall have a current ICC Evaluation Service report for use in fully-grouted concrete masonry construction when tested and assessed in accordance with ICC-ES AC01.
- F. Hollow Concrete Masonry Sleeve Expansion Anchors:
1. General:
 - a. Sleeve expansion anchors shall each consist of an externally threaded stud with full length expanding sleeve.
 2. Products and Manufacturers: Provide one of the following:
 - a. HLC Sleeve Anchors, by Hilti Fastening Systems, Inc.
 - b. Dynabolt Sleeve Anchors, by ITW Red Head.
 - c. Or approved equal.

3. Anchors shall comply with physical requirements of FS A-A-1922A. Anchors shall be non-bottom bearing type with single-piece steel expansion sleeve providing 360-degree contact with base material, and shall not require oversized holes for installation.
 4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 5. Other Locations: Provide expansion anchors complete with nuts and washers, Type 316 stainless steel, in accordance with ASTM A276 or ASTM A493.
- G. Drop-in Expansion Anchors:
1. General:
 - a. Drop-in expansion anchors shall each consist of an internally threaded, deformation-controlled expansion anchor with pre-assembled expander plug.
 2. Products and Manufacturers: Provide one of the following:
 - a. HDI Drop-In Anchors, by Hilti Fastening Systems, Inc.
 - b. Drop-In Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or approved equal.
 3. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633, complying with physical requirements of FS A-A-55614, Type I. Anchors shall be flush or shell type. Provide low-profile anchors for use in precast concrete planks.
- H. Concrete Undercut Anchors:
1. General:
 - a. Each concrete undercut anchor shall consist of threaded stud, thick-walled expansion sleeve, expander coupler, and nut and washer. Anchors shall be pre-set type or through-set type, as shown on the Drawings.
 2. Products and Manufacturers: Provide one of the following:
 - a. HDA Undercut Anchor, by Hilti Fastening Systems, Inc.
 - b. DUC Ductile Undercut Anchor, by USP Structural Connectors.
 - c. Or equal.
 3. Provide concrete undercut expansion anchors in accordance with ACI 318 Chapter 17 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete undercut anchors in accordance with ACI 355.2 prequalification tests.
 - a. Anchor shall comply with ductility requirements of ACI 350 Appendix D or ACI 318 Chapter 17.
 4. Installed anchor shall exhibit form fit between bearing elements and the undercut in the concrete.

5. Interior Dry Non-Corrosive Locations: Provide carbon steel anchors, complete with nuts and washers, zinc plated, in accordance with ASTM B633.
6. Other Locations: Provide stainless steel anchors, complete with nuts and washers, manufactured of AISI Type 316 stainless steel or materials complying with ISO 3506-1 and having corrosion resistance equivalent to AISI Type 316 stainless steel.
7. Concrete undercut anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete for seismic recognition for seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.

I. Concrete Inserts:

1. Manufacturers: Provide products of one of the following:
 - a. Unistrut Corporation.
 - b. Cooper B-Line, Inc.
 - c. Anvil International, Inc.
 - d. Or approved equal.
2. Spot Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall comply with ANSI/MSS SP-58, malleable iron, Type 18. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Provide nuts compatible with insert and to suit threaded hanger rod sizes.
3. Continuous Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall be continuous type and shall be manufactured from minimum 12-gage cold-formed channel sections, complying with ASTM A1011/A1011M, stainless steel, Grade 33, complete with styrofoam inserts, end caps, and means for attaching to forms. Provide channel nuts compatible with insert suitable for threaded hanger rod sizes.
4. Provide inserts with plain finish.

J. Drive-In Expansion Anchors:

1. General:
 - a. Drive-In expansion anchors shall each consist of stainless steel drive pin and expanding alloy body.
2. Products and Manufacturers: Provide one of the following:
 - a. Metal HIT Anchor, by Hilti Fastening Systems, Inc.
 - b. Zinc Nailon Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
3. Provide Type 316 stainless steel drive pin with zinc alloy body. Anchor shall comply with physical requirements of FS A-A-1925A, Type 1.

- K. Unless approved by ENGINEER, do not use power-actuated fasteners or other types of bolts and fasteners not specified in this Section.
- L. Anti-Seizing Compound:
 - 1. Products and Manufacturers: Provide one of the following:
 - a. Pure Nickel Never-Seez, by Bostik.
 - b. Nickel-Graf, by Anti-Seize Technology.
 - c. Or approved equal.
 - 2. Provide pure nickel anti-seizing compound.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials will be installed and advise ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Anchor Bolts:
 - 1. Provide anchor bolts as shown or indicated in the Contract Documents, or as required to secure structural element to the appropriate anchor surface.
 - 2. Locate and accurately set anchor bolts using templates or other devices as required, prior to placing concrete. Wet setting of anchor bolts is unacceptable.
 - 3. Protect threads and shank from damage during installation and subsequent construction operations.
 - 4. Unless otherwise shown or approved by ENGINEER anchor bolts shall comply with Table 05 05 33-B:
- B. Adhesive Anchors, Undercut Anchors, and Expansion Anchors – General:
 - 1. Prior to drilling, locate existing reinforcing steel in vicinity of proposed holes. If reinforcing conflicts with proposed hole location, obtain ENGINEER's approval of alternate hole locations to avoid drilling through or damaging existing reinforcing bars.
- C. Adhesive Anchors:
 - 1. Installation conditions shall comply with all requirements of the approved product Evaluation Service Report (ESR), including "Conditions of Use." Comply with manufacturer's written installation instructions and the following.
 - 2. Drill holes to adhesive system manufacturer's recommended drill bit

diameter to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits that comply with the tolerances of ANSI B212.15. Core-drilled holes are unacceptable.

3. Before setting adhesive anchor, hole shall be made free of dust and debris by method recommended by adhesive anchor system manufacturer. Hole shall be brushed with adhesive system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
4. Before injecting adhesive, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
5. Prior to injecting adhesive into the drilled hole, dispense, to a location appropriate for such waste, an initial amount of adhesive from the mixing nozzle, until adhesive is uniform color.
6. Inject adhesive into hole through injection system-mixing nozzle and necessary extension tubes, placed to bottom of hole. Discharge end shall be withdrawn as adhesive is placed but kept immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during anchor placement.
7. Twist anchors during insertion into partially-filled hole to guarantee full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.
8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining Work that could place load on installed adhesive anchors. Do not begin adjoining Work until adhesive anchors are successfully tested or when allowed by ENGINEER.
9. Limitations:
 - a. Core drilled holes shall not be allowed.
 - b. At time of anchor installation, concrete shall have compressive strength (f'c) of not less than 3,000 psi.
 - b. At time of anchor installation, concrete shall have age of not less than 21 days.
 - c. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with anchor systems manufacturer's requirements during installation and curing of adhesive anchor system.
 - d. Oversized Holes: Advise ENGINEER immediately if size of drilled hole is larger than recommended by anchor system manufacturer. Cost of corrective measures, including but not limited to redesign of anchors due to decreased anchor capacities, shall be paid by CONTRACTOR.

- e. Embedment depths shall be based on installation in normal-weight concrete with compressive strength of 3,000 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.
- f. Obstructions in drill path: When existing reinforcing steel is encountered during drilling, stop and do not damage existing reinforcing. Obtain ENGINEER approval for any required modifications.

D. Expansion Anchors:

- 1. Comply with expansion anchor manufacturer's written installation instructions and the following:
- 2. Drill holes using anchor system manufacturer's recommended drill bit diameter and to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances of ANSI B212.15. Core drilled holes are unacceptable.
- 3. Before installing anchor, hole shall be made free of dust and debris by method recommended by anchor system manufacturer. Hole shall be brushed with anchor system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
- 4. Before installing anchor, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
- 5. Protect threads from damage during anchor installation. Drive anchors not less than four threads below surface of the attachment. Set anchors to anchor manufacturer's recommended torque using a torque wrench.
- 6. Limitations:
 - a. At time of anchor installation, concrete shall have age of not less than 7 days.
 - b. At time of anchor loading, concrete shall have attained full specified compressive strength (f'c).

E. Concrete Undercut Anchors:

- 1. Comply with undercut anchor manufacturer's written installation instructions and the following.
- 2. Protect threads from damage during anchor installation.
- 3. Drill hole to anchor manufacturer's specified depth and diameter using a drill bit matched to the specific anchor.
- 4. Before setting the undercut anchor, hole shall be free of dust and debris using method recommended by undercut anchor system manufacturer. Hole shall be blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
- 5. Insert the anchor by hand until anchor reaches bottom of hole.
- 6. Set anchor in accordance with manufacturer's instructions using anchor manufacturer's specified setting tool.
- 7. Verify that the setting mark is visible on the threaded rod above the sleeve.

8. Anchor shall be set to manufacturer's recommended torque, using a torque wrench.
 9. Limitations:
 - a. At time of anchor installation, concrete shall have age of not less than 7 days.
 - b. At time of anchor loading, concrete shall have attained full specified compressive strength (f'_c).
- F. Concrete Inserts:
1. Comply with concrete insert manufacturer's installation instructions.
 2. Inserts shall be flush with slab bottom surface.
 3. Protect embedded items from damage during concrete placing. Ensure that embedded items are securely fastened to prevent movement during concrete placing, and ensure that embedded items do fill with concrete during concrete placing.
 4. Inserts intended for piping greater than four-inch diameter shall be provided with hooked rods attached to concrete reinforcing.
- G. Anti-Seizing Compound:
1. Provide anti-seizing compound in accordance with anti-seizing compound manufacturer's installation instructions, at locations indicated in Paragraph 2.1.B of this Section.
 2. Do not use anti-seizing compound at locations where anchor bolt or adhesive anchor will contact potable water or water that will be treated to become potable.

3.3 CLEANING

- A. After embedding concrete is placed, remove protection and clean bolts and inserts.

3.4 FIELD QUALITY CONTROL

- A. Site Tests:
1. Contractor shall furnish services of independent testing laboratory to perform field quality tensile testing of production adhesive anchors at the Site, unless otherwise specified.
 - a. Testing shall comply with ASTM E488.
 - b. Test at least ten percent of all types of adhesive anchors. If one or more adhesive anchors fail the test, CONTRACTOR shall pay cost of testing all anchors of the same type installed in the Work. CONTRACTOR shall be responsible for retesting costs.
 - c. ENGINEER will direct which adhesive anchors are to be tested and indicate test load to be used
 - d. Apply test loads with hydraulic ram.

- e. Displacement of post-installed anchors shall not exceed $D/10$, where D is nominal diameter of anchor being tested.
 - 2. Mechanical Anchors:
 - a. Responsibility:
 - 1) Contractor shall furnish services of independent testing laboratory agency to perform field quality control tensile testing of mechanical anchors at the Site.
 - 2) CONTRACTOR shall demonstrate competence in installing mechanical anchors by performing field quality control tests.
 - b. Perform field quality control tests on test anchors at location directed by ENGINEER. Test anchors shall not be part of the finished Work.
 - c. Test not less than one installation of each type of mechanical anchor used in the Work.
 - 1) ENGINEER will indicate test loads to be used.
 - 2) Testing shall comply with ASTM E488.
 - 3) Apply test loads with hydraulic ram.
 - d. Anchors that fail to reach the specified test load shall be considered as not passing the test and shall be re-tested at no additional cost to OWNER.
 - e. Testing agency shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.
 - 3. Correct defective Work by removing and replacing or correcting, as directed by ENGINEER.
 - 4. CONTRACTOR shall pay for all corrections and subsequent testing required to confirm competence in the installation of post-installed mechanical anchors.
 - 5. Testing agency shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.
- B. Manufacturer's Services:
- 1. Provide at the Site services of qualified adhesive manufacturer's representative during initial installation of adhesive anchor systems to train CONTRACTOR's personnel in proper installation procedures. Manufacturer's representative shall observe to confirm that installer demonstrates proper installation procedures for adhesive anchors and adhesive material.

++ END OF SECTION ++

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install structural steel framing, including surface preparation and shop priming.
 - 2. Structural steel framing is the Work defined in AISC 303, Section 2, and as shown or indicated in the Contract Documents. The Work also includes:
 - a. Providing openings in and attachments to structural steel framing to accommodate the Work under this and other Sections, and providing for structural steel framing items such as anchorage devices, studs, and all items required for which provision is not specifically included under other Sections.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before structural steel framing Work.
- C. Related Sections:
 - 1. Section 03 00 05, Concrete.
 - 2. Section 05 05 33, Anchor Systems.
 - 3. Section 09 91 00, Painting.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. AISC 303, Code of Standard Practice for Steel Buildings and Bridges.
 - 2. AISC 325, Steel Construction Manual.
 - 3. AISC 360, Specification for Structural Steel Buildings.
 - 4. ASME B46.1, Surface Texture (Surface Roughness, Waviness and Lay).
 - 5. ASTM A6/A6M, Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 - 6. ASTM A36/A36M, Specification for Carbon Structural Steel.
 - 7. ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 8. ASTM A108, Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

9. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
10. ASTM A325, Specification for Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength.
11. ASTM A490, Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
12. ASTM A500/A500M, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
13. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
14. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
15. ASTM A992/A992M, Specification for Structural Steel Shapes.
16. ASTM E329, for Agencies Engaged in Construction Inspection, Special Inspection, or Testing Materials Used in Construction.
17. ASTM F436, Specification for Hardened Steel Washers.
18. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
19. ASTM F959, Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
20. ASTM F1852, Specification for "Twist off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
21. AWS D1.1/D1.1M, Structural Welding Code-Steel.
22. CMAA 74, Specifications for Top Running & Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist.
23. ISO 2859-1, Sampling Procedures for Inspection by Attributes -- Part 1: Sampling Schemes Indexed by Acceptance Quality Limit (AQL) for Lot-by-Lot Inspection.
24. ISO 4017, Hexagon Head Screws -- Product Grades A and B.
25. RCSC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Steel Fabricator:
 - a. Structural steel fabricating plant shall possess current certificate from AISC stating that the fabrication facility complies with requirements for certification of "Standard for Steel Building Structures (STD)" of AISC's quality certification program. Fabricating plant shall maintain this certification throughout time of fabrication for this Project.
2. Welders and Welding Processes:
 - a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, Section 5, Qualification.

- b. Each welder employed on or to be employed for the Work shall possess current AWS certification in the welding process with which welder will be working. Certifications shall be current and valid throughout the Work.
- 3. Surveyor:
 - a. Engage a registered professional land surveyor legally qualified to practice in the same jurisdiction as the Site, and experienced in providing surveying services of the kind indicated.
 - b. Responsibilities include but are not necessarily limited to:
 - 1) Performing or supervising performance of field survey work to check lines and elevations of concrete and masonry bearing surfaces, and locations of anchorage devices and similar devices, before steel erection proceeds.
 - 2) Notifying CONTRACTOR and ENGINEER in writing when surveyed Work does not comply with the Contract Documents.
 - 3) Submit to CONTRACTOR field survey reports.
- 4. Testing Laboratory:
 - a. CONTRACTOR shall retain the services of an independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials specified in this Section.
 - b. Laboratory shall comply with ASTM E329.
 - c. Testing laboratory shall be experienced in the types of testing required.
 - d. Welding inspection and welding inspector qualifications shall be in accordance with AWS D1.1/D1.1M
 - e. Selection of testing laboratory is subject to ENGINEER's acceptance

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Complete details and schedules for fabrication and shop assembly of members and details, schedules, procedures, and diagrams showing proposed sequence of erection. Shop Drawings shall not be reproductions of Contract Drawings.
 - b. Include complete information for fabrication of the structure's components, including but not limited to location, type, and size of bolts, details of blocks, copes and cuts, connections, camber, holes, member sizes and lengths, and other pertinent data. Clearly indicate welds using standard AWS notations and symbols, and clearly show or indicate size, length, and type of each weld.
 - c. Setting drawings, templates, and directions for installing anchorage devices.
 - d. Where not indicated on the drawings, steel member sizes, connections, and support systems shall be designed by CONTRACTOR's retained Professional Engineer registered in the state of Georgia.

CONTRACTOR shall submit signed and sealed drawings and calculations.

2. Product Data:
 - a. Manufacturer's specifications and installation instructions for products listed below.
 - 1) High-strength bolts of each type, including nuts and washers.
 - 2) Welding electrodes and rods.
 - 3) Load indicator bolts and washers.
 - b. Hollow structural section (HSS) cavity connector manufacturer specifications, load tables, dimension diagrams, and acceptable base material conditions. Clearly indicate allowable strength design safety factors when ultimate load carrying capacities are submitted for approval.
- B. Informational Submittals: Submit the following:
1. Certificates.
 - a. Fabricator's AISC quality certification.
 - b. Welders' certifications.
 - c. Certified reports of laboratory tests on previously-manufactured, identical materials, and other data as necessary, to demonstrate compliance with the Contract Documents for the materials listed below:
 - 1) Structural steel of each type, including certified mill reports indicating chemical and physical properties.
 - 2) High-strength bolts of each type, including nuts and washers.
 2. Supplier Instructions:
 - a. Installation data, handling, and storage instructions.
 3. Source Quality Control Submittals:
 - a. When performed or when required by ENGINEER, submit results of source quality control testing and inspections performed at the mill or shop.
 4. Field Quality Control Submittals:
 - a. Submit results of testing and inspection performed in the field by testing laboratory employed by CONTRACTOR.
 - b. Written field survey reports for all bearing surfaces surveyed, verifying tolerance requirements, areas out of tolerance, and corrective measures required.
 5. Qualifications Statements.
 - a. Land surveyor.
 - b. Testing laboratory.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage:

1. Protect steel members and packaged materials from corrosion and deterioration.
2. Do not store materials in or on the building or structure in manner that may cause distortion or damage to structural steel members, building, or supporting structures.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Steel Types:

1. W-Shapes and WT-Shapes: ASTM A992/A992M.
2. S-shapes and Channels: ASTM A572/A572M, Grade 50.
3. Hollow Structural Sections: ASTM A500/A500M, Grade B
4. Angles, Plates, and Bars: ASTM A36/A36M.
5. Steel Pipe: ASTM A53/A53M, Grade B.

B. Anchorages, Fasteners, and Connectors:

1. Anchorage Devices: Refer to Section 05 05 33, Anchor Systems.
2. Headed Stud Type Shear Connectors: ASTM A108, Grades 1010/1020, complying with AWS D1.1/D1.1M, Section 7.
3. High-Strength Threaded Fasteners: Heavy hexagonal structural bolts, heavy hexagon nuts, and hardened washers, as follows:
 - a. Unless otherwise indicated, fasteners shall be quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A325, Type I, nuts complying with ASTM A563C, A563DH or A194/A194M 2H, and hardened washers complying with ASTM F436. Bolts, nuts and washers shall be hot-dip galvanized where shown or indicated.
 - b. Tension control bolts, when used, shall comply with ASTM F1852.
 - c. Compressible washer-type direct-tension indicators, when used, shall comply with ASTM F959, Type 325.
4. Hollow Structural Section (HSS) Cavity Connectors: High-strength fastening system for hollow structural sections, as follows:
 - a. General:
 - 1) Each connector shall be hexagon-headed, expansion anchor for connecting structural steel tubes.
 - 2) Use hollow structural section cavity connectors only in the sizes and at locations shown or indicated in the Contract Documents.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Hollo-Bolt, by Lindapter International.
 - 2) BoxBolt, by Key Safety, Inc.
 - 3) Or approved equal.
 - c. Materials:

- 1) Body/shoulder and wedge manufactured from mild steel bars.
 - 2) Core bolt manufactured with high tensile steel ISO 4017.
 - 3) Finish: Hot-dip galvanized.
 - d. Test bolts at time of manufacture in accordance with ISO 2859-1. Do not ship bolts that do not successfully pass the test.
 4. Threaded Rod: Provide threaded rods with heavy hexagon nuts, and hardened washers, as follows:
 - a. Interior and Dry Locations: Provide threaded carbon steel rods complying with ASTM F1554 grade 36, with heavy hex nuts complying with ASTM A563A, unless otherwise shown or indicated on the Drawings.
 - b. Exterior, Buried, or Submerged Locations, or When Exposed to Wastewater: Provide stainless steel threaded rods complete with washers complying with ASTM F593, AISI Type 316, Condition A, with ASTM A194/A194M, Grade 8S (nitronic 60) stainless steel nuts. Other AISI types may be used when approved by ENGINEER.
- C. Electrodes for Welding: E70XX complying with AWS D1.1/D1.1M.

2.2 FABRICATION

- A. Shop Fabrication and Assembly:
1. General:
 - a. Fabricate and assemble structural assemblies in the shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC 325, the Contract Documents, and as shown on approved Shop Drawings. Provide camber in structural members as shown or indicated.
 - b. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize handling of materials for storage and minimize handling at the Site.
 - c. Where finishing is required, complete the assembly, including welding of units, before commencing finishing operations. Provide finish surfaces of members exposed-to-view in the completed Work that are free of markings, burrs, and other defects.
- B. Connections:
1. Shop Connections:
 - a. Unless otherwise shown or indicated, shop connections may be welded or high-strength bolted connections. Welds shall be 3/16-inch minimum.
 - b. Where reaction values of beam are not shown or indicated, connections shall be detailed to support one-half the total uniform load capacity tabulated in tables contained in AISC 325 for allowable loads

- on beams for the associated shape, span, and steel specified for the beam.
- c. Shop-welded connections shall be detailed to eliminate or minimize eccentricity in the connection.
- d. End-connection angles fastened to webs of beams and girders, and the thickness of angles, size, and extent of fasteners or shop welds, shall comply with tables of "Framed Beam Connections" in AISC 325. Connections shall be two-sided, unless otherwise shown or indicated.
- 2. Field Connections:
 - a. Field connections, unless otherwise shown or indicated, shall be made with high-strength bolts, and shall be bearing-type connections.
 - b. Use field welding only where shown or indicated or where approved by ENGINEER.
- 3. High-Strength Bolted Construction:
 - a. Provide high-strength threaded fasteners in accordance with RCSC Specifications for Structural Joints using ASTM A325 or ASTM A490 Bolts.
 - b. High-strength bolt design shear values shall be as specified in AISC 325 for bolts with threads in the shear plane for bearing type connections, or as specified in this Section for slip-critical connections.
 - c. Bolted connections shown or indicated as "SC" shall comply with slip-critical connection requirements in RCSC Specifications for Structural Joints Using ASTM A325 or ASTM A490 Bolts.
 - 1) Faying surfaces shall have a Class A surface condition.
 - 2) Slip-critical bolts shall be fully pre-tensioned to 70 percent of minimum specified tensile strength of the bolt using one of the following methods:
 - a) Turn of nut with matchmarking.
 - b) Twist-off tension control bolt (ASTM F1852).
 - c) Direct tension indicator washer (ASTM F959).
 - d. Minimum bolt diameter shall be 3/4-inch, unless otherwise shown or indicated.
- 4. Welded Construction: Comply with AWS D1.1/D1.1M for procedures, appearance, and quality of welds, and methods used in correcting defective welding Work.
- 5. Where rigid connections are required by stresses shown or indicated, provide web shear reinforcement and stiffeners in accordance with AISC 360.
- 6. Moment connections shown but not detailed on the Drawings shall be detailed for bending moments and shears indicated on the Drawings.

C. Bracing:

- 1. Bracing for which stress is not shown or indicated shall have minimum two-bolt connection, or shop-welded connection of equivalent strength.

2. Vertical bracing and knee braces connecting to columns shall be on the centerline of columns, unless otherwise shown or indicated.
 3. Knee braces shall be at 45-degree angle, unless otherwise shown or indicated.
 4. Gussets shall be not less than 3/8-inch thick, unless otherwise shown or indicated.
- D. Columns: Column shafts shall have finished bearing surface roughness not greater than 500 micro-inch in accordance with ASME B46.1, and ends shall be square within tolerances for milled ends in accordance with ASTM A6/A6M at the base and at splice lines.
- E. Structural Tubing: Properly seal structural tubing to protect internal surfaces.
- F. Holes and Appurtenances for Other Work:
1. Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on the approved Shop Drawings. If large block-outs are required and approved, reinforce the webs to develop specified shears. Provide threaded nuts welded to framing and other specialty items as shown or indicated to receive other work.
 2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.3 FINISHING

- A. Surface Preparation and Shop Priming: Structural steel shall be primed in the shop. For surface preparation and shop priming requirements refer to Section 09 91 00, Painting.

2.4 SOURCE QUALITY CONTROL

- A. Inspection and Testing at the Mill or Shop:
1. Perform fabricator's standard procedures for source quality control, including inspections and testing.
 2. Materials and fabrication procedures shall be subject to inspection and tests in mill and shop, conducted by a qualified inspection laboratory. Such inspections and tests do not relieve CONTRACTOR of responsibility for providing the Work in accordance with the Contract Documents.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which the Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 ERECTION

- A. General: Comply with AISC 303, AISC 360, and the Contract Documents.
- B. Checking of Lines and Elevations: Before proceeding with structural steel erection, furnish services of a qualified surveyor to check lines and elevations of concrete and masonry bearing surfaces, and locations of anchorage devices and similar devices. Immediately report discrepancies to ENGINEER. Do not proceed with erection until defective Work that will support structural steel is corrected, including agreeing with ENGINEER upon compensating adjustments (if any) to structural steel Work.
- C. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy-lines to achieve proper alignment of structures as erection proceeds.
- D. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete the Work. Provide sufficient planking to comply with Laws and Regulations, and provide tightly-planked substantial floor within two stories or 30 feet, whichever is less, below each tier of steel beams on which work is performed.
- E. Anchorage Devices:
 - 1. Provide anchorage devices, including anchor bolts, and other connectors required for securing structural steel to foundations and other in-place construction.
 - 2. Provide templates and other devices necessary for presetting anchorage devices to accurate locations.
 - 3. Refer to Section 05 05 33, Anchor Systems, for anchorage requirements.
- F. Setting Bases and Bearing Plates:
 - 1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
 - 2. Set loose and attached base plates and bearing plates for structural members on steel wedges or other adjusting devices.

3. Tighten anchorage devices after supported members are positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 4. Place grout between bearing surfaces and bases or plates in accordance with Section 03 00 05, Concrete. Finish exposed surfaces, protect installed materials, and allow to cure in accordance with grout manufacturer's instructions, and as otherwise required.
 5. Do not use leveling plates or wood wedges.
- G. Field Assembly:
1. Set structural frames accurately to the lines and elevations shown and indicated. Align and adjust the various members forming part of a complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 2. Level and plumb individual members of structure within tolerances as specified in AISC 325. For members requiring accurate alignment, provide clip angles, lintels, and other members, with slotted holes for horizontal adjustment at least 3/8-inch in each direction, or more when required.
 3. Splice members only where shown or indicated.
- H. Erection Bolts: On exposed-to-view, welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.
- I. Connections:
1. Comply with AISC 325 for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.
 2. Do not enlarge inadequate holes in members by burning or by using drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
 3. Hollow Structural Section Cavity Connectors:
 - a. Comply with manufacturer's written installation instructions and the following.
 - b. Cavity Connectors shall be torqued in accordance with manufacturer's instructions.
- J. Gas Cutting: Do not use gas-cutting torches for correcting fabrication defects in structural framing. Cutting will be allowed only on secondary members that are not under stress, as approved by ENGINEER. Finish gas-cut sections equal to a sheared appearance, when allowed.
- K. Crane Runways:
1. Provide crane stops and other required items. Set runway girders straight and level, and to tolerances specified in CMAA 74.

- L. Touch-up Painting:
 - 1. Unless otherwise specified, comply with touch-up painting requirements in Section 09 91 00, Painting.
 - 2. Immediately after erection, clean field welds, bolted connections, and damaged or abraded areas of shop-applied paint. Apply paint to exposed areas with the same paint or coating material applied in the shop. Apply by brush or spray to provide not less than the dry film thickness specified in Section 09 91 00, Painting.

3.3 FIELD QUALITY CONTROL

- A. Site Tests and Inspections: Materials and erection procedures shall be subject to inspection and tests at the Site conducted by qualified inspection laboratory. Such inspections and tests do not relieve CONTRACTOR of responsibility for providing the Work in accordance with the Contract Documents.
 - 1. CONTRACTOR will engage independent testing and inspection laboratory to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.
 - a. Testing laboratory shall conduct and interpret tests, prepare and state in each report of results whether test specimens comply with the Contract Documents and specifically indicate all deviations.
 - b. High-strength Bolted Connections: Each high-strength bolted connection shall be visually inspected. Inspection shall identify whether the Work complies with Sections 2, 3, and 8 of RCSC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 - 1) For connections that are slip-critical or subject to axial tension, inspector shall verify proper pre-tensioning.
 - 2) For connections that are not slip critical and not subject to direct tension, bolt does not need to be inspected for bolt tension, but shall be visually inspected to verify that plies of connected elements are in snug contact.
 - 3) Where bolts or connections are defective, correct defective workmanship, remove and replace, or correct as required defective bolts and connections. CONTRACTOR shall pay for correcting defective Work and tests required to confirm integrity of corrected Work.
 - c. Welds: Each weld shall be visually inspected.
 - 1) Where visually defective welds are evident, further test welds using non-destructive methods. If welds are determined to be acceptable, OWNER will pay for non-destructive testing. When welds are defective, CONTRACTOR shall pay for non-destructive testing.
 - 2) Correct, or remove and replace, defective Work as directed by ENGINEER.

- 3) CONTRACTOR shall pay for corrections and subsequent tests required to determine weld compliance with the Contract Documents.

+ + END OF SECTION + +

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish miscellaneous metal fabrications including surface preparation and shop priming.
 - 2. The Work also includes:
 - a. Providing openings in miscellaneous metal fabrications to accommodate the Work under this and other Sections and attaching to miscellaneous metal fabrications all items such as sleeves, bands, studs, fasteners, and all items required for which provision is not specifically included under other Sections.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the Work to be installed with or attached to miscellaneous metal fabrications Work.
 - 2. Hot-dip Galvanizing: Coordinate with steel fabricator detailing for and fabrication of assemblies to be hot-dip galvanized, to minimize distortion during galvanizing process.
- C. Related Sections:
 - 1. Section 03 00 05, Concrete.
 - 2. Section 05 05 33, Anchor Systems.
 - 3. Section 05 52 15, Aluminum Handrails and Railings.
 - 4. Section 05 53 16, Aluminum Grating.
 - 5. Section 09 91 00, Painting,

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ANSI A14.3, Ladders – Fixed –Safety Requirements.
 - 2. ANSI Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems, and Components.
 - 3. ASTM A36/A36M, Specification for Carbon Structural Steel.
 - 4. ASTM A53/A53M, Specification for Pipe Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.w

5. ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
6. ASTM A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
7. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
8. ASTM A320/A320M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
9. ASTM A384/A384M-02 Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
10. ASTM A500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
11. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
12. ASTM A793, Specification for Rolled Floor Plate, Stainless Steel.
13. ASTM A992/A992M, Specification for Structural Steel Shapes.
14. ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
15. ASTM B211, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.
16. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
17. ASTM B308/B308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
18. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
19. ASTM B632/B632M, Specification for Aluminum-Alloy Rolled Tread Plate.
20. AWS D1.1/D1.1M, Structural Welding Code – Steel.
21. AWS D1.2/D1.2M, Structural Welding Code – Aluminum.
22. AWS D1.6, Structural Welding Code – Stainless Steel.
23. NAAMM, Metal Finishes Manual.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Welding:

- a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, D1.2/D1.2M, or D1.6, as applicable.
- b. When requested by ENGINEER, provide certification that each welder employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.

B. Regulatory Requirements: Conform to the following:

1. 29 CFR 1910, Occupational Health and Safety Standards.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Fabrication and erection details for assemblies of miscellaneous metal Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings and templates for locating and installing miscellaneous metal items and anchorage devices. Provide signed and sealed shop drawings and design calculations by a Professional Engineer registered in the state of Georgia.
 2. Product Data:
 - a. Copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal Work.
- B. Informational Submittals: Submit the following:
 1. Test and Evaluation Reports:
 - a. Mill test report that indicate chemical and physical properties of each type of material, when requested by ENGINEER.
 2. Qualifications Statements:
 - a. Copies of welder's certifications, when requested by ENGINEER.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 1. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in other construction in ample time to prevent delaying the Work.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Steel:
 1. W-Shapes and WT-Shapes: ASTM A992/A992M.
 2. S-Shapes and Channels: ASTM A572/A572M, Grade 50.
 3. Hollow Structural Sections: ASTM A500, Grade B.
 4. Angles, Plates, Bars: ASTM A36/A36M.
 5. Steel Pipe: ASTM A53/A53M, Grade B.
- B. Aluminum:

1. Aluminum Shapes: ASTM B308/B308M, Alloy 6061-T6, ASTM B 221, Alloy 6061-T6.
 2. Aluminum Tubes and Pipes: ASTM B429, Alloy 6061-T6.
 3. Aluminum Bars and Rod: ASTM B211, Alloy 6061-T6.
 4. Aluminum Plates: ASTM B209, Alloy 6061-T6.
- C. Stainless Steel:
1. Plates and Sheets: ASTM A240/A240M, Type 316 stainless steel.
 2. Submerged or Intermittently Submerged: Type 316 stainless steel.
 3. Non-submerged: Type 316L stainless steel.
- D. Stainless Steel Fasteners and Fittings: ASTM A 320/A 320M, Type 316 Stainless Steel.
- E. Zinc-coated Hardware: ASTM A153/A153M.

2.2 MISCELLANEOUS METAL ITEMS

- A. Shop Assembly:
1. Pre-assemble items in the shop to the greatest extent possible to minimize field-splicing and field-assembly of units at the Site. Disassemble units only to extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Aluminum Ladders:
1. Fabricate ladders for locations shown or indicated with dimensions, spacing, details, and anchorages as shown and specified. Comply with OSHA 29 CFR 1910 and ANSI A14.3, except as otherwise shown or specified.
 - a. Unless otherwise shown, provide 1.5-inch diameter continuous side rails, spaced at least 1.5 feet apart.
 - b. Provide extruded square rungs, spaced maximum of 12 inches on centers, with non-slip surface on top of each rung. Adhesive strips for non-slip surfaces are not acceptable.
 2. Fit rungs in centerline of side rails, plug weld, and grind smooth on outer rail faces.
 3. Support each ladder at top and bottom and at intermediate points spaced not more than five feet on centers.
 4. Use welded or bolted brackets, designed for adequate support and anchorage, and to hold ladder clear of wall surface with minimum of seven inches between wall and centerline of rungs.
 5. Unless otherwise shown or approved by ENGINEER, extend rails 3.5 feet above top rung, and return rails to wall or structure, unless other secure handholds are provided. If adjacent structure does not extend above top rung, goose-neck extended rails back to structure to provide secure ladder access.

6. Use extruded aluminum conforming to alloy and temper 6061-T6.
7. Provide OSHA compliance gate at top of ladders with platforms or thru ladder access.

C. Steel Lintels:

1. Provide loose structural steel lintels for openings and recesses in masonry walls and brick walls as specified or as shown.
2. Weld adjoining members together to form a single unit, where shown or indicated.
3. Provide not less than eight inches bearing at each side of openings, unless otherwise shown.
4. Steel lintels to be installed in exterior walls shall be hot-dip galvanized and finish painted. Other steel lintels shall be painted.
5. Surface preparation and painting shall conform to Section 09 91 00, Painting.
6. Where lintels are not shown on the Drawings, provide lintels as specified in the following table. Provide other lintels where shown and of size indicated on the Drawings.

Clear Span (Max)	Exterior Angle	Interior Angles (typical 8-inch wall)
4.0 feet	3.5 inches by 3.5 inches by 5/16 inches	Two 3.5 inches by 3.5 inches by 5/16 inches
6.0 feet	Four inches by 3.5-inches by 5/16 inches	Two 4 inches by 3.5 inches by 5/16 inches
8.0 feet	Five inches by 3.5 inches by 5/16 inches	Two 5 inches by 3.5 inches by 5/16 inches

D. Shelf Angles:

1. Provide structural steel shelf angles of sizes shown, for attachment to concrete or masonry construction. Provide slotted holes to receive 3/4-inch bolts, spaced not more than six inches from ends and not more than 2.0 feet on centers, unless otherwise shown.
2. Provide adhesive anchors, complete with fasteners, for attachment of shelf angles to cast-in-place concrete.
3. Provide shelf angle system at monumental CMU shelf or relieving angle.
 - a. Provide manufacturer's thermal shelf angle support system with delegated professional engineer design seal and calculation.
 - b. Basis of Design: Fero Fast Bracket 3" deep with anchors 36-inches on center.
 - b. Manufacturer: Provide products of one of the following:
 - 1) Fast Thermal Bracket Offset Shelf Angle and Fast Punched Angle by Fero Corporation.
 - 2) Or approved equal.

E. Aluminum Stair Nosings:

1. Manufacturers: Provide products of one of the following:
 - a. Supergrit Type 241BF by Wooster Products, Inc.
 - b. Or approved equal.
 2. Fabricate extruded aluminum nosing of sizes and configurations as shown on the Drawings.
 - a. Unless otherwise shown, provide ribbed abrasive filled type, using black abrasive filler.
 3. Provide anchors for embedding in concrete, either integral or applied to treads, as standard with manufacturer.
- F. Fall Prevention System:
1. Provide each ladder with a fall prevention system complying with 29 CFR 1910, ANSI A14.3, and ANSI Z359.1.
 2. System shall consist of a carrier rail securely and permanently attached to ladder, over which travels a sleeve to which harness belt can be attached.
 3. Products and Manufacturers: Provide products of one of the following:
 - a. Saf-T-Climb by North Safety Products.
 - b. Or approved equal.
 4. Rail:
 - a. Notched at six-inch intervals and constructed of galvanized steel.
 - b. Provide ladder attachments/rail mounting brackets of same material as rail, and as required by Supplier.
 - c. For all ladders, include provisions to secure safety sleeve to carrier rail at top of vertical ladder so that sleeve will not slide down rail when safety belt is unsnapped.
 - d. Ladders Below Hatches: Rail for ladder shall extend from bottom of ladder to top of ladder. Provide telescoping safety post as specified in this Article.
 - e. Ladders Not Below Hatches: Rail for ladder shall extend from bottom of ladder to above horizontal landing or roof at top of ladder, Provide removable extension section at top of ladder. Arrange rail to allow climber to land on landing or roof without unsnapping climber's safety harness
 5. Accessories: Provide with each ladder the following, all furnished by fall prevention system Supplier:
 - a. One safety sleeve compatible for use with the rail. Sleeve shall be cast bronze with five zinc-plated steel roller bearings. Sleeve shall travel smoothly on straight or curved rail.
 - b. One safety harness that attaches to sleeve. Harness shall be of woven, high-strength nylon, with padded straps and forged steel buckles and rings. Harness shall distribute impact forces of a fall over climber's thighs, buttocks, chest, and shoulders.
- G. Safety Post:

1. Provide safety post for each fixed access ladder located below an access hatch. Safety post shall be manufactured of high-strength structural material with telescoping tubular section that locks automatically when fully extended.
2. Products and Manufacturers: Provide products of one of the following:
 - a. LadderUP Safety Post by Bilco Company
 - b. Or approved equal.
3. Use upward and downward movement of post shall be controlled by stainless steel spring balancing mechanism.
4. Safety post shall be hot-dip galvanized steel.

H. Bollards:

1. Provide Schedule 80 galvanized steel pipe filled with concrete as shown on the Drawings. Paint as required in accordance with Section 09 91 00, Painting. Unless otherwise shown or specified, finish-paint bollard "Safety Yellow."

I. Miscellaneous Framing and Supports:

1. Provide miscellaneous metal framing and supports that are not part of structural steel framework and are required to complete the Work.
2. Fabricate miscellaneous units to sizes, shapes, and profiles shown on the Drawings or, if not shown, of required dimensions to receive adjacent grating, plates, tanks, doors, and other work to be retained by the framing.
3. Except as otherwise shown, fabricate from structural shapes, plates, and bars, of all-welded construction using mitered corners, welded brackets, and splice plates and minimum number of joints for field connection.
4. Cut, drill, and tap units to receive hardware and similar items to be anchored to the Work.
5. Furnish units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units are to be installed after concrete is placed.
 - a. Except as otherwise shown, space anchors, 2.0 feet on centers, and provide units the equivalent of 1.25-inch by 1/4-inch by eight-inch strips.
 - b. Galvanize exterior miscellaneous frames and supports.
 - c. Where shown or indicated, galvanize miscellaneous frames and supports that are not to be installed outdoors.
6. Miscellaneous steel framing and supports shall be hot-dip galvanized and finish-painted, unless otherwise shown or indicated.
7. For railings, refer to Section 05 52 15, Aluminum Handrails and Railing.
8. For grating requirements refer to Section 05 53 16, Aluminum Grating.
9. Surface preparation and painting of galvanized surface shall conform to Section 09 91 00, Painting

- J. Fasteners and Hardware: Provide Type 316 stainless steel fasteners for aluminum fabrications and zinc-coated hardware for galvanized fabrications, unless otherwise shown or specified.

- K. Anchors and Expansion Anchors: Refer to Section 05 05 33, Anchor Systems.

2.3 FINISHING

- A. Surface Preparation and Shop Priming: Perform surface preparation and apply primer coat to miscellaneous metal fabrications in the shop. Conform to surface preparation and shop priming requirements in Section 09 91 00, Painting.
- B. Galvanizing:
1. Galvanizing of fabricated steel items shall comply with ASTM A123/A123M.
 2. Details of fabrication of steel items and assemblies to be hot-dip galvanized shall conform to recommendations of ASTM A384/A384M to minimize the potential for distortion.
- C. Aluminum Finish: Provide natural mill finish for aluminum Work unless otherwise shown or specified.

2.4 SOURCE QUALITY CONTROL

- A. Tests and Inspections:
1. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures complying with the Contract Documents.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine conditions under which the Work is to be performed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install miscellaneous metal fabrications accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels. Brace temporarily or anchor temporarily in formwork where fabrications are to be built into concrete, masonry, or other construction.

- B. Anchor securely as shown and as required for the intended use, using concealed anchors where possible.
- C. Fit exposed connections accurately together to form tight, hairline joints. Field-weld steel connections that are not to be exposed joints and cannot be shop-welded because of shipping size limitations. Comply with AWS D1.1/D1.1M, D1.2/D1.2M and D1.6, as applicable to the material being welded. Grind steel joints smooth and touch-up shop paint coat. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- D. Protection of Aluminum from Dissimilar Materials:
 - 1. Coat surfaces of aluminum that will contact dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09 91 00, Painting.

+ + END OF SECTION + +

SECTION 05 51 17

ALUMINUM STAIRS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all professional services, labor, materials, equipment, and incidentals as shown, specified, and required to design, furnish, and install aluminum stairs, including surface preparation and shop priming.
 - 2. The extent of aluminum stairs shall be as shown.
 - 3. The Work includes:
 - a. Providing openings in and attachments to aluminum stairs to accommodate the Work under this and other Sections of the Specifications, and providing for aluminum stairs all items such as anchorage devices, bolts, studs, and all items required for which provision is not specifically included under other Sections.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the Work that must be installed with, before, or attached to aluminum stairs.
- C. Related Sections:
 - 1. Section 05 05 33, Anchor Systems.
 - 2. Section 05 52 15, Aluminum Handrails and Railings.
 - 3. Section 05 53 16, Aluminum Grating.
 - 4. Section 09 91 00, Painting.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. AISC 360, Specification for Structural Steel Buildings.
 - 2. AA, Aluminum Associations.
 - 3. ASTM B26, Standard Specification for Aluminum-Alloy Sand Castings.
 - 4. ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plates.
 - 5. ASTM B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 6. ASTM B308/B 308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
 - 7. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - 8. ASTM B632, Standard Specification for Aluminum-Alloy Tread Plate.
 - 9. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.

10. ASTM F 94, Specification for Stainless Steel Nuts.
11. AWS D1.2, Structural Welding Code.
12. NAAMM AMP 504, Metal Finishes Manual (Aluminum).
13. NAAMM AMP 510, Metal Stairs Manual.
14. ANSI/NAAMM MBG 531, Metal Bar Grating Manual.
15. 2018 International Building Code with Georgia Amendments.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer shall have a minimum of five years' experience producing products substantially similar to those specified and shall be able to provide documentation of at least five satisfactory installations in place for at least five years each.
2. Professional Engineer:
 - a. Engage a registered professional engineer legally qualified to practice in the same jurisdiction as the Site and experienced in providing engineering services of the kind indicated.
 - b. Submit qualifications data.
 - c. Responsibilities include:
 - 1) Carefully reviewing aluminum stairs performance and design criteria stated in the Contract Documents.
 - 2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to Engineer by Contractor.
 - 3) Preparing or supervising preparation of design calculations and related drawings, Shop Drawings, test plan development and test-result interpretation as required, and comprehensive engineering analyses verifying compliance of metal steel stairs with requirements of the Contract Documents.
 - 4) Signing and sealing all calculations, design drawings, and Shop Drawings.
 - 5) Certifying that:
 - a) it has performed the design of metal steel stairs in accordance with performance and design criteria stated in the Contract Documents, and
 - b) said design conforms to all applicable local, state, and federal Laws and Regulations, and to prevailing standards of practice.
3. Welders and Welding Processes:
 - a. Qualify procedures and personnel according to AWS D1.1.
 - b. Submit certification that each welder employed on or to be employed for the Work possesses current AWS certification in the welding process with which welder will be working. Certifications shall be current and valid throughout the Work.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section, regardless of the component manufacturer from a single pre-engineered steel stair Supplier.

2. Pre-engineered steel stair manufacturer shall to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. All components shall be specifically constructed for specified service conditions and be integrated into the overall assembly by pre-engineered steel stair manufacturer.
- C. Source Quality Control: Contractor shall be responsible for entire design, fabrication, and installation of pre-engineered aluminum stair Work.
- D. Regulatory Requirements: Comply with applicable requirements of Laws and Regulations, including local building codes listed in Section 01 42 00, References.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Detailed Shop Drawings for fabrication and erection showing in plan the location of products, elevations, and details for the pre-engineered aluminum stair Work. Shop Drawings shall be coordinated with all approved building shop drawings or field dimensions.
 - b. Include details of all connections between all materials.
 - c. Include anchorage to supporting structures, foundations, and accessory items.
 2. Product Data:
 - a. Manufacturer's complete product information, specifications and installation instructions for aluminum stair components and accessories. Include material descriptions, dimensions and profiles of individual system components.
 - b. Proposed coatings products, surface preparation, and coatings application procedures.
 3. Samples:
 - a. Representative samples of materials including nosings, tread material, and others items as requested by Engineer. Review will be for type only. Compliance with all other requirements is exclusive responsibility of Contractor.
- B. Delegated Design Submittals:
1. Design Data: Submit the following:
 - a. Complete calculations for the aluminum stair framing, anchorage, and connections, as one package with the Shop Drawings. Structural calculations shall include all specified performance criteria, required load cases and load combinations used in the design and resulting member forces, reactions, deflections, and other anticipated movements. The magnitude of maximum reactions to supporting structures and foundations from all critical load combinations shall be tabulated separately. All calculations and assumptions shall be presented so that Engineer can easily follow the progress and logic of Contractor's professional engineer. The

design analysis shall include the name and office phone number of the designer to answer questions during the shop drawing review.

C. Informational Submittals: Submit the following:

1. Certificates:
 - a. Certification by professional engineer that aluminum stair design is in accordance with performance and design criteria stated in the Contract Documents, and that design conforms to applicable local, state, and federal Laws and Regulations, and to prevailing standards of practice.
2. Qualifications Statements:
 - a. Manufacturer.
 - b. Professional engineer.
 - c. Provide certification that all welders employed on the fabrication of the aluminum stairs have satisfactorily passed AWS qualification tests within the previous twelve months. Manufacturer shall ensure that all certifications are kept current.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:

1. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage products to be embedded in concrete in ample time to prevent delaying the Work.
2. Inspect all boxes, crates, packages, and products upon delivery to Site and notify Engineer in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.
3. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:

1. Keep all products off ground using pallets, platforms, or other supports. Protect steel and packaged materials from corrosion and deterioration.
2. Conform to Section 01 66 00, Product Storage and Handling Requirements.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 PROJECT CONDITIONS

A. Site Measurements:

1. Verify dimensions in areas of erection by taking measurements at the Site before fabrication. Indicate field dimensions on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delay.
2. Where Site-measurements cannot be made without delaying the Work, establish dimensions from approved shop drawings and proceed with fabricating components without Site-measurements.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Criteria:

1. Provide aluminum stairs capable of withstanding controlling effects of gravity and lateral loads in accordance with basic load and load combinations in accordance with Laws and Regulations. Comply with applicable standards, recommendations and specified publications of ASCE-7, and NAAMM AMP 510 except to the extent more stringent requirements are specified or required by governing authorities having jurisdiction at the Site.
2. Structural steel members and their connections shall be designed in accordance with AISC 360 for design requirements and allowable stresses. Deflection and user comfort shall be considered in the serviceability of the stairs.
3. Dead Load:
 - a. Dead load shall consist of the weight of the structural frame and all other materials of the aluminum stair.
4. Live Load:
 - a. Live loads shall be determined and applied in accordance with the minimum applicable Building Code, but shall not be lower than a non-reducible minimum of 100 pounds per square foot and a non-concurrent concentrated load of 1000 lbs applied where it is most critical.
5. Snow and Ice Loads:
 - a. Loads induced by the weight of snow or ice shall be as determined in accordance with minimum applicable Building Code requirements.
6. Railing Loads:
 - a. Railing loads shall be applied to stair framing as required by applicable Building Code requirements.
7. Wind Load:
 - a. Provide aluminum stairs capable of withstanding the effects of wind forces determined in accordance with the applicable Building Code using location design factors shown on the Drawings.
8. Seismic Load:
 - a. Provide aluminum stairs capable of withstanding the effects of seismic forces determined in accordance with the applicable Building Code using seismic design factors shown on the Drawings.
9. Stair Configuration:
 - a. Provide stair or ships stair in compliance with OSHA 1910.35, 1910.36, and 1910.25. Delegated designer shall certify that local building code is not applicable.

2.2 MATERIALS, FABRICATION, AND SHOP ASSEMBLY

A. General:

1. Aluminum stairs shall be fabricated from aluminum shapes, tubes, pipes, rods, bars, sheets and plates of 6061-T6 in conformance with ASTM B308 and ASTM B429.
2. Jointing:

- a. Join pieces together by welding unless otherwise shown or specified. Welding shall comply with applicable provisions of AWS D1.2.
 - b. Fabricate units so that bolts and other fastenings do not appear on finished surfaces.
 - c. Make joints true and tight and make connections between parts lightproof and tight.
 - d. Provide continuous welds, ground smooth where exposed.
 3. Construct stair units to conform to sizes and arrangements shown on the Drawings. Provide aluminum framing, columns, struts, clips, brackets, bearing plates, and other components for supporting aluminum stairs and platforms. Provide stainless steel hangers in support of aluminum stair from building framing and structural systems. Fabricate aluminum stairs for installation to line, plumb, square, and true with runs that will register level with floor and platforms.
 4. Provide brackets and bearing surfaces per the Drawings and as required to anchor and contain aluminum stairs on supporting structures.
 5. All stair flights shall end with a treads and floor or landing level.
 6. All stair flights shall begin with riser set back from landing 11-inches, unless otherwise noted.
 7. Risers shall be closed, unless otherwise noted on construction drawings.
 - a. All equipment platforms and lands shall have closed riser at flights up from landing or platform.
- B. Stair Framing:
1. Fabricate stringers of structural steel channels, or plates, or combination thereof, as shown. Provide closures for exposed ends of stringers.
 2. Construct platforms of structural steel channel headers and miscellaneous framing members as shown. Bolt or weld headers to stringers. Bolt or weld framing members to stringers and headers.
- C. Aluminum Grating Treads and Platforms:
1. For aluminum grating and treads, refer to Section 05 53 16, Aluminum Grating.
 2. Comply with ANSI/NAAMM MBG 531.
 3. Fabricate grating treads with abrasive nosing on one edge and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with stainless steel bolts.
 4. Fabricate grating platforms, with nosing matching that on grating treads, for all landings. Provide toe-plates at open-sided edges of floor grating fastened to platform framing members.
 5. Provide platforms 3/8-inch minimum thick with solid abrasive surface matching that on treads. Secure platforms to platform framing members with bolts.
- D. Stair Railing: Conform to requirements listed below and in other Specifications Sections, as applicable.
1. Section 05 52 15, Aluminum Handrails and Railings.

2.3 FINISHING

- A. Provide primer coating to aluminum stairs in manufacturer's shop in accordance with Section 09 91 00, Painting, and NAAMM AMP 504.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which products are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Fastening to In-Place Construction: Provide all anchorage devices and fasteners for securing pre-engineered aluminum stairs to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts and other connectors as required and as specified in Section 05 05 33, Anchor Systems.
- B. Cutting, Fitting, and Placement:
 - 1. Perform cutting, drilling and fitting required for installation of aluminum stairs. Set aluminum stairs accurately in location, alignment, and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
 - 2. Fit exposed connections accurately together to form tight, hairline joints.
 - 3. Field Welding:
 - a. Field-weld connections that are not to be left as exposed joints and cannot be shop-welded because of shipping limitations. Grind joints smooth and touch-up shop-applied paint. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.
 - b. Comply with applicable provisions of AWS D1.2 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding.
- C. Field Painting:
 - 1. Touch-up: Immediately after erecting aluminum stairs, clean field welds, bolted connections, and abraded areas of shop-applied painting. Apply to all exposed areas touch-up paint, which shall be same paint used for shop painting. Apply touch-up paint by brush or spray to provide minimum dry film thickness as specified in Section 09 91 00, Painting.
 - 2. Field-apply to dissimilar coat of paint as specified in Section 09 91 00, Painting.

++ END OF SECTION ++

SECTION 05 52 15

ALUMINUM HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install aluminum handrail and railing systems. The Work also includes:
 - a. Providing openings in, and attachments to, aluminum handrail and railing systems to accommodate the Work under this and other Specification Sections. Provide all items for aluminum handrails and railings, including anchorages, fasteners, studs, and other items required for which provision for is not specifically included under other Sections.
2. Aluminum handrails and railings Work shall include components and features shown and specified, and all components and features available from specified manufacturers required for providing complete aluminum handrail and railing system in accordance with the Contract Documents.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before aluminum handrails and railings Work.
2. Aluminum handrail and railing locations shall comply with Laws and Regulations.

C. Related Sections:

1. Section 03 60 00, Grouting.
2. Section 05 05 33, Anchor Systems.
3. Section 09 91 00, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AA, Aluminum Design Manual.
2. ASTM B26/B26M, Specification for Aluminum-Alloy Sand Castings.
3. ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
4. ASTM B136, Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum.
5. ASTM B137, Standard Test Method for Measurement of Coating Mass per Unit Area on Anodically Coated Aluminum.
6. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.

7. ASTM B241/B241M, Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
8. ASTM B244, Standard Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments.
9. ASTM B247, Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and rolled Ring Forgings.
10. ASTM B429/B429M, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
11. ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
12. ASTM E935, Standard Test Methods for Permanent Metal Railing Systems and Rails for Buildings.
13. Bim 36NAAMM/Architectural Metal Products Division (AMP), Pipe Railing Manual.
14. NAAMM/AMP AMP 501 Finishes for Aluminum.
15. 2018 International Building Code with Georgia Amendments.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Upon request manufacturer shall submit document at least five years successful experience in fabricating aluminum handrail and railing systems of scope and type similar to that required.
 - b. Manufacturer shall be capable of providing custom detail drawings for the products required.
2. Professional Engineer:
 - a. Contractor or handrail and railing manufacturer shall retain a registered professional engineer legally qualified to practice in same state as the Site. Professional engineer shall have at least five years' experience designing aluminum handrails and railings.
 - b. Responsibilities include:
 - 1) Reviewing aluminum handrail and railing system performance and design criteria stated in the Contract Documents.
 - 2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to Engineer by Contractor.
 - 3) Preparing or supervising preparation of design calculations verifying compliance of aluminum handrail and railing system with requirements of the Contract Documents.
 - 4) Signing and sealing all calculations.
 - 5) Certifying that:
 - a) Design of aluminum handrail and railing system was performed in accordance with performance and design criteria stated in the Contract Documents, and
 - b) Design conforms to all applicable local, state, and federal Laws and Regulations, and to prevailing standards of practice.

3. Installer:
 - a. Retain a single installer trained and with record of successful experience in installing aluminum handrail and railing systems.
 - b. Installer shall have record of successfully installing aluminum handrail and railing systems in accordance with recommendations and requirements of manufacturer, or shall provide evidence of being acceptable to the manufacturer.
 - c. Installer shall employ only tradesmen with specific skill and successful experience in the type of Work required.
 - d. When requested by Engineer, submit name and qualifications of installer with the following information for at least three successful, completed projects:
 - 1) Names and telephone numbers of owner and architect or engineer responsible for each project.
 - 2) Approximate contract cost of the aluminum handrail and railing systems for which installer was responsible.
 - 3) Amount (linear feet) of aluminum handrail and railing installed.
- B. Component Supply and Compatibility:
 1. Obtain all materials furnished under this Section regardless of component manufacturer, from a single aluminum handrail and railing system manufacturer.
 2. Aluminum handrail and railing system manufacturer shall review and approve or prepare all Shop Drawings and other submittals (except for delegated design submittals, when professional engineer is retained by other than handrail and railing manufacturer) for all components furnished under this Section.
 3. Components shall be specifically constructed for specified service conditions and shall be integrated into overall assembly by aluminum handrails and railings manufacturer.
- C. Regulatory Requirements: Comply with Laws and Regulations, including:
 1. International Building Code.
 2. OSHA Part 1910.28, Duty to have fall protection and falling object protection.
 3. OSHA Part 1910.29, Fall protection systems and falling object protection-criteria and practices.
- D. Certifications:
 1. Submit certification, signed by authorized officer of manufacturer and notarized, stating that handrail and railing systems comply with the design prepared by the professional engineer.
 2. Submit certification, signed by authorized officer of Contractor and notarized, stating that all components and fittings are furnished by the same manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Drawings for fabrication and installation of aluminum handrail and railing systems with sizes of members, pipe wall thickness, information on components, and anchorage devices. Show all anchorages. Provide details drawn at scale of 1.5-inch equal to one foot.
 - b. Indicate required location of posts.
 - c. Indicate locations and details of all expansion joints, if any.
 - d. Indicate locations and details of gaps across seismic joints, if any.
 - e. Profile drawings of aluminum handrail and railing system components.
 - f. Custom detail drawings. Details of forming, jointing, sections, connections, internal supports, trim and accessories. Provide details drawn at scale of 1.5-inch equal to one foot.
 2. Product Data:
 - a. Manufacturer's specifications, standard detail drawings, and installation instructions for aluminum handrail and railing systems.
 - b. Manufacturer's catalogs showing complete selection of standard and custom components and miscellaneous accessories for selection by Engineer.
 3. Delegated Design Submittals:
 - a. Design Data:
 - 1) Design computations or complete structural analysis of handrail and railing systems, signed and sealed by professional engineer. Professional engineer's seal shall be clearly legible, including state of registration, registration number, and name on seal.
 - 2) Certification by professional engineer that professional engineer has performed design of aluminum handrail and railing systems in accordance with performance and design criteria stated in the Contract Documents, and that design conforms to all local, state, and federal Laws and Regulations, and to prevailing standards of practice.
 4. Samples:
 - a. Full-size Sample, two feet long, of assembled railing system at post and rail intersections. Sample shall have all associated components including typical connections, mounted toeboard and sleeve, and handrail at wall return, complete with mounting brackets, all with specified controlled uniform metal finish.
 - b. Color Samples: Maximum range of clear, anodized aluminum that shall appear in finished Work. Prepare range Samples, to show highest level of color control feasible for actual handrail and railing systems, as determined by licensor of finishing process specified, on actual extrusions and castings of the Work.
 - c. Engineer will review Samples for finish, color, joint tolerances, workmanship, and general component assembly only. Compliance with other requirements is the responsibility of the Contractor.

- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Certification on source of supply, as specified in Article 1.3 of this Section.
 - b. Manufacturer certification specified in Article 1.3 of this Section.
 - 2. Qualifications Statements: Submit qualifications for the following:
 - a. Manufacturer, when requested by Engineer.
 - b. Professional engineer.
 - c. Installer, when requested by Engineer. Qualifications statement shall include record of experience with references specified.
- C. Closeout Submittals: Submit the following:
 - 1. Maintenance Manuals: Furnish detailed maintenance manuals that include the following:
 - a. Product name and number.
 - b. Detailed procedures for routine maintenance and cleaning, including cleaning materials, application methods and precautions in use of products that may be detrimental to finish when improperly applied.
 - c. Handrail and railings systems manufacturer's current catalog including individual parts.
 - d. Maintenance manuals shall be in accordance with Section 01 78 23, Operations and Maintenance Data.
 - 2. Guarantee: Provide in maintenance manual the guarantee specified.
- D. Maintenance Material Submittals: Submit the following:
 - 1. Extra Stock Materials:
 - a. After completing installation, deliver to Owner two percent of actual quantity of each handrail and railing system component used in the Work.
 - b. Label each piece or sealed container with name and product number.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, and Unloading:
 - 1. Prior to shipping, completely inspect products to assure that components are complete and comply with requirements of Contract Documents and recommendations of manufacturer. Box or crate products as required to prevent damage during shipment.
 - 2. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
 - 3. Inspect all boxes, crates, and packages upon delivery to Site and notify Engineer in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.
 - 4. Conform to Section 01 65 00, Product Delivery Requirements.
- B. Storage and Protection:
 - 1. Keep products off ground using pallets, platforms, or other supports. Protect products from corrosion and deterioration.

C. Handling of Products:

1. Do not subject handrail and railing products to bending or stress.
2. Do not damage edges or handle products in a manner that will cause scratches, warping, or dents.
3. Protect handrails and railings by paper or coating as acceptable to handrail and railing manufacturer, against scratching, splashes of mortar, paint, and other marring during transportation, handling, and erection. Protect until completion of adjacent work.

1.6 GUARANTEE

- A. Guarantee: Manufacturer shall provide written guarantee of availability of replacement parts and components for period of at least five years after completion of the Project.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. System Description: Aluminum handrail and railing system shall consist of equally spaced horizontal rails with totally concealed mechanical fasteners, internally threaded tubular rivets and components fastened to posts spaced no more than five feet on centers and system of handrails supported from adjacent construction by mounting brackets spaced at no more than five feet on centers.
- B. Design Criteria and Performance Criteria:
1. Design, fabricate, and install aluminum handrail and railing systems to withstand the most critical effects resulting from the following loads (loads listed below do not act concurrently):
 - a. Uniform Load: 50 pounds per foot, applied at top in any direction.
 - b. Concentrated Load: 200 pounds single load, applied at any point along the top in any direction.
 - c. Components: Intermediate rails (all rails except the handrail), balusters, and panel fillers, if any, shall withstand horizontally-applied normal load of 50 pounds on an area equal to one square foot, including openings and space between rails. Reactions due to this loading are not required to be superimposed to loading specified for main supporting members of handrails and railings.
 - d. Comply with AA Aluminum Design Manual for determining allowable stresses and safety factors for aluminum structural components.
 - e. Limit deflection in each single span of railing and handrail to 1.5-inch maximum. Horizontal deflection of posts shall comply with ASTM E985. Applied loads shall not produce permanent deflection in the completed Work when loads are removed.
 2. Thermal Control: Provide adequate expansion within fabricated systems that allows for thermal expansion and contraction caused by material temperature

change of 140 degrees F to -20 degrees F without warp or bow of system components. Distance between expansion joints shall be based on providing 1/4-inch wide joint at 70 degrees F, which accommodates movement of 150 percent of calculated amount of movement for specified temperature range.

3. Where handrail and railing systems cross expansion joints in the building or structure, provide expansion joints in handrail and railings systems.
4. For posts located at or near end of runs as shown, uniformly space intermediate posts as required to conform to loading and deflection criteria specified, at intervals no greater than maximum post spacing specified. Where posts are shown for handrails along both sides of walkways and other similar locations, locate posts opposite each other; do not stagger post locations.
5. Delegated designer shall provide railing in compliance with Georgia Fire Code and Building Code.
 - a. Guardrail: 42" minimum height.
 - b. Handrail: 34" minimum height.
 - c. Combination railing (guard and handrail) shall only be allowed at Type 'F' Occupancy. Containment areas shall be considered Type 'H' Occupancy and combined railing is not allowed.

2.2 MANUFACTURERS

- A. Products and Manufacturers: Provide one of the following:
 1. Custom Fabricated Connectorail System, by Julius Blum & Company, Inc.
 2. Custom Fabricated Series 5H Non-Welded Aluminum Pipe Aluminum handrails and railing systems, by Superior Aluminum Products, Inc.
 3. Or equal.

2.3 MATERIALS

- A. Extruded Aluminum Architectural and Ornamental Shapes: ASTM B221, Alloy 6063-T52.
- B. Aluminum Forgings: ASTM B247.
- C. Extruded or Drawn Aluminum Pipe and Tube:
 1. ASTM B429 or ASTM B241/B241M, Alloy 6061-T6, 6063-T6, 6063-T5, 6063-T52, or 6063-T832 as required by loadings, deflections, and post spacing specified.
 2. Provide Schedule 40 pipe, minimum, unless conditions of detail and fabrication require extra-heavy pipe to comply with Specifications. Rails and posts shall have minimum outside diameter of 1.90 inches.
- D. Reinforcing Bars: Solid, circular profile, two feet long, 6061-T6 aluminum reinforcing bars with same outside diameter as inside diameter of post.

- E. Anchors and Fastenings:
 - 1. For anchors and fasteners, use Type 316 stainless steel conforming to ASTM F593; minimum 3/8-inch diameter.
 - 2. Provide minimum of four bolt fasteners per post where top or side mounted posts are shown. Components shall be in accordance with manufacturer's recommendations and as approved or accepted (as applicable) by Engineer on submittals.
 - 3. Anchors: In accordance with Section 05 05 33, Anchor Systems.
- F. Castings:
 - 1. Provide high-strength aluminum alloy brackets, flanges, and fittings suitable for anodizing as specified.
 - 2. Aluminum alloy sand castings: ASTM B26/B26M.
- G. Connector Sleeves: Schedule 40, five-inch long by 1.610-inch diameter.
- H. Sockets: Provide six-inch deep by 2.5-inch outside diameter aluminum sockets with 3.5-inch wide socket cover on bottom of each socket and on top and bottom of removable post sockets.
- I. Custom Cover Flanges: 1/4-inch high by four-inch diameter, aluminum.
- J. Adhesive: Two-part waterproof epoxy-type as recommended by handrail and railing systems manufacturer.
- K. Non-shrink Grout: Comply with Section 03 60 00, Grouting.
- L. Toeboards:
 - 1. Provide extruded Alloy 6063-T5 or T52 aluminum alloy toeboards, unless railing is mounted on curbs or other construction of sufficient height and type to comply with OSHA 1910.29. Bars or plates are not acceptable.
 - 2. Unless otherwise specified, toeboards shall comply with OSHA 1910.29(k).
- M. System Components and Miscellaneous Accessories: Provide complete selection of manufacturer's standard and custom aluminum handrail and railing systems components and miscellaneous accessories required. Show type and location of all such items on Shop Drawings and other submittals as applicable.

2.4 FABRICATION

- A. General: Unless otherwise shown or specified, provide typical non-welded construction details and fabrication techniques recommended in NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501.
- B. Fabricate handrail and railing systems true to line and level, with accurate angles, surfaces and straight edges. Fabricate corners without using fittings. Provide bent-metal corners to radius shown without causing grain separation or otherwise

impairing the Work. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces, or use prefabricated bends. Provide not less than four-inch outside radius.

- C. Remove burrs from exposed edges.
- D. Close aluminum pipe ends by using prefabricated fittings.
- E. Weep Holes:
 - 1. Fabricate joints that will be exposed to weather to exclude water.
 - 2. Provide 15/64-inch diameter weep holes at lowest possible point on each post in handrail and railing systems.
 - 3. Provide pressure relief holes at closed ends of handrail and railing systems.
- F. Toeboards:
 - 1. Provide manufacturer's standard toeboard, that accommodates movement caused by thermal change specified without warping or bowing toeboards.
 - 2. Provide manufacturer's standard toeboard, which accommodates storage for removable socket covers.
 - 3. Coordinate and cope toeboard as required to accommodate cover flanges at posts.
 - 4. Toeboards shall follow curvature of railing. Where railing is shown to have curved contours at corners, or other locations, toeboard shall likewise be curved to follow line of railing system.
- G. Reinforcing Bars: Provide reinforcing bar friction-fitted at each post in railing system. Extend reinforcing bars of tubes six inches into cast-in-place sleeves or other types of supporting brackets.
- H. Mechanically Fitted Component Pipe Handrail and Railing System:
 - 1. Use non-welded pipe handrail and railing system with posts, top and intermediate rail(s), and flush joints.
 - 2. Provide top and one intermediate horizontal rail(s), equally spaced.
 - 3. Do not use blind rivets, pop rivets, or other exposed fastening devices in the Work under this Section. Fasteners used for side-mounting fascia flanges where shown or specified may be exposed in the Work. Provide internal threaded aluminum rivets, stainless steel through-bolts with lock nuts, stainless steel sheet metal screws with lock washers, and epoxy adhesive for fastening components of the Work.

2.5 FINISHES

- A. General:
 - 1. Prepare surfaces for finishing in accordance with recommendation of aluminum producer and the aluminum finisher or processor.
 - 2. Adjust and control direction of mechanical finishes specified to achieve best overall visual effect in the Work.

3. Color and Texture Tolerance: Provide uniform color and continuous mechanical texture for aluminum components. Engineer reserves the right to reject aluminum materials because of color or texture variations that are visually objectionable, but only where variation exceed range of variations established by manufacturer prior to fabrication, by means of range of Samples approved by Engineer.
 4. Anodize aluminum components.
- B. Finish:
1. Mechanically finish aluminum by wheel or belt polishing with aluminum oxide grit of 180 to 220 size, using peripheral wheel speed of 6,000 feet per minute; AA Designation - M32 Medium Satin Directional Texture.
 2. Hand-Rubbed Finish: Where required to complete the Work and provide uniform, continuous texture, provide hand-rubbed finish to match medium satin directional texture specified to even out and blend satin finishes produced by other means.
- C. Cleaning:
1. Provide non-etching chemical cleaning by immersing aluminum in inhibited chemical solution, as recommended by coating applicator, to remove lard oil, fats, mineral grease, and other contamination detrimental to providing specified finishes.
 2. Clean and rinse with water between steps as recommended by aluminum manufacturer.
- D. Exposed Aluminum Anodic Coating: Provide anodic coatings as specified that do not depend on dyes, organic or inorganic pigments, or impregnation processes to obtain color. Apply coatings using only the alloy, temperature, current density, and acid electrolytes to obtain specified colors in compliance with designation system and requirements of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501. Comply with the following:
1. Provide Architectural Class I high density anodic treatment by immersing the components in tank containing solution of 15 percent sulfuric acid at 70 degrees F with 12 amperes per square foot of direct current for minimum of sixty minutes; AA Designation A41 Clear.
 2. Physical Properties:
 - a. Anodic Coating Thickness, ASTM B244: Minimum of 0.7-mils thick.
 - b. Anodic Coating Weight, ASTM B137: Minimum of 32 mg/sq. in.
 - c. Resistance to Staining, ASTM B136: No stain after five minutes dye solution exposure.
 - d. Salt Spray, ASTM B117: 30,000 hours exposure with no corrosion or shade change.
 3. Seal finished anodized coatings using deionized boiling water to seal pores and prevent further absorption.
 4. Products and Manufacturers: Provide one of the following:
 - a. Alumilite 215 Clear by Aluminum Company of America, Inc.
 - b. Or equal.

2.6 SOURCE QUALITY CONTROL

- A. Allowable Tolerances:
 - 1. Limit variation of cast-in-place inserts, sleeves and field-drilled anchor and fastener holes to the following:
 - a. Spacing: Plus-or-minus 3/8-inch.
 - b. Alignment: Plus-or-minus 1/4-inch.
 - c. Plumbness: Plus-or-minus 1/8-inch.
 - 2. Minimum Handrails and Railings Systems Plumb Criteria:
 - a. Limit variation of completed handrail and railing system alignment to 1/4-inch in 12 feet with posts set plumb to within 1/16-inch in 3.0 feet.
 - b. Align rails so variations from level for horizontal members and from parallel with rake of stairs and ramps for sloping members do not exceed 1/4-inch in 12.0 feet.
 - 3. Provide "pencil-line" thin butt joints.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which Work will be performed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.
- B. Verify to Engineer the gage of aluminum pipe railing posts and rails brought to the Site by actual measurement of on-Site material in presence of Engineer.

3.2 INSTALLATION

- A. General:
 - 1. Do not erect components that are scarred, dented, chipped, discolored, otherwise damaged, or defaced. Remove from Site railing and handrail system components that have holes, cuts, gouges, deep scratches, or dents of any kind. Repairs to correct such Work will not be accepted. Remove and replace with new material.
 - 2. Comply with installation and anchorage recommendations of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501 in addition to requirements specified and approved or accepted (as applicable) submittals.
- B. Fastening to In-Place Construction:
 - 1. Remove protective plastic immediately before installing.
 - 2. Adjust handrails and railings prior to securing in place, to ensure proper matching at butting joints and correct alignment throughout their length. Plumb posts in each direction. Secure posts and rail ends to building or structure as follows:

- a. Anchor posts to concrete by means of 4-bolt floor flanges or side mount sleeve brackets anchored into the concrete using stainless adhesive anchors. Refer to Section 05 05 33, Anchor Systems.
 - b. Anchor posts to stair stringers with stringer or support flanges, angle type or floor type as required by conditions, shop-connected to posts and bolted to steel supporting members. Flanges shall be as recommended by manufacturer. Verify that reinforcing bars are inserted into posts before installation. Do not install posts without reinforcing bar.
 - c. Side-mount posts by fastening them securely in brackets attached to steel or concrete fascia as shown and in accordance with approved or accepted (as applicable) submittals.
3. Use devices and fasteners recommended by handrail and railing systems manufacturer and as shown on approved or accepted (as applicable) submittals.
- C. Cutting, Fitting, and Placement:
1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels.
 2. Fit exposed connections accurately together to form tight hairline joints. Do not cut or abrade surfaces of units that have been finished after fabrication, and are intended for field connections.
 3. Make permanent field splice connections using manufacturer's recommended epoxy adhesive and five-inch minimum length connector sleeves. Tight press-fit field splice connectors and install in accordance with manufacturer's written instructions. Follow epoxy manufacturer's recommendations for requirements of installation and conditions of use.
 4. Make splices as near as possible to posts, but not exceeding 12 inches from nearest post.
 5. Field welding is not allowed. Make splices using pipe splice lock employing a single allen screw to lock joint.
 6. Securely fasten toeboards in place with not more than 1/4-inch clearance above floor level.
 7. Drill one 15/64-inch diameter weep hole not more than 1/4-inch above top of location of solid reinforcing bar or tube in each post.
- D. Fastening to Existing Construction:
1. Provide heavy-duty floor flange and anchorage devices and fasteners where necessary for securing handrail and railing systems components to existing construction; including stainless steel threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as required. Refer to Section 05 05 33, Anchor Systems.
 2. Use devices and fasteners recommended by handrail and railing systems manufacturer and as shown on approved or accepted (as applicable) submittals.
- E. Expansion Joints:
1. Provide slip joint with internal sleeve extending not less than two inches beyond joint on each side.

2. Construct expansion joints as for field splices, except fasten internal sleeve securely to one side of rail only.
 3. Locate joints within six inches of posts.
- F. Protection from Dissimilar Materials:
1. Coat aluminum surfaces in contact with dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09 91 00, Painting.
 2. Do not extend coating beyond contact surfaces. Remove coating where exposed-to-view in the finished Work.

3.3 CLEANING AND REPAIRING

- A. Cleaning:
1. Clean exposed surfaces of handrail and railing systems after completion of installation. Comply with recommendations of both handrail and railing system manufacturer and finish manufacturer. Do not use abrasives or unacceptable solvent cleaners. Test cleaning techniques on an unused section of railing before employing cleaning technique.
 2. Remove stains, dirt, grease, and other substances by washing handrails and railings systems thoroughly using clean water and soap; rinse with clean water.
 3. Do not use acid solution, steel wool, or other harsh abrasives.
 4. If stain remains after washing, remove defective sections and replace with new material complying with this Section.
- B. Handrails and railings shall be free of dents, burrs, scratches, holes, and other blemishes. Replace damaged or otherwise defective Work with new material that complies with this Section at no additional cost to Owner.
- C. Prior to Substantial Completion, replace adjacent work marred by the Work of this Section.

+ + END OF SECTION + +

SECTION 05 53 16

ALUMINUM GRATING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install aluminum grating and frames.
 - 2. The Work includes:
 - a. Providing grating, frames, and appurtenances.
 - b. Providing openings in aluminum grating to accommodate the Work under this and other Sections, and attaching to aluminum grating all items such as sleeves, bands, studs, fasteners, and items required for which provision is not specifically included under other Sections.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before aluminum grating Work.
- C. Related Sections:
 - 1. Section 09 91 00, Painting.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. AA Aluminum Design Manual.
 - 2. ASTM B210, Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
 - 3. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 4. NAAMM MBG 531, Metal Bar Grating Manual.
 - 5. NAAMM MBG 533, Welding Specifications for Fabrication of Steel, Aluminum and Stainless-Steel Bar Grating.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Shall have at least five years-experience manufacturing products substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

- B. Component Supply and Compatibility:
 - 1. Obtain all products and materials included in this Section regardless of component manufacturer from a single aluminum-grating manufacturer.
 - 2. Aluminum grating manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all products and materials furnished under this Section.
 - 3. Components shall be suitable for the specified service conditions and be integrated into overall assembly by aluminum grating manufacturer.
 - 4. Provide only one type of aluminum grating exclusively throughout the Project.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Fabrication and erection of all Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.
 - b. Setting drawings and templates for location and installation of anchorage devices.
 - 2. Product Data:
 - a. Manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions.
 - 3. Samples:
 - a. Representative Samples of grating, appurtenances and other finished products requested by Engineer.
 - b. Engineer's review will be for type and finish only. Compliance with all other requirements is exclusive responsibility of Contractor.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices to be embedded in cast-in-place concrete in ample time to prevent delaying the Work.
 - 2. Comply with Section 01 65 00, Product Delivery Requirements.
- B. Storage and Protection:
 - 1. Protect materials from corrosion and deterioration.
 - 2. Do not store materials in contact with concrete or other materials that might cause corrosion, staining, scratching, or damage materials or finish.
 - 3. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 - PRODUCTS**2.1 SYSTEM PERFORMANCE**

- A. Aluminum Grating: Provide aluminum grating complying with the following:
1. Grating Design Loads: Uniform live load shall be as shown or indicated in the Contract Documents. Where live load is not shown or indicated, uniform live and concentrated loads shall be as indicated in the table below, whichever results in the greater design stresses.

	Live Load	Concentrated Load
b.	150 psf	750 lbs. per foot of grating width at center of span

2. Maximum Clear Span Deflection for Uniform Live Loads: 1/120 of span, but not more than 1/4-inch.
 3. Maximum Fiber Stress: 12,000 psi.
 4. Do not install aluminum grating in areas subject to vehicular traffic.
 5. Minimum Size of Members:
 - a. Minimum size of bearing bars shall be within standard mill tolerance as indicated in load tables in NAAMM MBG 531 for applicable loading and deflection requirements.
 - b. Minimum dimensions of cross bars shall be as indicated in tables of Minimum Standard Cross Bars and Connecting Bars in NAAMM MBG 531.
 6. Banding bar shall be 1/4-inch thick minimum. Top of banding bar shall be flush with top of grating, unless otherwise shown or indicated. Banding bar shall be 1/4-inch shorter than the bearing bar height.
 7. Comply with requirements of AA Aluminum Design Manual.
- B. Stair Treads: Provide stair treads complying with the following:
1. Stair Tread Design Loads: Concentrated live load shall be:
 - a. 300 pounds on front-most five inches of tread at center of tread of span up to 5.5 feet.
 - b. 300 pounds on front-most five inches of tread at the one-third points of tread of span greater than 5.5 feet.
 2. Maximum Clear Span Deflection for Concentrated Live Loads: 1/240 of span, but not more than 1/4-inch.
 3. Maximum Fiber Stress: 12,000 psi.
 4. Minimum Size of Members:
 - a. Minimum size of bearing bars shall be within standard mill tolerance as indicated in load tables in NAAMM MBG 531 for applicable loading and deflection requirements.
 - b. Minimum dimensions of cross bars shall be as indicated in tables of Minimum Standard Cross Bars and Connecting Bars in NAAMM MBG 531.

5. Carrier plate shall be 1/4-inch thick minimum. Top of carrier plate shall be flush with top of tread, unless otherwise shown or indicated. Provide carrier plate with hole and slot for attachment to stringer.
6. Comply with requirements of AA Aluminum Design Manual.

2.2 MANUFACTURERS

- A. Grating, Products and Manufacturers: Provide one of the following:
 1. Swage-Locked I-Bar Grating, by IKG Industries.
 2. Swage-Locked I-Bar Grating, by Ohio Gratings.
 3. Or equal.
- B. Stair Treads, Products and Manufacturers: Provide one of the following:
 1. I-Bar Treads, by IKG Industries.
 2. I-Bar Treads, by Ohio Gratings.
 3. Or equal.

2.3 MATERIALS

- A. Bearing Bars: Aluminum alloy 6061-T6 or alloy 6063-T6, complying with ASTM B221.
- B. Cross Bars or Bent Connecting Bars: Aluminum alloy 6061-T6 or alloy 6063-T6, complying with either ASTM B221 or ASTM B210.
- C. Frames: Aluminum alloy 6061-T6 or alloy 6063-T6, complying with ASTM B221.
- D. Stud anchors welded to steel supports and other fasteners shall be Type 316 stainless steel.

2.4 FABRICATION

- A. Use materials of minimum depth and thickness specified and required to comply with performance criteria in the Contract Documents.
- B. Provide grating as follows:
 1. Grating Type: Aluminum I-bar with swage-locked cross bars at right angles to bearing bars.
 2. Depth: One-inch minimum.
 3. Bearing Bars: Aluminum I-bar minimum of one-inch spaced at 1-3/16-inch on centers.
 4. Cross-Bars: Swage-locked to bearing bars at maximum spacing of four inches on centers.
 5. Surface: Grooved.
 6. Finish: Mill.

- C. Provide stair treads as follows:
 - 1. Tread Type: Aluminum I-bar with swage-locked cross bars at right angles to bearing bars.
 - 2. Depth: One-inch minimum.
 - 3. Bearing Bars: Aluminum I-bar minimum one-inch spaced at 1-3/16-inch on centers.
 - 4. Cross Bars: Swage-locked to bearing bars at maximum spacing of four inches on centers.
 - 5. Surface: Grooved.
 - 6. Nosing: Cast aluminum abrasive nosing.
 - 7. Finish: Mill.
- D. Provide cutouts in grating for passage of piping, electrical conduit, valve stems, columns, ducts, and similar work. Where more than two bearing bars are included in a cut out, provide banding bars of same dimensions as bearing bars around opening welded to grating component parts.
- E. Gratings shall be accurately fabricated, free from warps, twists, and other defects that would affect grating appearance and grating serviceability.
- F. Welding shall conform to requirements of NAAMM MBG 533. Welds shall be ground smooth at top surfaces and bearing surfaces.
- G. Openings in and edges of gratings sections shall be banded with banding bars. Weld bands to intersecting members.
- H. Size each section of grating to weigh not more than 100 pounds, unless otherwise indicated in the Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions under which Work is to be performed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.
- B. Check all dimensions at the Site after piping and equipment are in place and determine exact locations of openings and cutouts.

3.2 INSTALLATION

- A. Fastening to In-Place Construction:
 - 1. Use anchorage devices and fasteners to secure aluminum grating to supporting members or prepared openings, as recommended by manufacturer.

2. Weld Type 316 stainless steel stud bolts to receive saddle clip or flange block anchors to supporting steel members. Drill for machine bolts when supports are aluminum.
- B. Cutting, Fitting, and Placing:
1. Perform cutting, drilling, and fitting required for installation. Set the Work accurately in location, alignment and elevation, plumb, level, true, and free of rack. Do not use wedges or shimming devices.
 2. Where gratings are penetrated by piping, electrical conduit, ducts, structural members, or similar protrusions, cut openings neatly and accurately to size and attach banding bar as specified.
 3. Divide panels into sections only to extent required for installation where aluminum grating is to be installed around previously installed piping, electrical conduit, ducts, structural members, or similar protrusions.
- C. Aluminum gratings in concrete floors shall be removable and arranged in sizes to be readily lifted. Provide aluminum gratings in concrete with aluminum angle frames with mitered corners and welded joints. Grind exposed joints smooth. Frames shall have welded anchors set into concrete. Angle size shall match grating depth selected for flush fit.
- D. Clearance at ends or between sections of grating shall be a maximum of 1/4-inch.
- E. Tops of aluminum gratings shall be set flush with surrounding construction.
- F. Aluminum gratings shall be set with full and uniform end bearing on frames to preclude rocking movement; do not use wedges or similar shimming devices.
- G. Protection of Aluminum from Dissimilar Materials: Coat aluminum surfaces in contact with dissimilar materials such as concrete, masonry, steel, or other metals, in accordance with Section 09 91 00, Painting.

++ END OF SECTION ++

SECTION 06 82 13

FIBERGLASS-REINFORCED PLASTIC GRATING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install fiberglass-reinforced plastic (FRP) grating. The Work also includes:
 - a. Providing openings in FRP grating to accommodate the Work under this and other Sections and attaching to FRP grating all items such as sleeves, bands, studs, fasteners, and items required for which provision is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before FRP grating Work.

C. Related Sections:

1. Section 05 05 33 Anchor Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AASHTO, Standard Specifications for Highway Bridges.
2. ASTM D635, Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
3. ASTM E84, Test Method for Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Manufacturer shall have a minimum of five years experience producing materials substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all products furnished under this Section regardless of component manufacturer from a single FRP grating manufacturer.
2. FRP grating manufacturer shall prepare, or shall review and approve, all Shop Drawings and other submittals for components furnished under this Section.

- C. Regulatory Requirements: Comply with the following:
 - 1. OSHA, 29 CFR 1910.28, Duty to have fall protection and falling object protection.
 - 2. OSHA, 29 CFR 1910.29, Fall protection systems and falling object protection.
 - 3. Building codes referred to in Section 01 42 20, References.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Fabrication and erection drawings and schedules of all materials included under this Section. Include plans, elevations, and details, including connection details. Show anchorage and accessory items. Shop Drawings shall indicate location of planned field cut-outs in grating.
 - b. Obtain ENGINEER'S approval of field cut-outs in grating.
 - 2. Product Data:
 - a. Manufacturer's specifications, load tables, dimension diagrams, and anchorage details.
 - 3. Samples:
 - a. Representative Samples of grating, appurtenances, and other finished materials requested by ENGINEER.
 - b. ENGINEER'S review will be for type and finish only. Compliance with all other requirements is exclusive responsibility of CONTRACTOR.
- B. Informational Submittals; Submit the following:
 - 1. Manufacturer Instructions:
 - a. Setting drawings and templates for location and installation of anchorage devices.
 - b. Manufacturer instructions for handling, storing, and installing the materials furnished.
 - 2. Qualifications Statements:
 - a. Manufacturer qualifications, when requested by ENGINEER.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection:
 - 1. Protect materials from corrosion, staining, scratching, and deterioration.

PART 2 – PRODUCTS2.1 SYSTEM PERFORMANCE

A. General:

1. Maximum clear span deflection under uniform load equal to 250 pounds per square foot shall be the smaller of 1/200 of span or 1/4-inch, at four feet.
2. Flame Spread Rating: 25 or less, ASTM E84; self-extinguishing ASTM D635.
3. Sheet Size: As shown or indicated in the Contract Documents, and as required to comply with deflection requirements.
4. Design Loads:
 - a. Uniform live load shall be as shown. Where the live load is not shown, the uniform live load shall be as indicated below or the indicated concentrated load, whichever gives the greatest stresses.

	Live Load (psf)	Concentrated Load (lbs per foot of grating at center of span)	Location(s)
1)	100	500	All containment area sumps

- b. Maximum Clear Span Deflection for Uniform Live Loads: 1/240 of span, but not more than 1/4-inch.
- c. Maximum Clear Span Deflection for Concentrated Loads: 1/180 of span.

B. Molded FRP Grating: Provide materials complying with the following:

1. Grating shall be molded construction with tops and bottoms of bearing bars and cross-bars in same plane. Grating shall have square mesh pattern providing bi-directional strength.
2. Pattern: 1.5-inch on centers.
3. Thickness: 1.5-inch.

2.2 MANUFACTURERS

A. Molded FRP Grating:

1. Products and Manufacturers: Provide one of the following:
 - a. Fibergrate Molded Grating, by Fibergrate Composite Structures, Inc.
 - b. Duragrate Molded Fiberglass Grating, by Strongwell Corporation.
 - c. Or equal.

2.3 MATERIALS

A. Fiberglass-Reinforced Plastic (FRP):

1. Premium-grade, fire-retardant vinyl ester resin with glass reinforcing.
2. Finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes, or un-reinforced areas. Glass fibers shall be well-covered with resin to protect against exposure due to wear and weathering.

- B. Attachment, Clips, Fasteners, and Hardware: Provide Hastelloy C clips, bolts, nuts, washers, sleeves, fasteners, and associated hardware.

2.4 FABRICATION

A. General:

1. Use materials in accordance with the Contract Documents and approved Shop Drawings and submittals.
2. Sealing: Coat shop-fabricated cuts in FRP with vinyl ester resin.

B. Grating:

1. Reinforce grating with continuous rovings of equal number of layers in each direction. Top layer of reinforcing shall be no more than 1/8-inch below top surface of grating to provide maximum stiffness and prevent resin chipping of un-reinforced surfaces. Percentage of glass (by weight) shall not exceed 35 percent.
2. After molding, dry glass fibers shall not be visible on surface of bearing bars or cross bars. Bars shall be smooth and uniform with no evidence of fiber orientation irregularities, interlaminar voids, porosity, resin over-rich, or resin-starved areas.
3. Non-slip Surfacing: Grating shall have integrally-applied grit top on the surface of each bar providing maximum slip resistance.
4. Grating bar intersections shall be filleted to minimum radius of 1/16-inch to eliminate local stress concentrations and reduce the potential for resin cracking.
5. Layout: Each grating section shall be readily removable, except where shown or indicated on the Drawings. Manufacturer shall provide openings and holes where shown or indicated on the Drawings. Grating openings around protrusions such as structural elements, piping, conduit, shafts or other machinery, shall be discontinuous at the approximate centerline of the associated opening so each section of grating is readily removable.
4. Provide FRP grating to be installed in concrete with FRP angle frames having mitered corners and welded joints. Frames shall have welded anchors set into concrete. Angle size shall match grating depth selected for flush fit of grating.
5. Where grating is cut, seal the cut surfaces with catalyzed resin sealant of equal or superior corrosion resistance to the grating. Sealant shall be as recommended by grating manufacturer.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Grating Installation:
1. After structural elements, piping, conduit, shafts and other equipment are in place check all dimensions in the field and determine required grating cutouts.
 2. Placing:
 - a. Install FRP grating with each section readily removable and replaceable, unless shown or indicated otherwise in the Contract Documents. Provide end-banding bars for each grating panel.
 - b. Set tops of FRP gratings flush with surrounding construction.
 - c. Install FRP grating with full and uniform end bearing on frames or bearing surfaces to preclude rocking movement. Do not use wedges or similar shimming devices.
 - d. Provide FRP grating in concrete with angle frames. Grind exposed joints of angle frames smooth.
 3. Cutting and Fitting:
 - a. Perform cutting, drilling, and fitting required for installation. Set the grating Work accurately in location, alignment, and elevation, plumb, level, true, and free of rack. Do not use wedges or shimming devices.
 - b. Provide cutouts or openings in the field as approved by ENGINEER.
 - c. Seal cut surfaces of grating requiring cutting during installation with sealant.
 4. Connections to Structural Elements and Bearing Surfaces:
 - a. Attach gratings to bearing surface in accordance with grating manufacturer's recommendations
 - b. Secure grating to FRP structural members, as required by manufacturers of grating and FRP structural member.
 5. Joints:
 - a. Fit exposed connections accurately together to form tight joints.
 - b. Adjacent units of FRP grating sections shall be neatly fitted together.
 - c. Clearance at the ends or between sections of FRP grating shall be a maximum of 1/4-inch.
 6. Jointing Connections:
 - a. Secure edges of grating to each other with end-panel clips.
 - b. Secure clips to grating with bolts so that grating acts as a unit. Install bolts not more than three inches from each plate section end and not more than two feet on centers.
 - c. For each FRP grating panel, provide four saddle clip anchors designed to fit over two adjacent grating section, and four stud bolts with washers and

nuts for each grating panel

++ END OF SECTION ++

SECTION 07 54 23

THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Adhered thermoplastic polyolefin (TPO) roofing system.
 - 2. Vapor retarder.
 - 3. Roof insulation.
- B. Related Requirements:
 - 1. Section 06 10 53, Miscellaneous Rough Carpentry.
 - 2. Section 07 22 16, Roof Board Insulation.
 - 3. Section 07 62 00, Sheet Metal Flashing and Trim.
 - 4. Section 07 92 00, Joint Sealants.
 - 5. Section 07 95 13, Expansion Joint Cover Assemblies.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site and via Teams or Zoom.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.

6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
 7. Review governing regulations and requirements for insurance and certificates if applicable.
 8. Review temporary protection requirements for roofing system during and after installation.
 9. Review roof observation and repair procedures after roofing installation.
- B. Preinstallation Roofing Conference: Conduct conference at Project site and via Teams or Zoom.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
 7. Review governing regulations and requirements for insurance and certificates if applicable.
 8. Review temporary protection requirements for roofing system during and after installation.
 9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:
1. Base flashings and membrane terminations.
 2. Tapered insulation, including slopes.
 3. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Samples for Verification: For the following products:
1. Sheet roofing, of color required.
 2. Walkway pads or rolls, of color required.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of compliance with performance requirements.
- C. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field quality-control reports.
- F. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed and FM Global approved for roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, and other components of roofing system.
 - 2. Warranty Period: 25 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carlisle SynTec Incorporated.
 - 2. Cooley Engineered Membranes.
 - 3. Custom Seal Roofing.
 - 4. Firestone Building Products.
 - 5. Flex Roofing Systems.
 - 6. GAF Materials Corporation.
 - 7. GenFlex Roofing Systems.
 - 8. Johns Manville.
 - 9. Mule-Hide Products Co., Inc.
 - 10. Versico Incorporated.
 - 11. Or Equal.
- B. Source Limitations: Obtain components including roof insulation and fasteners for roofing system from same manufacturer as membrane roofing.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
- B. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
 - 1. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- C. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- D. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:
 - 1. Corner Uplift Pressure: 50 lbf/sq. ft.
 - 2. Perimeter Uplift Pressure: 45 lbf/sq. ft.
 - 3. Field-of-Roof Uplift Pressure: 40 lbf/sq. ft.
- E. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a built-up roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 - 1. Fire/Windstorm Classification: Class 1A-120.
 - 2. Hail-Resistance Rating: SH.
- F. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- G. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- H. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.78 and an emissivity of not less than 0.75 when tested according to CRRC-1.
- I. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- J. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 TPO ROOFING

- A. Fabric-Reinforced TPO Sheet: ASTM D 6878, internally fabric- or scrim-reinforced, uniform, flexible[fabric-backed] TPO sheet.
 - 1. Thickness: 60 mils, nominal.
 - 2. Exposed Face Color: White.

2.4 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 - 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content:
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Single-Ply Roof Membrane Adhesives: 250 g/L.
 - f. Single-Ply Roof Membrane Sealants: 450 g/L.
 - g. Nonmembrane Roof Sealants: 300 g/L.
 - h. Sealant Primers for Nonporous Substrates: 250 g/L.
 - i. Sealant Primers for Porous Substrates: 775 g/L.
 - j. Other Adhesives and Sealants: 250 g/L.
 - 3. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services) "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.
- C. Bonding Adhesive: Manufacturer's standard.
- D. Slip Sheet: Manufacturer's standard, of thickness required for application.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05-inch thick, prepunched.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.

- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; GlasRoc Sheathing.
 - b. Georgia-Pacific Corporation; Dens Deck DuraGuard.
 - c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
 - d. Temple-Inland, Inc; GreenGlass Exterior Sheathing.
 - e. USG Corporation; Securock Glass Mat Roof Board.
 - f. Or Equal.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.6 VAPOR RETARDER

- A. Self-Adhering-Sheet Vapor Retarder: Polyethylene film laminated to layer of butyl rubber adhesive, minimum **30-mil** total thickness; maximum permeance rating of **0.1 perm**; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

2.7 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by TPO roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 3, felt or glass-fiber mat facer on both major surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas Roofing Corporation.
 - b. Carlisle SynTec Incorporated.
 - c. Firestone Building Products.
 - d. GAF Materials Corporation.
 - e. Insulfoam LLC; a Carlisle company.
 - f. Johns Manville.
 - g. Or Equal.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.

- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.8 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
 - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 - 3. Full-spread spray-applied, low-rise, two-component urethane adhesive.
- D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick, factory primed.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; GlasRoc Sheathing.
 - b. Georgia-Pacific Corporation; Dens Deck DuraGuard.
 - c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
 - d. Temple-Inland, Inc; GreenGlass Exterior Sheathing.
 - e. USG Corporation; Securock Glass Mat Roof Board.
 - f. Or Equal.
- E. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.9 ASPHALT MATERIALS

- A. Roofing Asphalt: [ASTM D 312, Type III or Type IV] [ASTM D 6152, SEBS modified].
- B. Asphalt Primer: ASTM D 41/D 41M.

2.10 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

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 roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 - 4. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 5. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Install insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 SUBSTRATE BOARD INSTALLATION

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 - 1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Global's "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
 - 2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 VAPOR-RETARDER INSTALLATION

- A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 4 inches and 6 inches, respectively. Seal laps by rolling.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
 - 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
 - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

- G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft., and allow primer to dry.
 - 2. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- H. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
 - 2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
- I. Mechanically Fastened and Adhered Insulation: Install each layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten first layer of insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
 - 2. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
 - 3. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
 - 4. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - 5. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- J. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.
 - 1. Fasten cover boards according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
 - 2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.
- K. Install slip sheet over cover board and immediately beneath roofing.

3.7 ADHERED ROOFING INSTALLATION

- A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

- D. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.
- E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.
- F. Apply roofing with side laps shingled with slope of roof deck where possible.
- G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.
- H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.8 MECHANICALLY FASTENED ROOFING INSTALLATION

- A. Mechanically fasten roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.
 - 1. For in-splice attachment, install roofing with long dimension perpendicular to steel roof deck flutes.
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Mechanically fasten or adhere roofing securely at terminations, penetrations, and perimeter of roofing.
- E. Apply roofing with side laps shingled with slope of roof deck where possible.
- F. In-Seam Attachment: Secure one edge of TPO sheet using fastening plates or metal battens centered within seam, and mechanically fasten TPO sheet to roof deck.
- G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.

2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.
- H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.9 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashing and mechanically anchor to substrate through termination bars.

3.10 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.
 1. Electric Field Vector Mapping (EFVM): Testing agency shall survey entire roof area for potential leaks using electric field vector mapping (EFVM).
- B. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 1. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of base flashing.
 2. Flood each area for 48 hours.

3. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.12 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.13 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 1. Owner: <Insert name of Owner>.
 2. Address: <Insert address>.
 3. Building Name/Type: <Insert information>.
 4. Address: <Insert address>.
 5. Area of Work: <Insert information>.
 6. Acceptance Date: _____.
 7. Warranty Period: <Insert time>.
 8. Expiration Date: _____.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct

faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;
 - b. peak gust wind speed exceeding 137 mph;
 - c. fire;
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of

original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

- E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.
1. Authorized Signature: _____.
 2. Name: _____.
 3. Title: _____.

END OF SECTION

SECTION 07 71 00

ROOF SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all roof specialties Work.
 2. The extent of the roof specialties is shown.
 3. The types of roof specialties Work required include, but is not necessarily limited to, the following:
 - a. Extruded gravel stops.
 - b. Custom shop-fabricated gravel stop corner and transition flashings.
 - d. Exposed, gutters, and downspouts.
 - e. Welded miters, end caps, downspout elbows and downspouts.
 - c. Complete selection of full-strength, polyvinylidene fluoride finishes and colors with extended life topcoat.
 - d. Protective strippable film on all surfaces of snap-lock metal coping, extruded aluminum gravel stops, fascia extensions and metal coping corner and transition flashings.
 - e. Miscellaneous accessories, fasteners, cleats and incidental sheet metal flashing and trim system components necessary for a complete installation.
- B. Coordination:
1. Review installation procedures under other Sections and coordinate the installation of items that shall be installed with the roof specialties Work.
- C. Related Sections:
1. Section 07 54 23, Thermoplastic Polyolefin (TPO) Roofing.
 2. Section 09 91 00, Painting.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
1. AAMA 621, Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates.
 2. FM Global, Loss Prevention Data for Roofing Contractors, 1-49 - Perimeter Flashing.
 3. FS H-C-494, Coating Compound, Bituminous, Solvent Type, Acid Resistant.
 4. FS TT-C-494, Federal Specification, Coating Compound, Bituminous, Solvent Type, Acid Resistant.
 5. NRCA, The Roofing Manual.

6. SMACNA : Architectural Sheet Metal Manual.

1.3 QUALITY ASSURANCE

A. Installer Qualifications:

1. Engage a single installer who is a recognized roof specialties installer, skilled and experienced in the type of roof specialties Work required, and equipped to perform workmanship in accordance with recognized standards so that there will be undivided responsibility for the performance of the Work. Submit name and qualifications to ENGINEER along with at least three successfully completed Projects including names and telephone numbers of owners, architects and engineers, responsible for the project and the approximate contract price for roof specialties work.
2. The installer of the roof specialties Work shall be franchised or otherwise accepted in writing by the roofing materials manufacturer for installation of fully guaranteed roofing Work in accordance with these Specifications.

B. Design Criteria:

1. Standards: Comply with applicable standards and recommendations of SMACNA, Architectural Sheet Metal Manual, for the fabrication and installation of roof specialties Work, except to the extent more stringent requirements are specified.

C. Component Supply and Compatibility: Provide roof specialties as a complete unit produced by a single manufacturer specializing in the production of this type of Work, including hardware, accessories, mounting and installation components.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

- a. Shop Drawings showing the manner of forming, jointing and securing the metal to form roof specialties Work. Show expansion joint details and water-proof connections to adjoining work and at obstructions and penetrations.
- b. Drawings showing the coordination of the Work of this Section with Section 07 54 23, Thermoplastic Polyolefin (TPO) Roofing. Provide detailed Shop Drawings showing large scale details of sections and profiles of all roof specialties to be used in the Work, with all items, including fastener locations, cleats and other miscellaneous accessories necessary to complete the Work, fully dimensioned, properly located, quantified and presented such that sequence of installation is acceptable to each roofing system and adjacent construction material installer.

2. Product Data:

- a. Copies of manufacturer's specifications, recommendations and installation instructions for roof specialties applications. Include manufacturer's

certification or other data substantiating that the materials comply with the requirements.

3. Samples:
 - a. Each item of roof specialty, demonstrating assembly of system joint components and fasteners, securely mounted to substrate simulating actual installation in the Work.
 - b. Polyvinylidene fluoride manufacturer's color samples for final selection by ENGINEER. After initial selection of colors by ENGINEER from manufacturer's color charts, submit ENGINEER'S preliminary color choices on actual samples of metal substrate for final color selections by ENGINEER.
 - c. Samples will be reviewed by ENGINEER for color and texture only. Compliance with other requirements is the responsibility of CONTRACTOR.

B. Informational Submittals: Submit the following:

1. Qualifications Statements:
 - a. Installer's qualifications

C. Closeout Submittals: Submit the following:

1. Warranty
 - a. Submit warranty as specified in section 1.7

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:

1. Deliver, store and handle materials to preclude denting, scratching or otherwise marring the surface and finish of the roof specialties material.
2. Items delivered in broken, damaged, rusted, or unlabeled condition shall immediately be removed from Site and not offered again for approval by ENGINEER.

B. Storage of Materials:

1. Store materials in an area undercover and protected from construction traffic.
2. Store materials in same package in which they were shipped, off the ground and on platforms protected from dirt and other contamination.
3. Store in a manner which does not permit water to remain on roof specialties materials and system components.

C. Handling of Materials:

1. Protect roof specialties from dents, scratches, warps and bends.
2. Remove strippable protective film, immediately preceding installation of each system component.

1.6 JOB CONDITIONS

A. Scheduling:

1. Coordinate roof specialties Work with roofing, flashing, trim, and the construction of decks, parapets and other adjoining work, to provide a permanently watertight, leak-proof, secure and non-corrosive installation.
2. Deliver materials to the Site in sufficient quantities to ensure uninterrupted progress of the Work.
3. Schedule the installation of roof specialties to coincide with the installation of roofing, waterproofing, drains, piping, blocking, nailers, reglets, framing at openings, curbs, parapets and other adjoining and substrate Work.
4. Proceed with and complete the Work only when materials, equipment, and knowledgeable tradesmen, required for the installation of roof specialties, are at the Site and are ready to follow, and integrate roof specialties Work with roofing Work, in order to maintain watertight conditions.

1.7 WARRANTY

- A. Provide coping and cap flashing manufacturer's fifteen-year warranty against blow-off, leak, or premature membrane failure in winds of up to 90 miles per hour.
- B. Provide manufacturer's twenty-year warranty on the specified polyvinylidene fluoride-based coating.
- C. Guarantee that the polyvinylidene fluoride-based coating meets all criteria specified and will not spall, check, craze, peel or otherwise lose adhesion for a period of twenty years from the date of installation, to the extent that such shall create unsightly conditions or otherwise impair the intended architectural qualities of the building.
- D. In the event that the polyvinylidene fluoride-based coating fails to meet the specified standards the manufacturer shall, at their own expense, replace or field paint, at the discretion of OWNER, all areas affected by the failure. In the event that repainting is selected, it shall be done at mutually agreeable intervals throughout the term of the warranty.
- E. The warranty specified 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.
- F. The warranty does not apply where failure is caused by accidents, or external conditions or forces beyond the control of the manufacturer.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Performance Criteria:

1. Roof specialties shall be permanently watertight, and not deteriorate in excess of manufacturer's published limitations.
2. Snap-lock coping shall be detailed, fabricated and installed to provide a minimum of FM 1-90 wind up-lift resistance and require no exposed fasteners of any kind.
3. Comply with fabrication details recommended by FM Global, Loss Prevention Data for Roofing Contractors; SMACNA, Architectural Sheet Metal Manual; The NRCA Roofing Manual, and the requirements of the roof specialties manufacturer, and as shown on approved Shop Drawings.

2.2 MATERIALS

- A. Extruded Aluminum Gravel Stops and Fascia Sections: Provide extrusions of 6063-T-52 aluminum alloy, .040- inch, complying with the following:
 1. Provide gravel stops that utilize concealed joint covers for a flat, clean, unbroken line appearance.
 2. Provide hold-down clips 36 inches on center.
 3. Concealed Joint Plates: Same material and finish as gravel stop flashing 9 feet - 11 inches on center.
 4. Provide special flashings as required, all pre-fabricated at the shop; of formed sheet 5005-H134, aluminum alloy, .040- inch. Finish to match extruded aluminum gravel stops and fascia sections.
 5. Products and Manufacturers: Provide one of the following:
 - a. Type SP Gravel Stop Section by Architectural Products Company.
 - b. Anchor-Tite Gravel Stop by Metal-Era Incorporated.
 - c. Or equal.
- C. Custom Gutters, and Downspouts:
 1. Provide aluminum sheet 6063-T6 alloy, with smooth finish; in accordance with SMACNA.
 2. Size, Thickness, and Profile:
 - a. Gutters and Downspouts: 0.063-inch thick; As shown.
 3. Products and Manufacturers: Provide one of the following:
 - a. Custom Gutters, and Downspouts by Architectural Products Company.
 - b. Custom Seal-Tite Gutters, and Industrial Downspouts by Metal-Era Incorporated.
 - c. Or equal.
 4. Miscellaneous Materials:
 - a. Provide the materials and types of fasteners, solder, welding rods, coatings, separators, aluminum wall penetration, sealants, and accessory items as recommended by the sheet metal manufacturer for roof specialties Work, except as otherwise shown.
 - b. Cleats and Straps: Same metal as roof specialties Work being anchored or supported.
 - c. Roofing Cement: Neoprene adhesive, compatible with substrate and adjoining work.

- d. Bituminous Coating: Cold-applied asphaltic coating, FS TT-C-494, Type II, compounded for minimum thickness per coat of 15-mils (dry).
- e. Miscellaneous steel scuppers, escutcheons, and bearing plates: Refer to Section 05 50 13, Miscellaneous Metal Fabrications.

2.3 FABRICATION

A. General:

1. The fabrication requirements for roof specialty Work apply to both shop-fabricated and on-site-fabricated Work.
2. Manufacturer's Recommendations: Except as otherwise shown or specified, comply with the recommendations and instructions of the manufacturer of the roof specialty being fabricated.
3. Provide for thermal expansion of exposed items. Maintain a water-tight seal at expansion joints. Locate expansion joints at the following maximum spacings:
 - a. Midpoint of run.
4. Fabricate Work with lines and corners of exposed units true and accurate. Form exposed faces flat and free of buckles, excessive waves, and avoidable tool marks, considering the temper and reflectivity of the metal. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant. Fold back the sheet metal to form a hem on the concealed side of exposed edges.
5. Fabricate drainage sumps and downspouts and supports as shown.
6. Support and Anchorage: Fabricate units with adequate provisions for support and anchorage, of the types required for the indicated method of installation.

- B. Aluminum Downspouts: Fabricate aluminum sheet using double flat-lock seams. Rivet joints where necessary for strength. Pop rivets are not acceptable.

2.4 FINISHES

- A. High-Performance Organic Finish (Three-Coat Fluoropolymer): AAMA 2605: manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 621 and the coating and resin manufacturers' written instructions.
 1. Colors: Provide the following:
 - a. Full selection of manufacturer's standard colors for final selection by ENGINEER.
 2. Products and Manufacturers: Provide one of the following:
 - a. Kynar 500 Fluoropon by the Valspar Corporation.
 - b. Kynar 500 Duranar XL by PPG Industries.
 - c. Or equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and installer shall examine the supporting structure and other elements of the substrate and conditions under which the roof specialties Work is to be performed and notify ENGINEER, in writing, of any conditions detrimental to the proper and timely completion of the Work and performance of the drainage sumps, roof and overflow drains, and downspouts. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

- A. Wherever possible, take field measurements, prior to completion of shop fabrication and finishing of roof specialties Work. Do not delay job progress. Allow for erection tolerances corresponding with specified tolerances where final dimensions cannot be established before fabrication.
- B. Coordinate the installation of the roof specialty system with the roofing system. Refer to Section 07 54 23, Thermoplastic Polyolefin (TPO) Roofing for details.

3.3 INSTALLATION

- A. Comply with manufacturer's recommendations and installation instructions.
- B. Protection of Aluminum from Dissimilar Materials: Coat all aluminum surfaces in contact with dissimilar materials such as concrete, masonry, steel and other metals as specified in Section 09 91 00, Painting.
- C. Conceal fasteners and expansion provisions, wherever possible, in exposed Work, and locate so as to minimize the possibility of leakage. Cover and seal Work, as required, for a tight installation.
- D. Provide concealed cleat-type anchorages wherever practical and arrange to relieve stresses in the roof specialties Work which result from building movement and thermal expansion.
- E. Splice and Expansion Units: Use 0.050-inch thick splice plates.
- F. Bed flashing flanges in a bed of roofing cement or other setting compound which is compatible with adjoining work and substrate.
- G. On vertical overlaps, lap sheet metal a minimum of 3-inches.
- H. On sloping overlaps, of slopes of not less than 6-inches in 12-inches, lap unsealed overlaps a minimum of 6-inches.
- I. For embedment of metal flanges in elastic sheet flashing or stripping, extend flanges for a minimum of 4-inches embedment.

- J. Support and anchor each unit of Work in the manner as shown, but in no case in a manner which would be inadequate for thermal expansion stresses and the normal loading of water, wind and similar loadings.
- K. Install units with lines and corners true and accurate in alignment and location. Install drainage sumps to assure positive drainage to downspouts.
- L. Installation of Extruded Gravel Stops:
 - 1. Install metal copings using concealed fasteners and plates in compliance with manufacturer's written recommendations as shown on approved Shop Drawings.
 - 2. Coping and cap flashings shall be installed with 3/8-inch wide butt joints 12 feet-0 inches on center, unless otherwise shown.
 - 3. Use all items supplied by the manufacturer for a complete, watertight and blow-off resistant installation.
 - 4. Set all flashings straight, level and plumb.

3.4 FIELD QUALITY CONTROL

- A. Polyvinylidene Fluoride Based Coatings: Determine conformity of sheet metal flashing and trim Work requiring painted finish to these Specifications as follows:
 - 1. The manufacturer of the roofing specialties Work shall set aside and label samples of each component of the sheet metal flashing and trim Work from each production lot for the Project. Protect samples from weather.
 - 2. Make samples of sheet metal flashing and trim Work available at all times, for comparison with installed sheet metal flashing and trim Work as requested by OWNER, for the full time of the warranty.
 - 3. Make color comparison measurements with a Hunter Tristimulus Color Difference Meter employing methods of computation in use at the National Bureau of Standards.

3.5 CLEANING AND PROTECTION

- A. Protect the roof specialties from all damage until Final Completion.
- B. Roof specialties damaged before Final Completion shall be replaced with new material as specified herein, at no additional cost to OWNER.
- C. Clean exposed surfaces of every substance which is visible or might cause corrosion of the metal or deterioration of the finish.

+ + END OF SECTION + +

SECTION 07 92 00

JOINT SEALANTS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install joint sealants.
 - 2. Extent of each type of calking and sealant is shown or indicated and includes the following:
 - a. Interior and exterior joints in equipment and construction systems not filled by another material, and that are not required to be open for operation.
 - b. Joints specified to be recalked.
- B. Coordination:
 - 1. Review installation procedures under other Sections and coordinate installation of items to be installed with or before joint sealants.
 - 2. Coordinate final selection of joint sealants so that materials are compatible with all calking and sealant substrates specified.
- C. Related Sections:
 - 1. Section 03 15 00, Concrete Accessories.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ASTM C510, Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants.
 - 2. ASTM C661, Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.
 - 3. ASTM C793, Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants.
 - 4. ASTM C794, Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
 - 5. ASTM C920, Specification for Elastomeric Joint Sealants.
 - 6. ASTM C1021, Practice for Laboratories Engaged in Testing Building Sealants.
 - 7. ASTM C1087, Test method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
 - 8. ASTM C1193, Guide for Use of Joint Sealants.

9. ASTM C1247, Practice for Durability of Sealants Exposed to Continuous Immersion in Liquids.
10. BAAQMD Regulation 8, Rule 51.
11. FS TT-S-00227, Sealing Compound: Elastomeric Type, Multi-component (for Calking, Sealing, and Glazing in Buildings and Other Structures).
12. FS TT-S-00230 Sealing Compound: Elastomeric Type, Single Component (for Calking, Sealing, and Glazing in Buildings and Other Structures).
13. NSF/ANSI Standard 61, Drinking Water System Components - Health Effects.
14. SCAQMD Rule 1168.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Installer:
 - a. Engage a single installer, approved by product manufacturer, regularly engaged in calking and sealant installation and with successful experience in applying types of products required, and who employs only tradesmen with specific skill and successful experience in the type of Work required.
2. Testing Laboratory:
 - a. Furnish services of independent testing laboratory qualified according to ASTM C1021, for conducting testing required.

B. Component Supply and Compatibility:

1. Obtain materials only from manufacturers who will, if required:
 - a. Furnish at the Site services of a qualified technical representative to advise installer of proper procedures and precautions for using materials.
 - b. Test joint sealants for compatibility with substrates for conformance with FS-TT-S-00227, and recommend remedial procedures as required.
2. Before purchasing each sealant, investigate its compatibility with joint surfaces, joint fillers, and other materials in joint system. Provide products that are fully compatible with actual installation condition, verified by manufacturer's published data or certification, and as shown on approved Shop Drawings and other approved submittals.

C. Product Testing: Provide test results of laboratory pre-construction compatibility and adhesion testing, as specified in Article 3.1 of this Section, by qualified testing laboratory, based on testing of current sealant formulations within a 36-month period preceding the Notice to Proceed for the Work.

1. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920 and, where applicable, to other standard test methods.
2. Test other joint sealants for compliance using specified post-construction field adhesion test.

D. Mock-ups:

1. Prior to installing joint sealant Work but after ENGINEER's approval of Samples, provide Sample of each type of calking and sealant in areas selected by ENGINEER to show representative installation of calkings and sealants. Obtain ENGINEER's approval of visual qualities of mock-ups before starting calking and sealant Work. Retain and protect mock-ups during construction as a standard for judging completed calking and sealant Work. Do not alter or destroy mock-ups until so allowed by ENGINEER.
2. Perform the following testing on calking and sealant mock-up, as specified in this Section: Post-construction field adhesion testing and water leak test.
3. Work that does not comply with test requirements on Sample areas will be considered defective.

E. Pre-installation Conference:

1. Prior to installing joint sealants and associated Work, schedule and meet at the Site with calking and sealant installer, calking and sealant manufacturer's technical representative, other trades involved in coordinating with calking and sealant Work, ENGINEER, and OWNER. Record discussions of pre-installation conference and decisions, agreements, and disagreements, and furnish copy of record to each party attending conference. Review foreseeable methods and procedures related to calking and sealant Work, including reviewing:
 - a. Required submittals, both completed and yet to be completed.
 - b. Status of test reports.
 - c. Mock-up construction results.
 - d. Status of substrate and similar considerations.
 - e. Each major calking and sealant application required.
 - f. Availability of products, tradesmen, equipment, and facilities required for avoiding delays.
2. Reconvene conference at earliest opportunity if additional information must be developed to conclude subjects under consideration.
3. Record revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Schedule of joint sealants installation, indication each specific surface where calking or sealants are to be provided and the material proposed for each application.
2. Product Data:
 - a. Copies of manufacturer's data sheets including color charts, specifications, recommendations, and installation instructions for each type of sealant, calking compound, and associated miscellaneous material required. Include manufacturer's published data, indicating

that each product complies with the Contract Documents and is intended for the applications shown or indicated.

- b. Product test reports.
3. Samples:
 - a. Each type of actual cured material of each calking and sealant specified, in each of manufacturer's standard colors.
 - b. Samples will be reviewed by ENGINEER for color and texture only. Compliance with other requirements is responsibility of CONTRACTOR.
- B. Informational Submittals: Submit the following:
 1. Certificates:
 - a. Certify that materials are suitable for intended use and materials meet or exceed requirements of the Contract Documents.
 - b. Certification from manufacturer that products furnished are appropriate for surfaces and conditions to which they will be applied.
 - c. Certify that applicator is approved by manufacturer.
 2. Field Quality Control Submittals:
 - a. Results of tests on job mock-ups.
 - b. Pre-construction and post-construction field test reports.
 - c. Compatibility and adhesion test reports.
 - d. Contractor's Field Test Report Logs:
 - 1) Indicate time present at the Site.
 - 2) Include observations and results of field tests, and document compliance with manufacturer's installation instructions and supplemental instructions provided to installers.
 3. Pre-installation conference record.
 4. Qualifications: Submit qualifications for:
 - a. Installer.
 - b. Testing laboratory (if not already submitted under Section 01 45 23, Testing Laboratory Services Furnished by Owner, or Section 01 45 13, Testing Laboratory Services Furnished by Contractor).
- C. Closeout Submittals: Submit the following:
 1. Operation and Maintenance Data:
 - a. Recommended inspection intervals.
 - b. Instructions for repairing and replacing failed sealant joints.
 2. Warranty: Submit written warranties as specified in this Section.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with Section 01 65 00, Product Delivery Requirements, and Section 01 66 00, Product Storage and Handling Requirements, and the following:
 1. Delivery of Products:
 - a. Deliver products in calking and sealant manufacturer's original unopened, undamaged containers, indicating compliance with approved Shop Drawings and approved Sample color selections.

- b. Include the following information on label:
 - 1) Name of material and Supplier.
 - 2) Formula or Specification Section number, lot number, color and date of manufacture.
 - 3) Mixing instructions, shelf life, and curing time, when applicable.
- 2. Storage of Products:
 - a. Do not store or expose materials to temperature above 90 degrees F or store in direct sunlight.
 - b. Do not use materials that are outdated as indicated by shelf life.
 - c. Store sealant tape in manner that will not deform tape.
 - d. In cool or cold weather, store containers for sixteen hours before using in temperature of approximately 75 degrees F.
 - e. When high temperatures prevail, store mixed sealants in a cool place.
- 3. Handling:
 - a. Do not open containers or mix components until necessary preparatory Work and priming are complete.

1.6 JOB CONDITIONS

- A. Environmental Conditions:
 - 1. Do not install joint sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.
 - 2. Proceed with the Work when forecasted weather conditions are favorable for proper cure and development of high-early bond strength.
 - 3. Where joint width is affected by ambient temperature variations, install elastomeric sealants when temperatures are in the lower third of manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.
 - 4. When high temperatures prevail, avoid mixing sealants in direct sunlight.
 - 5. Supplemental heat sources required to maintain both ambient and surface temperatures within the range recommended by manufacturer for material applications are not available at the Site.
 - 6. Provide supplemental heat and energy sources, power, equipment, and operating, maintenance, and temperature monitoring personnel.
 - 7. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas of calking, sealants, and painting Work, and areas where OWNER's personnel or construction personnel may work. Properly locate and vent such heat sources to outdoors so that joint sealants and other Work are unaffected by exhaust.

1.7 WARRANTY

- A. Provide written warranty, signed by manufacturer and CONTRACTOR, agreeing to repair or replace sealants that fail to perform as air-tight and watertight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion

resistance, migration resistance, stain resistance, or general durability; or appear to deteriorate in any other manner not clearly specified in approved Shop Drawings and other submittals, as an inherent quality of material for exposure indicated.

1. Provide manufacturer warranty for period of one year from date of Substantial Completion of joint sealants Work.
2. Provide installer warranty for period of two years from date of Substantial Completion of joint sealants Work.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Provide elastomeric joint sealants for interior and exterior joint applications that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. VOC Performance Criteria:
 1. VOC content of sealants used shall comply with current VOC content limits of SCAQMD Rule 1168. Sealants used as fillers shall comply with or exceed requirements of BAAQMD Regulation 8, Rule 51.
 - a. Sealants: 250 g/L.
 - b. Sealant Primers for Nonporous Substrates: 250 g/L.
 - c. Sealant Primers for Porous Substrates: 775 g/L.
- C. Provide colors selected by ENGINEER from calking and sealant manufacturer's standard and custom color charts. "Or equal" manufacturers shall provide same generic products and colors as available from manufacturers specified.

2.2 MATERIALS

- A. Exterior and Interior Vertical Joints; Non-submerged:
 1. Two-component Polyurethane Sealant:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Sikaflex- 2c NS by Sika Corporation.
 - 2) Dymeric 240 FC by Tremco Sealant/Waterproofing Division of RPM International, Inc.
 - 3) Or equal.
 - b. Polyurethane based, two-component elastomeric sealant complying with:
 - 1) FS TT-S-00227E: Type II (non-sag) Class A and ASTM C920, Type M, Grade NS, Class 25.
 - 2) Adhesion-in-Peel, FS TT-S-00227E and ASTM C794: (Minimum five pounds per linear inch with no adhesion failure): 10 pounds.
 - 3) Hardness (Standard Conditions), ASTM C661: 25 to 35 (Shore A).
 - 4) Stain and color change, FS TT-S-00227E and ASTM C510: No discoloration or stain.

- 5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
- 6) Rheological Vertical Displacement at 120 degrees F, FS TT-S-00227E: No sag.
- 7) VOC Content: 100 g/L, maximum.

B. Exterior and Interior Horizontal Joints; Non-submerged:

1. Two-component Polyurethane Sealant:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Sikaflex- 2c SL by Sika Corporation.
 - 2) THC/900 by Tremco Sealant/Waterproofing Division of RPM International, Inc.
 - 3) Or equal.
 - b. Polyurethane based, two-component elastomeric, self-leveling sealant complying with the following:
 - 1) FS TT-S-00227E, Type I (self-leveling) Class A. and ASTM C920, Type M, Grade P, Class 25
 - 2) Water Immersion Bond, FS TT-S-00227E: Elongation of 50 percent with no adhesive failure.
 - 3) Hardness (Standard Conditions), ASTM C661: 35 to 45.
 - 4) Stain and Color Change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
 - 5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
 - 6) VOC Content: 165 g/L, maximum.

C. Miscellaneous Materials:

1. Joint Cleaner: As recommended by calking and sealant manufacturer.
2. Joint Primer and Sealer: As recommended for compatibility with calking and sealant by calking and sealant manufacturer.
3. Bond Breaker Type: Polyethylene tape or other plastic tape as recommended for compatibility with calking and sealant by calking and sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of calking and sealant. Provide self-adhesive tape where applicable.
4. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable nonabsorptive material as recommended for compatibility with calking and sealant by calking and sealant manufacturer. Provide size and shape of rod that will control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide highly-compressible backer to minimize possibility of sealant extrusion when joint is compressed.
5. Low-temperature Catalyst: As recommended by calking and sealant manufacturer.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine joint surfaces, substrates, backing, and anchorage of units forming sealant rabbet, and conditions under which calking and sealant Work will be performed, and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work and performance of sealants. Do not proceed with calking and sealant Work until unsatisfactory conditions are corrected.
- B. Laboratory Pre-construction Compatibility and Adhesion Testing: Submit to joint sealant manufacturers for testing indicated below samples of materials that will contact or affect joint sealants.
 - 1. Use ASTM C1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Submit at least eight pieces of each type of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For products that fail tests, obtain joint-sealant manufacturer's written instructions for corrective measures including using specially formulated primers.
 - 5. Immersion Testing: ASTM C1247 for potable water and wastewater.
 - 6. Testing will not be required if joint sealant manufacturers submit joint preparation data based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted and mock-up field testing is acceptable.

3.2 PREPARATION

- A. Protection: Do not allow joint sealants to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces including rough textured materials. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either the primer/sealer or calking and sealant materials.
- B. Joint Surface Preparation:
 - 1. Clean joint surfaces immediately before installing sealant compound. Remove dirt, weakly adhering coatings, moisture and other substances that would interfere with bonds of sealant compound as recommended in sealant manufacturer's written instructions as shown on approved Shop Drawings.
 - 2. If necessary, clean porous materials by grinding, sandblasting, or mechanical abrading. Blow out joints with oil-free compressed air or by vacuuming joints prior to applying primer or sealant.
 - 3. Roughen joint surfaces on vitreous coated and similar non-porous materials, when sealant manufacturer's data indicates lower bond strength than for

porous surfaces. Rub with fine abrasive cloth or steel wool to produce a dull sheen.

4. Concrete Joint Preparation: Refer to Section 03 15 00, Concrete Accessories

C. Mixing:

1. Comply with sealant manufacturer's written instructions for mixing multi-component sealants.
2. Thoroughly mix components before use.
3. Add entire contents of activator can to base container. Do not mix partial units.
4. Mix contents for minimum of five minutes or as recommended by sealant manufacturer, until color and consistency are uniform.

3.3 INSTALLATION

- A. Install joint sealants after adjacent areas have been cleaned and before joint has been cleaned and primed, to ensure calking and sealant joints will not be soiled. Replace calking and sealant joints soiled after installation.
- B. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or indicated in the Contract Documents, and except where manufacturer's technical representative directs otherwise, only as acceptable to ENGINEER.
- C. Prime or seal joint surfaces as shown on approved Shop Drawings and approved other submittals. Do not allow primer or sealer to spill or migrate onto adjoining surfaces. Allow primer to dry prior to applying sealants.
- D. Apply masking tape before installing primer, in continuous strips in alignment with joint edge to produce sharp, clean interface with adjoining materials. Remove tape immediately after joints have been sealed and tooled as directed.
- E. Confirm that compressible filler is installed before installing sealants.
- F. Do not install sealants without backer rods and bond breaker tape.
- G. Roll back-up rod stock into joint to avoid lengthwise stretching. Do not twist, braid, puncture, or prime backer rods.
- H. Employ only proven installation techniques that will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

- I. Install sealants to depths recommended by sealant manufacturer but within the following general limitations, measured at the center (thin) section of bead.
 - 1. For horizontal joints in sidewalks, pavements, and similar locations sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but not more than 5/8-inch deep or less than 3/8-inch deep.
 - 2. For vertical joints subjected to normal movement and sealed with elastomeric sealants and not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2-inch deep or less than 1/4-inch deep.
- J. Remove excess and spillage of compounds promptly as the Work progresses.
- K. Cure calking and sealant compounds in compliance with manufacturer's instructions and recommendations, to obtain high-early bond strength, internal cohesive strength, and surface durability.

3.4 EXISTING JOINTS

- A. Mechanically remove existing sealant and backer rod.
- B. Clean joint surfaces of residual sealant and other contaminants capable of affecting sealant bond to joint surface.
- C. Conduct laboratory pre-construction compatibility and adhesion testing on joint surfaces in accordance with Paragraph 3.1.B of this Section.
- D. Allow joint surfaces to dry before installing new sealants.

3.5 FIELD QUALITY CONTROL

- A. Post-construction Field Adhesion Testing: Before installing elastomeric sealants, field-test joint sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform ten tests for the first 1,000 feet of joint length for each type of elastomeric sealant and joint substrate.
 - b. Perform one test for each 1,000 feet of joint length thereafter, and minimum of one test per each floor per elevation.
 - c. Test Method: Test joint sealants according to Method A, Field-applied Sealant Joint Hand Pull Tab, and Method D, Water Immersion in Appendix X1 of ASTM C1193. For joints with dissimilar substrates, verify adhesion to each substrate separately by extending cut along one side and verifying adhesion to opposite side. Repeat procedure for opposite side.
 - d. Inspect joints for complete fill, absence of voids, and joint configuration complying with specified requirements. Record results in a log of field adhesion tests.
 - e. Inspect tested joints and report on whether:

- 1) Sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 - 2) Sealants filled the joint cavities and are free of voids.
 - 3) Sealant dimensions and configurations comply with specified requirements.
- f. Record test results in a log of field adhesion tests. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 - g. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
 - h. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other requirements will be satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
 - i. Do not proceed with installation of elastomeric sealants over joint surfaces that have been painted, lacquered, waterproofed, or treated with water repellent or other treatment or coating unless a laboratory test for durability (adhesion), in compliance with FS TT-S-00227, has successfully demonstrated that sealant bond is not impaired by the coating or treatment. If laboratory test has not been performed or shows bond interference, remove coating or treatment from joint surfaces before installing sealant.
- B. Water Leak Testing: Field test for water leaks as follows:
1. Flood the joint exposure with water directed from a 3/4-inch diameter garden hose, without nozzle, held perpendicular to wall face, two feet from joint and connected to water system with 30 psi minimum normal water pressure. Move stream of water along joint at an approximate rate of 20 feet per minute.
 2. Test approximately five percent of total joint system, in locations that are typical of every joint condition, and that can be inspected easily for leakage on opposite face. Conduct test in presence of ENGINEER, who will determine actual percentage of joints to be tested and actual period of exposure to water from hose, based on extent of observed leakage or lack of observed leakage.
 3. Where nature of observed leaks indicates potential of inadequate joint bond strength, ENGINEER may direct that additional testing be performed at a time when joints are fully cured, and before Substantial Completion.

3.6 ADJUSTING AND CLEANING

- A. Where leaks and lack of adhesion are evident, replace sealant.
- B. Clean adjacent surfaces of sealant and soiling resulting from the Work. Use solvent or cleaning agent recommended by sealant manufacturer. Leave all finish Work in neat, clean condition.
- C. Protect sealants during construction so that they will be without deterioration, soiling, or damage at time of readiness for final payment of the Contract.

3.7 PROTECTION

- A. During and after curing period, protect joint sealants from contact with contaminating substances and from damage resulting from construction operations or other causes, so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original Work.

++ END OF SECTION ++

SECTION 08 90 00

LOUVERS AND VENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all louvers and vents Work.
 2. Extent of louvers and vents Work is shown.
 3. Types of products required include the following:
 - a. Six-inch fixed, drainable, extruded-aluminum louvers.
 - b. Sill extensions, bird screens, insect screens, and other miscellaneous trim, fasteners, blank-off panels, supports and other accessories.
 - c. Polyvinylidene fluoride finish.
- B. Coordination:
1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the louvers and vents Work.
 2. Verify size, location and placement of louver and vents prior to fabrication, wherever possible. Coordinate field measurements and Shop Drawings with fabrication and shop assembly to minimize field adjustments, splicing, mechanical joints and field assembly of units. Preassemble units in as large sections as practicable.
- C. Related Sections:
1. Section 07 92 00, Joint Sealants.
 2. Section 09 91 00, Painting.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
1. AAMA 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 2. ASCE 7-2002: Minimum Design Loads for Buildings and Other Structures.
 3. ASCE/SEI 24-14: Flood Resistant Design and Construction.
 4. AMCA Standard 501, Application Manual for Air Louvers.
 5. AMCA Standard 500-L, Test Methods for Louvers, Dampers.
 6. AMCA Certified Ratings Program.
 7. ASTM B 26, Standard Specification for Aluminum-Alloy Sand Castings.
 8. ASTM B 209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

9. ASTM B 221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
10. ASTM E 90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
11. ASTM E 329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
12. ASTM E 488, Standard Test Method for Strength of Anchors in Concrete and Masonry Elements.
13. AWS D1.2/D1.2M, Structural Welding Code – Aluminum.
14. AWS D1.3, Structural Welding Code – Sheet Steel.
15. AWS D1.6, Structural Welding Code - Stainless Steel.
16. FEMA FNIP, Technical Bulletin 1, Requirements for Flood Openings in Foundation Walls and Walls of Enclosures.
17. NEMA MG 1 Motors and Generators.
18. SMACNA, Architectural Sheet Metal Manual.
19. UL 1400, Standard for Electric Motors.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
- C. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.
- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.
- F. Hurricane-Resistant Louvers: Louvers complying with the Miami- Dade County Product Control Approval System or the Florida Building Code Approval System.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 1. Supplier Qualifications: Supplier shall have a minimum of five years experience producing substantially similar products to those required and shall be able to document at least five installations in satisfactory operation for at least five years.

- B. Performance Criteria: Comply with Sheet Metal and Air Conditioning Contractor's National Association, Architectural Sheet Metal Manual, recommendations for fabrication, construction details, and installation procedures, except as otherwise shown on the Drawings or specified.
- C. Component Supply and Compatibility:
 - 1. Obtain each separate type of louver and vents from a single supplier and from a single manufacturer.
- D. Regulatory Requirements:
 - 1. Miami- Dade County Product Control Approval System or the Florida Building Code Approval System.
- E. Testing Agency Qualifications: The independent testing agency shall demonstrate to ENGINEER'S satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated in accordance with ASTM E 329, without delaying the Work.
- F. UL and NEMA Compliance: Provide motors and related components for motor-operated louvers that are listed and labeled by UL and comply with applicable NEMA standards.
- G. AMCA Certified Ratings Seal: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- H. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."
- I. Manufacturer shall certify compliance with all specified requirements for recycled louver material.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following
 - 1. Shop Drawings:
 - a. Include plans, elevations, sections, details and attachments to other work. Show blade profiles, angles and spacing.
 - 2. Product Data:
 - a. Copies of manufacturer's material specifications, recommended written installation instructions and manufacturer's specifications showing
 - 3. Delegated Design Submittals:

- a. For installed louvers and vents indicated to comply with design loads, include structural analysis data signed and sealed by a Registered Professional Engineer licensed in the State of Georgia, who is responsible for their preparation.
- b. For installed louvers and vents indicated to comply with design loads, include structural analysis data signed and sealed by a Registered Professional Engineer, who is responsible for their preparation.
4. Samples: For units with factory-applied color finishes.
 - a. Cut-a-way samples of corner section of each type of louver made from 12-inch lengths of full size components and showing the proposed details of joinery, anchorage, movement, glazing, flashing and drainage and with specified finish, prior to fabrication of the Work.
 - 1).ENGINEER reserves the right to require samples demonstrating design, detailing and fabrication techniques and workmanship for each auxiliary louver component and accessory, before fabrication proceeds.
 - b. Provide polyvinylidene fluoride coating manufacturer's complete color charts showing all colors and finishes, including custom, special and premium colors, available from the manufacturer.
 - c. Where normal color and texture variations are to be expected, include three or more 12-inch by 12-inch by 1/16-inch aluminum plates, painted as specified, to show the range of such variations. Provide minimum possible color range variation. ENGINEER reserves the right to reject material finishes with objectionable variations from the established samples.
 - d. One of each type fastener employed, with statement of intended use.
 - e. Samples will be reviewed by ENGINEER for materials, fabrication techniques, proposed system components, workmanship and color. Compliance with other requirements is the responsibility of CONTRACTOR.
- B. Informational Submittals: Submit the following:
 1. Certificates: Seismic Qualifications: For louvers, accessories, and components, from manufacturer.
 2. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
 - a. Hurricane-Resistant louvers: Laboratory test reports, verifying performance requirements for each type of unit required. Test reports indicating compliance with the Miami-Dade County Product Control Approval System or the Florida Building Code Approval System.
 3. Source Quality Control Submittals:
 - a. Comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

- A. Provide written warranty agreeing to replace louver and vent Work which fails in materials or workmanship within three years of the date of Final Acceptance. Failure of materials or workmanship shall include, but is not limited to, excessive leakage or air infiltration, excessive deflections, deterioration of finish or metal in excess of normal weathering, and defects in accessories, weatherstripping, and other components of the Work.
- B. Guarantee that the polyvinylidene fluoride based coating meets all criteria specified and will not spall, check, craze, peel or otherwise lose adhesion for a period of twenty years from the date of Final Acceptance, to the extent that such shall create unsightly conditions or otherwise impair the intended architectural qualities of the building.
- C. In the event that the polyvinylidene fluoride based coating fails to meet the specified standards, the manufacturer shall, at his own expense, replace or field paint, as directed by ENGINEER, all areas affected by the failure. In the event that repainting is selected, it shall be done at mutually agreeable intervals throughout the term of the warranty.
- D. The warranty does not apply where failure is caused by accidents, or external conditions or forces beyond the control of the manufacturer.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. Structural Performance: Provide louvers and vents capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act on vertical projection of louvers.
 - 1. Wind Loads: Determine loads based on a uniform pressure, acting inward or outward. Refer to Structural drawings.
- B. Seismic Performance: Provide louvers capable of withstanding the effects of earthquake motions determined according to the International Building Code and ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section

9, "Earthquake Loads". Refer Section 40 05 96, Vibration, Seismic and Wind Controls, for more information.

1. Seismic Design Criteria: Refer to Structural drawings.
- C. Thermal Movements: Provide louvers that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 20°F, ambient; 120°F, material surfaces.

2.2 MATERIALS

- A. Aluminum Sheet: ASTM B 209, Alloy 5005 with temper as required for forming or as otherwise recommended by the metal producer to provide the required finish.
- B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T52.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.
- D. Fastenings: Stainless steel. Provide types, gages and lengths to suit unit installation conditions. Use Phillips flat-head machine screws for exposed fasteners, unless otherwise specified. Use continuous aluminum closure angles on the inside perimeter frame of all louver and vents Work, finished to match louvers and vents.
- E. Post-installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to four times the loads imposed, for concrete, or six times the loads imposed, for masonry, as determined by testing conforming to ASTM E 488, conducted by a qualified independent testing agency.
- F. Protection of aluminum from dissimilar materials shall conform to Section 09 91 00, Painting.
- G. Recycled Content, Pre-Consumer:
 1. Extruded aluminum: 45 per cent by weight,
 2. Fabricated sheet aluminum: 28 per cent by weight,
 3. Aluminum bird screen: 38 per cent by weight.

2.3 FABRICATION, GENERAL

- A. Assemble louvers and vents in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. Fabricate frames, including integral sills, to fit in openings of sizes as shown, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: Channel, unless otherwise shown and as specified.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Where shown, provide subsills made of same material as louvers.
- F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise shown or size of louver assembly makes bolted connections between frame members necessary.

2.4 FIXED, DRAINABLE, EXTRUDED-ALUMINUM LOUVERS

- A. Furnish six-inch fixed louvers where shown, or scheduled. Drainable blades shall incorporate a front lip gutter and recessed second gutter, both of which direct water to jamb and mullion drains.
- B. Free Area Velocity:
 - 1. 6-inch: Maximum 1200 feet per minute free area velocity at a pressure drop of not more than 0.22-inches water gage carrying less than 0.01 ounces of water per square foot of free area.
- C. All blades shall be 0.081-inch thick. Provide all blades with integral drainage trough along edge of blades. Frame shall be 0.081-inches thick. Mullions shall be of the sliding interlock type.
- D. Free Area: For a 48-inch by 48-inch high louver.
 - 1. 4-inch: 49 percent.
 - 2. 6-inch: 45 percent.
- E. Install screen behind the louver.
- F. Products and Manufacturers: Provide one of the following:
 - 1. No. 6157 by Construction Specialties, Incorporated.
 - 2. No. K6846 by the Airolite Company, LLC.
 - 3. Or equal.

2.5 LOUVER SCREENS

- A. Provide removable screens for all louvers.

- B. Fabricate screen frames of the same metal and finish as the louver units to which secured. Provide frames consisting of extra heavy duty extruded 0.090-inch aluminum for permanently securing screen mesh. Frames shall be rewirable.
- C. Provide bird screen, 1/2-inch square stainless steel wire, 0.047-inch diameter wire.
- D. Locate screens on inside face of louvers. Secure screens to louver frames with machine screws, spaced at each corner and at 12-inches on centers.
- E. Provide minimum No. 8 stainless steel metal screws, unless larger screws are required by screen size.
- F. Provide cross bar screen reinforcement of same material and finish as louver which subdivides screens into maximum area of 50 square feet.

2.6 BLANK-OFF PANELS

- A. Insulated, Blank-off Panels: Laminated metal-faced panels consisting of insulating core surfaced on back and front with metal sheets.
 - 1. Thickness: Two-inches.
 - 2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch, nominal thickness.
 - 3. Insulating Core: Rigid fiberglass board insulation.
 - 4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
 - 5. Seal perimeter joints between panel faces and louver frames with 1/8 by 1-inch PVC compression gaskets.
 - 6. Attach blank-off panels to back of louver frames with stainless steel clips and sheet metal screws.

2.7 SILL EXTENSION

- A. Gage and Finish: Same as louver.

2.8 ATTACHMENT FRAME

- A. Gage and Finish: Same as louver.
- B. Size: As shown on the Drawings.

2.9 FINISHES

- A. Three Coat Fluorocarbon Coating:

1. Louvers to be finished with a minimum 1.4 mil thick full strength 70% resin, 3 coat Fluoropolymer system, meeting AAMA 2605 performance requirements.
2. All aluminum shall be thoroughly cleaned, etched and given a chromated conversion pretreatment before application of the Kynar/Hylar coating. The coating shall consist of a primer, a high metallic color coat and a clear PVF2 topcoat. It shall receive a bake cycle of 17 minutes at 4500F. All finishing procedures shall be one continuous operation in the plant of the manufacturer.
3. Manufacturer to furnish an extended 20 limited warranty for the Kynar/Hylar coating. This limited warranty shall begin on the date of material shipment.
4. Provide the following colors:
 - a. Full selection of manufacturer's standard, custom and premium colors for final selection by ENGINEER.
 - b. ENGINEER will select custom special extended life premium colors for louvers and vent Work at time of Shop Drawing and Sample submission review.
5. Products and Manufacturers: Provide one of the following:
 - a. Duranar Metallic XL Specialty Color 4-System by PPG Industries Coatings and Resins Division, Incorporated.
 - b. Fluoropon Premeire by Valspar Crporation.
 - b. Or equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and his installer must examine the areas and conditions under which louvers and vents Work and associated items are to be installed and notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions and directions for the installation of anchorages which are to be embedded in concrete or masonry construction. Coordinate the delivery of such items to the Site.

3.3 INSTALLATION

- A. Locate and place louver units plumb, level and in proper alignment with adjacent work.
- B. Use stainless steel expansion bolt anchors with stainless steel washers and neoprene gaskets. Use spring clips at all anchors to stop deflection of the louver

frame. Provide anchors spaced 2 feet-0 inches on centers. Provide continuous aluminum angles for anchoring all operable louvers.

- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers, as shown.
- D. Repair finishes damaged by cutting, welding, soldering and grinding operations required for fitting and jointing. Restore finishes and prime coats of paint so that there is no evidence of corrective Work. Return items which cannot be refinished in the field to the shop, make the required alterations, and refinish the entire unit, or provide new units, as determined by ENGINEER.
- E. Protection of Aluminum from Dissimilar Materials: Coat all aluminum surfaces in contact with dissimilar materials such as concrete, masonry, steel and other metals as specified in Section 09 91 00, Painting.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 92 00, Joint Sealants, for sealants applied during louver installation.

3.4 FIELD QUALITY CONTROL

- A. Determine conformity of louver polyvinylidene fluoride finish to these Specifications, as follows:
 - 1. The manufacturer of the louver and vents shall set aside and label samples of the metal from each production lot for the job. Protect samples from weather.
 - 2. Make sample louver and vent available at all times, for comparison with installed louver and vent Work as requested by OWNER, for the full time of the warranty.
 - 3. Make color comparison measurements with a Hunter Tristimulus Color Difference Meter employing methods of computation in use at the National Bureau of Standards conforming to ASTM D 2224.

3.5 ADJUSTMENT AND CLEANING

- A. Set operable louver blades and adjust as needed to produce fully functioning units that comply with requirements.
- B. Test operation of operable louvers and adjust as needed to produce fully functioning units that comply with requirements.
- C. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

- D. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- E. Louvers with dents, warps, gouges or scratches shall be replaced with new louvers, at no additional cost to OWNER.

++ END OF SECTION ++

SECTION 09 62 53

CONCRETE FLOOR TOPPINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install all trowel-applied concrete floor toppings. The Work also includes:
 - a. Providing openings in concrete toppings to accommodate the Work under this and other Sections and building into the concrete toppings all items to be embedded in, or penetrate, the concrete topping floor system.
 - b. All systems shall include scarification, acid etching and other substrate preparations, bond coats, reinforcements, underlayment fills, moisture barrier coatings, binder coats, top coats, sealants and other components and system accessories recommended by the manufacturer for cast-in-place concrete floor slabs, curbs, equipment pads, tops and sides of containment walls, trenches, steps, sumps, equipment pits and similar cast-in-place concrete items, described in Part 2, below.
 - c. Provide a concrete topping system at the chemical storage facilities in the chemical storage areas, as shown.
 - d. Include manufacturer's recommended details for conditions encountered in the Work and a Site Quality Control Report, including procedures, test methods, results of tests, remedial recommendations and actions.
 - e. Provide complete technical services, as available from the manufacturer, and on-Site technical representation by manufacturer's technical representative during the time of material delivery, storage, mock-up, substrate preparation and the advancement of installation to thirty percent of floor areas receiving concrete topping systems and during the start of field quality control testing.
2. Extent of concrete toppings is shown and, in addition, includes the following:
 - a. 8-inch high concrete topping cove bases for all walls in all areas receiving concrete toppings, of same type as used for floor in that area.
 - b. Concrete toppings on top and sides of all equipment pads and curbs, of same type as used for floor in that area.
 - c. Concrete topping on bottoms and sides of all trench drains, and horizontal pipe chases, of same type as used for floor in that area.
3. Types of products required include the following:
 - a. Heavy-duty, reinforced vinyl ester, trowel-applied chemical resistant concrete topping.
 - b. Textured, chemical resistant topcoats.
 - c. Auxiliary materials and accessories.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the concrete toppings Work.
2. Coordinate and schedule preparation of substrates, before equipment and similar items are installed to avoid later difficulty, or delay, in performing the Work of this Section, to provide substrates within tolerances and surface profile specified.
3. Coordinate the protection of existing equipment to remain in place during substrate preparation.
4. Coordinate floor drain mounting heights and types. Provide floor drain type that accommodates 1/4-inch thick concrete floor topping.

C. Alternatives:

1. Do not change products, system components, colors or manufacturers after Shop Drawings and Samples have been accepted by Engineer.
2. Clearly identify, in a manner which is highlighted to Engineer, all proposed substitutions, modifications, variations, unspecified features and "or equal" products. Provide complete comparative data with specified products at time of Shop Drawing submission.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. ASTM C 150, Specification for Portland cement.
2. ASTM C 267, Test Methods for Chemical Resistance of Mortars, Grouts and Monolithic Surfacing and Polymer Concretes.
3. ASTM C 307, Test Method for Strength of Chemical-Resistant Mortar, Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
4. ASTM C 321, Test Method for Bond Strength of Chemical-Resistant Mortars.
5. ASTM C 413, Test Method for Absorption of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing and Polymer Concretes.
6. ASTM C 531, Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
7. ASTM C 579, Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes.
8. ASTM C 580, Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
9. ASTM D 635, Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
10. ASTM D 2047, Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.

11. ASTM D 2240, Test Method for Rubber Property - Durometer Hardness.
12. ASTM D 4060, Test Method for Abrasion Resistance of Organic Coatings by the Taber Abaser.
13. ASTM D 4226, Test Methods for Impact Resistance of Rigid Poly (Vinyl Chloride) (PVC) Building Products.
14. ASTM D 4258, Practice for Surface Cleaning Concrete for Coating.
15. ASTM D 4259, Practice for Abrading Concrete.
16. ASTM D 4262, Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
17. ASTM D 4263, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
18. ASTM D 4541, Test Method for Pull-Off Strength of Coatings Using Portable Abrasion-Testers.
19. ASTM E 329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
20. ASTM E 548, Guide for General Criteria Used for Evaluating Laboratory Competence.
21. ASTM E 648, Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
22. ASTM F 1869, Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
23. ASTM F 2170, Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
24. 40 CFR 59 Subpart D, National Volatile Organic Compound Emission Standards for Architectural Coatings.
25. MIL-D-3134, Deck Covering Materials.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Provide all components of concrete topping system and auxiliary products produced by a single manufacturer, where possible, including recommended primers, adhesives and edging strips, as required.
2. Provide products from manufacturer who participates in ISO certification programs and who manufacture concrete topping systems and auxiliary products conforming to the requirements of those programs.
3. Engage a single concrete topping system manufacturer who shall furnish the services of a technical representative to assist Contractor, Engineer and Owner by providing technical opinions on the adequacy of materials and methods of installation and Site quality control testing. The concrete topping system material manufacturer shall provide engineering field services to review the Project and the material application prior to surface preparation: to approve the applicator, the materials used, and the procedure to be used; to provide the minimum pull-off adhesion strength, when testing for adhesion; to observe and approve surface preparation; and to observe application. The field representative of the concrete topping system material manufacturer shall submit, through Contractor, written approvals of the proposed system

materials, application procedures, applicator, and surface preparation. The engineering field representative shall be an employee of the material manufacturer.

4. Furnish such services during the time of delivery, storage, mock-up construction, installation and field quality control testing of all concrete topping components.

B. Installer's Qualifications:

1. Engage a single installer, certified or licensed by the flooring materials manufacturer, regularly performing concrete toppings installation, and with documented skill and successful experience in the installation of the types of materials required; and who agrees to employee only tradesmen who are trained, skilled and have successful experience in installing the types of materials specified.
2. Submit name and qualifications to Engineer along with the following information on a minimum of three successful projects:
 - a. Names and telephone numbers of owners, architects or engineers responsible for projects.
 - b. Approximate contract cost of the concrete toppings.
 - c. Amount of area installed.
3. Submit proof of acceptability of installer by manufacturer to Engineer.

C. Testing Agency Qualifications: The independent testing agency shall demonstrate to Engineer's satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work in accordance with ASTM E 329 and as documented according to ASTM E 548, without delaying the Work.

D. Source Quality Control:

1. Engage a manufacturer who will provide complete technical services including preparation and review of Shop Drawings, installation methods and proposed detailing. Where the manufacturer requires additions, or changes to the Contract Documents these shall be at no additional cost to the Owner and only as acceptable to Engineer.
2. Provide all components of each concrete topping system produced by a single manufacturer, including recommended primers (if any), basecoat, aggregate, and topcoat materials.
3. Certify product shelf-life history for each product. Do not use resins and catalysts manufactured more than six months prior to the time they will be incorporated into the Work.
4. Constantly, store material to be used in the Work between 60°F and 75°F, and in accordance with the manufacturer's approved written recommendations, for not more than six months. Certify to Engineer that concrete topping materials have been manufactured within six months of installation and have not, nor will be, subjected to freezing temperatures.

E. Regulatory Requirements:

1. Fire Performance Characteristics: Provide concrete toppings with the following fire performance characteristics as determined by testing products in accordance with ASTM method indicated below by a certified testing laboratory or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Critical Radiant Flux: Class 1 Rating per NFPA 253 (ASTM E 648) (0.45 watts/cm² or greater).
- F. Mock-Ups:
1. Prior to the installation of each concrete topping system, but after Engineer's approval of Samples and Shop Drawings, install stepped-back mock-ups using substrate preparation, materials and application techniques specified for final Work. Provide all components of the concrete topping systems showing the correct installation, substrate preparation and the workmanship quality that shall be achieved in the Work.
 2. Build mock-ups at the Site, in location approved by Engineer, of full thickness and approximately 12 feet square, minimum. Include methods of installation typical to the Work including penetrations, crack and joint sealer system and cove details using all system components required for the Work.
 3. Obtain Engineer's acceptance of visual qualities, color, tolerances and slip-resistance of the mock-ups before start of concrete topping Work. Retain and protect mock-ups during construction as a standard for judging completed concrete topping Work. Do not alter mock-up after acceptance by Engineer.
 4. Build as many mock-ups as necessary to achieve Engineer's acceptance of the concrete topping systems.
 5. Concrete topping Work that proceeds without an acceptable mock-up shall be stopped, and a mock-up prepared for acceptance.
 6. Concrete toppings that do not meet the standard acceptance on the acceptable sample areas shall be removed and replaced with new material.
- G. Pre-Installation Conference:
1. Before erecting sample mock-up, Contractor, installer, and technical representative of each concrete topping system manufacturer shall meet on-Site with Engineer to discuss approved products and workmanship to ensure proper application of concrete topping system components and substrate preparation requirements.
 2. Review foreseeable methods and procedures related to the concrete topping Work, including, but not necessarily limited to, the following:
 - a. Review Project requirements and the Contract Documents.
 - b. Review required submittals, both completed and yet to be completed.
 - c. Review status of substrate work, including acceptance of surface preparations, drying, structural loading limitations and similar considerations.
 - d. Review requirements of field quality control testing and requirements for preparing Site Quality Control Report, as specified herein.
 - e. Review availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.

- f. Review required inspection, testing and certifying.
 - g. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
 - h. Review regulations concerning code compliance, environmental protection, health, safety, fire and similar considerations.
 - i. Review procedures needed for protection of concrete toppings during the remainder of the construction period.
- 3. Record the discussions of the Pre-Installation Conference and the decisions and agreements or disagreements reached, and furnish a copy of the record to each party attending. Record any revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.
 - 4. Reconvene the conference at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

- 1. Shop Drawings:
 - a. Drawings showing the extent where concrete toppings occur in each space. Show Interface details with other items occurring in the spaces such as thresholds, floor drains, floor hatches, coves, equipment pads, steps and stair nosings, trench drains and horizontal pipe chases.
 - b. Furnish drawings coordinated with cast-in-place concrete and showing all construction and other conditions encountered in the Work and manufacturer's approved and recommended details appropriate to construction, expansion and seismic joints as required for full concrete topping systems performance, whether or not specific indication is shown to the details of the specified manufacturer. Show recommended locations of all control and expansion joints in concrete topping Work.
- 2. Product Data:
 - a. Copies of specifications, technical information, test results, installation instructions and general recommendations from the concrete toppings manufacturer, for each type of concrete toppings product required. Include requirements for environmental conditions, and other conditions required for an acceptable installation providing features and performance as stated in manufacturer's literature.
- 3. Samples:
 - a. Stepped-back concrete topping systems applied to a 12-inch by 12-inch by 2-inch-thick concrete sample exposing each system component and demonstrating required surface preparation to be used on sample mock-ups and required thicknesses of concrete toppings. Apply concrete toppings to only one-half of the sample board, leaving the other half visible and with required substrate preparation.
 - b. Full selection of manufacturer's standard and custom colors for selection by Engineer. Engineer will preliminarily select a maximum

of three colors for consideration for use in the Work. Prepare 12-inch by 12-inch Samples of each color. From these Engineer will select a maximum of one colors to be used in the Work. Engineer will provide Contractor with locations of each color after this final selection.

- c. In addition to color, provide range of textures from smooth to heavily non-slip for selection for use on sample mock-up panel.
- d. Samples will be reviewed by Engineer for color selection, general appearance and as examples of the types of components to be installed on the mock-ups. Compliance with other requirements is the responsibility of Contractor.

B. Informational Submittals: Submit the following:

1. Certifications:

- a. Certificates stating that materials meet or exceed this Section's requirements and stating that materials have been provided as specified to meet performance criteria and installation requirements specified.
- b. Evidence of shelf-life history for all products, verifying compliance with requirements specified.
- c. Evidence of acceptance of the substrate and primers by the concrete topping materials manufacturer's technical representative.
- d. Contractor's Review: Accompanying request, submit to Engineer a written statement signed by Contractor, stating that the Contract Documents have been reviewed with the concrete topping materials manufacturer who confirms that the selected systems are proper, compatible and that the details proposed for use in the Work are not in conflict with the manufacturer's details.
- e. Statement of Application: Upon completion of the concrete topping Work, submit a notarized statement to Engineer signed by Contractor stating that the Work complies with the requirements of these Specifications, was installed in compliance with manufacturer's written recommendations, and that the installation methods were proper and adequate for the conditions of installation and use. Include evidence of acceptance of substrate by installer and manufacturer.

2. Test Reports:

- a. Copies of test reports verifying compliance with physical properties specified.
- b. Final Site Quality Control Report: Provide Engineer with testing results in each area of the Work, and Contractor's recommended remedial measures, weather, humidity and dew point conditions during the time of installation and curing of the Work, and other requirements as specified for final approval. Final payment for the concrete topping Work is contingent upon Engineer's acceptance of final Site Quality Control Report, including recommendations for and completion of all remedial Work.
- c. Component Application and Thickness Report:

- 1) Copies of reports listing each component application, dry film thickness, surface temperature, component temperature, and ambient air temperature.
 - d. Site Conditions Report.
 3. Qualifications Data:
 - a. Installer's.
 - b. Testing laboratory.
 - c. Manufacturers of "or equal" products shall provide direct property comparison with the material specified in addition to complying with all other requirements of these Specifications. "Or equal" products shall employ the same generic materials and system components as the product specified.
- C. Closeout Submittals: Submit the following:
1. Operations and Maintenance Data: Submit a detailed maintenance manual for each product, including the following information:
 - a. Product name and number.
 - b. Name, address, e-mail address and telephone number of manufacturer and local distributor.
 - c. Detailed procedures for routine maintenance and cleaning.
 - d. Detailed procedures for light repairs such as dents, scratches and staining.
 - e. Manufacturers' installation procedures and recommendations.
 2. Warranty Documentation: Submit Contractor's and manufacturer's written warranties.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with applicable requirements of referenced standards, Section 01 65 00, Product Delivery Requirements and Section 01 66 00, Product Storage and Handling Requirements.
1. Store all materials in a dry, enclosed area, off the ground and away from all possible contact with water and in a location where temperature can be constantly maintained between 60 F and 75 F and out of direct sunlight and away from open flame, sparks or other hazards.

1.6 PROJECT CONDITIONS

- A. Existing Conditions:
1. Review the existing conditions effecting the surface preparation and installation of concrete toppings and submit a report to the Engineer before installation. Existing facilities must meet all the requirements listed in 1.6.B. below. All deficiencies must be corrected before beginning installation.
- B. Environmental Conditions:
1. Remove all chemicals, compounds and other materials, where such materials are unacceptable to manufacturers of concrete topping systems,

from substrates to receive the concrete topping specified at no additional cost to the Owner, even if chemicals, compounds and other materials are permitted by other Sections of these Specifications.

2. Proceed with concrete topping Work only when temperature and moisture content of concrete slabs, building air temperature, relative humidity, dew point and other conditions comply with the concrete topping manufacturer's written recommendations and when no damaging environmental conditions are forecasted for the time when the materials will be subject to such environmental damage. Record all such conditions and include in final Site Quality Control Report.
3. Maintain substrate temperature and room temperature before, during and after installation above 60°F and rising in accordance with concrete topping material manufacturer's instructions.
4. Do not begin concrete topping Work until buildings are enclosed and manufacturer's recommended environmental conditions can be maintained, and only when manufacturer and installer are willing to guarantee the Work as required, and without additional reservations and restrictions.
5. Supplemental Heat:
 - a. Provide supplemental heat and protection as required to maintain concrete toppings at minimum of 60°F during and after installation.
 - b. Supplemental heat and power sources, as may be required should ambient temperature fall below 60°F, are not available at the Site. The provision of all supplemental heat, including fuel, equipment, operating and maintenance personnel and power sources, is the responsibility of Contractor.
 - c. Distribute heat uniformly and provide deflection or protective screens as required to prevent concentration of heat on concrete toppings near heat source.
 - d. Source of supplemental heat shall not emit contaminants that will adversely affect the color, cure or performance of the concrete toppings. Concrete topping systems so affected shall be removed and replaced with new.
6. Provide adequate ventilation, not only during installation but also after installation until the system has totally cured, with exhaust air adequately diluted and discharged to a safe location. Avoid build-up of hazardous vapors or the creation of hazardous conditions or conditions that may retard the cure of the system.
7. Permanent lighting shall be installed before commencing thin-set terrazzo Work. If not, a minimum uniform level of 50 footcandles shall be maintained.
8. Close spaces to traffic during concrete topping application and for not less than 24 hours after application unless manufacturer recommends a longer period.

C. Site-Measurements:

1. Verify actual dimensions in areas of installation by measurements taken at the Site before installation. Indicate dimensions on Shop Drawings.

2. Where measurements cannot be made without delaying the Work, establish dimensions and proceed with Shop Drawing preparation without Site verified dimensions. Coordinate supports, adjacent construction, and equipment locations to ensure actual dimensions shown on Shop Drawings correspond to dimensions established for concrete toppings Work.

1.7 SEQUENCING

- A. Proceed with the concrete toppings Work only after projections and penetrations through the substrates have been installed, and when the substrate construction and framing of openings is complete.
- B. Coordinate and schedule shot blasting, grinding and filling of cast-in-place concrete with underlayments, in order to bring substrate within tolerances specified.
- C. Provide concrete toppings on top of equipment pads, within horizontal pipe chases and similar locations where installation of equipment, piping and similar items would cause concrete topping installation difficulties, before such equipment, piping and similar items have been installed. In order to advance the Work, be prepared to schedule multiple visits of concrete topping installer to the Site for the purpose of installing concrete topping in areas that will become inaccessible with the installation of equipment or piping, as may be required for proper sequencing of the Work.
- D. Sequence the Work so that other installers do not interfere with, or need to cross, the concrete topping installation areas until such time as the concrete toppings can be adequately protected from potential damage.
- E. If concrete topping is installed on slabs over liquid holding tanks, such as wet wells, install the concrete topping before filling the tanks in order to meet the manufacturer's moisture content requirements.

1.8 WARRANTY

- A. General: The special warranties specified in this Article shall not deprive Owner of other rights or remedies Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents.
- B. Special Warranties:
 1. Provide written warranty, signed by Contractor and running to benefit of Owner, agreeing to remove and replace, for a period of three-years from the date of Substantial Completion, concrete topping materials that show defects in installation and workmanship or defects in material such as cracking, flaking, eroding in excess of specified requirements, peeling, delamination, abnormal aging or loss of color.

2. Repairs and replacements required because of acts of God, occupant damages, improper maintenance, fire or exposure to environmental conditions other than those for which the concrete toppings materials were tested and recommended by the manufacturer, and other events beyond Contractor's, installer's or manufacturer's control (and that exceed limits of specified performance requirements) are excluded from this warranty.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Performance Criteria:
 1. General:
 - a. Standards: Comply with applicable standards, recommendations and specified publications of ASTM, except to the extent more stringent requirements are specified or required by governing authorities having jurisdiction at the Site.
 2. VOC Content: Provide concrete topping systems that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Epoxy matrix: 0.0 g/L
 - b. Vinyl ester matrix: 100 g/L
- B. The finished concrete topping system shall provide abrasion resistance and splash and spill protection from the chemicals listed below. The concrete topping system may be exposed to sunlight.

2.2 MATERIALS

- A. Chemical Resistant Concrete Floor Topping Physical Properties: Provide the following trowel-applied vinyl ester composition flooring system capable of, and recommended by the manufacturer for, resisting strong concentrations of chemicals, heavy-duty trucking and heavy traffic.
 1. Acid Etch: Provide manufacturer's recommended ten percent muriatic acid etching compound in addition to shot blast scarification, grinding and other required surface preparations.
 2. Primer: Two-component, highly cross-linked, penetrating vinyl ester, as recommended by the manufacturer.
 3. Woven Fiberglass Roving Reinforcement: Provide a ten-ounce glass cloth reinforced system using materials recommended for the system and chemical resistance specified. Provide Type H glass cloth.
 4. Mortar: Two layers of trowel-applied vinyl ester mortar consisting of a three-component, highly cross-linked combination of organic peroxides and catalyst, vinyl ester resin and styrene monomers and selected, graded aggregates blended with inorganic pigments.
 5. Saturant: Two-component, as recommended by the manufacturer.

6. Topcoats: Provide optional mineral composite topcoat for increased impermeability and a chemical resistant textured topcoat for slip-resistance.
7. Termination Strips: White metal, tapered bar type as recommended by the manufacturer.
8. Colors: To be selected by Engineer from manufacturer's full selection of standard colors.
9. Textures: Non-slip surface.
 - a. Tensile Strength, ASTM D 307: 2,700 pounds per square inch, minimum.
 - b. Indentation, MIL-D-3134: 0.062-inches, maximum.
 - c. Bond Strength, ASTM C 321: 400 pounds per square inch, minimum.
 - d. Flame Spread, ASTM D 635: Self-extinguishing.
 - e. Thermal Coefficient of Linear Expansion, ASTM C 531: 2×10^{-5} -inches per inch per degree C, maximum.
 - f. Abrasive Resistance, ASTM D 4060: 0.10 gram maximum weight loss.
 - g. Flexural Strength, ASTM C 580: 8,000 pounds per square inch, minimum.
 - h. Compressive Strength, ASTM C 579: 11,000 pounds per square inch, minimum.
 - i. Surface Hardness - Shore D Durometer, ASTM D 2240: 85 to 90.
 - j. Water Absorption, MIL-D-3134: 0.12.
 - k. Chemical Resistance, ASTM C 267:

Reagent

20 percent Sodium Hypochlorite
50 percent Sodium Hydroxide

Film Integrity

Unaffected
Unaffected

10. Products and Manufacturers: Provide one of the following:
 - a. Stonchem 870AFC by Stonhard, Incorporated, Part of the StonCor Group.
 - b. Key Vinyl Ester STD by Key Resins Incorporated.
 - c. Or equal.

B. Auxiliary System Components:

1. Underlayment Grout: Heavy-duty, three-component, fast-setting, high temperature resistant, 100 percent solids epoxy grout for filling and leveling deep holes, erosions, modifying pitch in trench drains and similar uses in the Work, and recommended by the concrete toppings manufacturer for compatibility with concrete toppings specified.
2. Epoxy Grout Primer: Compatible primer as recommended by the concrete toppings manufacturer.
3. Epoxy Sealants: Two-component, self-leveling and non-sag, chemical resistant, flexible epoxy/polyamide sealants.
4. Waterproof Membrane: 100 percent solids, liquid-applied membrane providing a positive barrier against water penetration.

5. Protective Joint Sealer: Two-component, traffic bearing, fluoro-elastomeric joint sealer, recommended by the concrete toppings manufacturer for sealing and protecting floor sealant joints.
6. Heavy-Duty Industrial Detergent: Concentrated, biodegradable, industrial cleaner and degreaser.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Contractor shall examine the surfaces to receive concrete toppings, and the conditions under which the concrete toppings are to be installed, and notify Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work and the performance of the concrete topping systems. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.
- B. Subfloor shall have a wood float finish. Concrete shall have cured for 28 days prior to initiation of this Work and shall contain maximum 14 percent moisture.
- C. Do not proceed with concrete topping installation until manufacturer's technical representative approves condition of subfloor for warranted construction. Correct all unsatisfactory conditions, as required by manufacturer's technical representative, at no additional cost to the Owner. Record all such requirements and remedial actions as part of the final Site Quality Control Report.

3.2 PREPARATION OF CAST-IN-PLACE CONCRETE SUBSTRATE

- A. Concrete shall be free of curing compounds and form release agents.
- B. Test cast-in-place concrete for moisture, in compliance with ASTM D 4263, in order to determine that the maximum safe moisture-emission level, recommended by the concrete topping system manufacturer's written installation limitations, will not be exceeded, before installation of the concrete topping system.
 1. Perform minimum of one test for every 1,000 square feet of substrate area to receive the concrete topping system. Perform tests on areas scheduled to be coated the following day.
 2. If moisture tests indicate unacceptable levels of moisture remaining in the substrate, do not install the concrete topping system. Report existing conditions, along with manufacturer's recommendations, to Engineer. Allow additional time for cast-in-place concrete to dry and retest.
 3. Contractor may, at its option and expense, enclose, dehumidify or provide additional heat, in order to speed the drying process. If, after remediation measures are implemented, retesting the cast-in-place concrete continues to indicate unacceptable levels of moisture, perform calcium chloride tests in accordance with ASTM F 1869. If readings are below five pounds per 1,000

square feet for 24 hours install the primer. If readings are between five and eight pounds per 1,000 square feet for 24 hours install the moisture barrier coating, if readings are over eight pounds per 1,000 square feet for 24 hours submit the concrete topping system manufacturer's recommended remedial action for Engineer's acceptance.

- C. Prepare and clean all surfaces of cast-in-place concrete to receive the concrete topping system in compliance with ASTM D 4259 to obtain a uniform and continuous anchor profile and to provide a surface texture similar to 40 to 60-grit sandpaper with aggregate showing. Use mechanical abrading procedures and abrasive blasting procedures as specified in ASTM D 4259. Use 40 to 80-mesh abrasive and clean, dry, compressed air. Compressed air cleanliness shall be in compliance with ASTM D 4285. Pressure at blasting nozzle shall not exceed 80 psi. Do not concentrate blast on surface, but move at a fairly rapid rate to provide a surface free of laitants and contaminants. Provide post-surface preparation cleaning in accordance with ASTM D 4258 to remove loose material. Surface preparation shall open all surface air holes by removing all laitance shoulders surrounding the air holes. Vacuum all surfaces to remove all dust and sand, and wash with potable water.
 - 1. Provide additional surface preparation if 40 to 60-grit texture with aggregate showing is not achieved after the first mechanical preparation procedure.
 - 2. All surface laitance and other contaminants shall be completely removed and surface profile shall be as specified, before commencement of surfacer installation.
- D. In addition to abrasive blasting, level and grind cast-in-place concrete substrates to manufacturer's recommended tolerances and to produce a smooth, uniform installation.
 - 1. Remove all cast-in-place concrete fins, projections and other surface irregularities that would protrude above the surfacer and finished base coat, by chipping and scarification by mechanical abrasion.
- E. Adhesion Testing: Before application of the concrete topping system, an adhesion test shall be conducted on a properly prepared concrete surface that is acceptable to the material manufacturer and Engineer. The test area shall be at least two square feet or larger to allow a minimum of three tests to be conducted. The test area shall be coated with the specified system and cured as recommended by the material manufacturer. Pull-off strength adhesion tests of concrete topping system shall be conducted by the material manufacturer in accordance with ASTM D 4541, using an Elcometer tensile adhesion tester. At least three adhesion tests shall be conducted and the results averaged. Adhesion strength shall equal or exceed the minimum adhesion strength recommended by the material manufacturer and shall exceed the tensile strength of the concrete. If the concrete topping system fails the adhesion test, the cause of the failure shall be determined and corrected before re-conducting the test.

- F. Start of the concrete topping system operations shall indicate acceptance of substrate conditions and full responsibility for the completed Work.
- G. Provide cast-in-place concrete substrates free from voids and sharp projections before placing any concrete topping system.
 - 1. Remove surface irregularities on cast-in-place concrete and fill all holes, honeycombs, spalls and cracks using manufacturer's recommended epoxy grout underlayment, flexible membrane, fiberglass woven roving and epoxy grout primer as indicated on manufacturer's details shown on approved Shop Drawings.
 - 2. The prepared substrate shall have a minimum tensile strength of 250 pounds per square inch when tested in compliance with ASTM D 4541. Repair areas of unacceptable consolidation.
- H. Slope or fill concrete substrate using epoxy grout underlayment and epoxy grout primer as may be required to achieve a uniform, smooth slope-to-drain finished appearance.
- I. Prior to start of applying concrete toppings, dry or wet vacuum surfaces to be covered and inspect the substrate. Remove all dust, loose stones and debris. Concrete shall be thoroughly dry before application of primer.
- J. Primer: Apply primer as recommended by concrete topping manufacturer, prior to application of the basecoat. Apply in accordance with manufacturer's instructions as accepted by Engineer at time of Shop Drawing submission.
- K. Waterproofing membrane: Apply membrane as recommended by concrete topping manufacturer, in accordance with manufacturer's instructions as accepted by Engineer at time of Shop Drawing submission.
- L. Reinforcing membrane: Apply membrane to all cracks as recommended by concrete topping manufacturer, in accordance with manufacturer's instructions as accepted by Engineer at time of Shop Drawing submission.
- M. As part of final Site Quality Control Report, include confirmation that the substrate was prepared as specified and was acceptable to install the Work conforming to the requirements of this Section.

3.3 INSTALLATION

- A. Do not power trowel concrete toppings, unless manufacturer provides written certification, accepted by Engineer, that material shall experience no loss in compressive strength or tensile strength.
- B. Apply termination and expansion joint strips at the junction of the flooring with other materials and at expansion joints as recommended by the manufacturer. Locate accent strips as shown.

- C. Mix materials and apply bonding coat in accordance with manufacturer's instructions.
- D. Apply integral cove base 8-inches high, with rounded corners in accordance with manufacturer's instructions. Apply cove base before flooring.
- E. Apply epoxy mortar floor topping body coat to not less than 1/4 -inch dry cured minimum thickness, or as specifically recommended by the manufacturer to achieve the physical properties and dimensional tolerances specified.
- F. Apply mortar coat evenly over substrate.
- G. Apply glass reinforcement fabric onto wet body coat mortar material, with glass reinforcement fabric between the two mortar layers. Overlap adjacent fabric a minimum of 1/2-inch. Immediately apply saturant, applying just enough to make the fabric lose its white color. When the fabric is completely saturated, roll with a ribbed roller to release all air pockets in the reinforcement, following manufacturer's approved written instructions.
- H. Apply mortar coat to tacky glass reinforcement fabric
- I. Apply vinyl ester floor topcoat to 15 mil -inch dry cured minimum thickness, or greater if specifically recommended to achieve the physical properties, chemical resistances and dimensional tolerances specified.
- J. Power sand to remove trowel marks. Vacuum the area completely before applying topcoats.
- K. Apply additional topcoats for maximum chemical resistance and cleanability as recommended by the manufacturers. Apply following manufacturer's approved written instructions.
- L. Total thickness: 1/4-inch, minimum.

3.4 FIELD QUALITY CONTROL

- A. General: Before start of installation of concrete toppings, perform the following field quality control tests and include procedures and results in final Site Quality Control Report. Incorporate installation or system improvements, as may be recommended based on test results, into the remainder of the Work.
- B. Core Sampling: At the direction of Owner and at locations designated by Owner, take one core sample per 1,000 sq. ft. of concrete toppings, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring and correct deficiencies.

- C. Material Sampling: Owner may, at any time and any number of times during concrete toppings application, require material samples for testing for compliance with requirements.
1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.
- D. Chemical Resistant Concrete Floor Topping Testing: After acceptance of mock-up and substrate preparations, install a minimum of 200 square feet of chemical resistant concrete topping system in a chemical containment dike area, in a location acceptable to the Engineer. Installation of test area shall be supervised and approved by manufacturer's technical representative as an acceptable installation. Test the chemical resistant concrete topping system for a minimum of 48 hours at normal operating temperatures. Place sodium hypochlorite at 15 percent concentration at normal operating temperature to a minimum depth of 1/2-inch over the entire floor surface of the containment area. Maintain operating temperature of space and sodium hypochlorite. After 48 hours remove the chemical and inspect the surfaces of the chemical resistant concrete topping. Concrete topping shall show no signs of delamination, cracking, crazing, color change, softening or any other physical or chemical changes whatsoever, and shall be unaffected from the immersion condition. If concrete topping shows any deterioration, the test shall be repeated at Contractor's expense. If the concrete topping fails to perform according to the requirements of this Section at the completion of this second test, the concrete topping system will be rejected by Engineer and an approved "equal" product shall be submitted for acceptance. Test approved "equal" product as specified herein.
- E. At the end of the quality control test periods and before installation commences, installer, Contractor, technical representative and Engineer shall make final inspections of concrete topping systems and Contractor shall prepare a written report to Engineer describing all methods, observations, results and deterioration or damage found in the Work with recommendations for correcting such damage.
1. Include photographic records of all test areas before, during and after the tests and photos of all damage and physical changes in the concrete toppings. The report shall contain all comments made by all parties, test results, and manufacturer's performance claims as accepted by Engineer at time of Shop Drawing submittal as compared to the actual results of the field-testing. Make changes to report as required by Engineer. Include quality control test report as part of final Site Quality Control Report.

- F. Allowable Installation Tolerances:
1. Do not install the Work until substrate preparation and tolerances have been accepted by Engineer, concrete topping manufacturer's technical representative and the concrete topping installer and Contractor has verified to Engineer that substrates are within tolerances and profiles specified and acceptable to produce acceptable Work. Work advanced, for any reason, without such verification shall be stopped, and concrete toppings removed and replaced with new material if substrates are determined to be unacceptable for the Work.
 2. Substrate Tolerances:
 - a. Out-of-Plane: 1/8-inch maximum in ten feet and 1/16-inch maximum in any 12-inches measured along the plane.
 - b. Maximum Offset in Plane Alignment: 1/16-inch.
 - c. Variation From Slope: 1/8-inch maximum in ten feet.
 3. Concrete Floor Toppings Tolerances:
 - a. Finished concrete toppings level to 1/8-inch in ten feet with smooth continuous uniformly sloped-to-drain planes.
 - b. Provide smooth continuous color with no color streaks or inconsistencies with smoothly textured non-slip finish.

3.5 PROTECTION, ADJUSTMENT AND CLEANING

- A. Upon completion of the Work, installer shall advise Contractor of recommended procedures for its surveillance and protection of the concrete topping Work during the remainder of the construction period.
- B. Do not allow construction traffic that is not associated with the installation of the concrete toppings and related materials in the area of Work. Concrete toppings shall be kept free of all traffic for a minimum of seven days after completion of topcoating. Protect installed concrete toppings from damage, by use of heavy Kraft paper and other covering placed after topcoat is tack-free.
- C. Concrete topping damaged in any manner shall be replaced.
- D. Only the original installer shall replace deteriorated or defective Work found at the time of final inspection. Only the original installer shall be engaged by Contractor to repair damages to the concrete toppings that occur subsequent to concrete topping installation and prior to final inspection.
- E. After the Work has been completed in the areas of concrete toppings, and before Substantial Completion, clean all floors and other surfaces containing concrete toppings, using methods recommended by the concrete topping manufacturer.
- F. The concrete toppings at the time of Substantial Completion shall be clean and without damage, and shall not be soiled in any way. Vacuum and wet mop areas that become soiled after initial cleaning, up to the time of Substantial Completion.

++ END OF SECTION ++

SECTION 09 91 00

PAINTING

PART 1 - GENERAL1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and apply paint systems.
 - a. CONTRACTOR is responsible for surface preparation and painting of all new and existing interior and exterior items and surfaces throughout the Project areas included under this and other Sections.
2. Extent of painting includes the Work specified below. Painting shown in schedules may not provide CONTRACTOR with complete indication of all painting Work. Refer to Article 2.2 of this Section where all surfaces of generic types specified are specified for preparation and painting according to their status, intended function, and location, using the painting system for that surface, function, and location as specified, unless specifically identified on the Drawings as a surface not to receive specified painting system.
 - a. All new and specifically identified existing surfaces and items except where the natural finish of the material is specified as a corrosion-resistant material not requiring paint; or is specifically indicated in the Contract Documents as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint them the same as adjacent similar materials or areas.
 - b. Mechanical and process items to be painted include:
 - 1) Piping, pipe insulation, pipe hangers, and supports, including electrical conduit.
 - 2) Heat exchangers.
 - 3) Tanks.
 - 4) Ductwork and insulation.
 - 5) Motors, mechanical equipment, and supports.
 - 6) Accessory items.
 - c. Surface preparation and painting of all new and specifically identified existing items, both interior and exterior, and other surfaces, including items furnished by OWNER, are included in the Work, except as otherwise shown or specified.
 - d. Removal of all substances, top coats, primers and all intermediate coats of paint and other protective or decorative coatings on those items and surfaces to remain that are identified to receive a painting system under this Section, to provide surfaces acceptable for application of painting specified.
 - e. Approved stepped-down mock-ups for all painting systems showing all components of the surface preparation and paint system application before start of Work. Check all dry film thicknesses; demonstrate methods of surface

preparation, and methods of application, and obtain ENGINEER's approval of colors and textures to be used in the Work.

B. Coordination:

1. Review installation, removal, and demolition procedures under other Sections and coordinate them with the Work specified in this Section.
2. Coordinate painting of areas that will become inaccessible once equipment, laboratory furniture, lockers and similar fixed items have been installed.
3. Coordinate primers with finish paint materials to provide primers that are compatible with finish paint materials. Review other Sections where primed surfaces are provided, to ensure compatibility of total painting system for each surface. CONTRACTOR is responsible for coordinating compatibility of all shop primed and field painted items in other Sections.
4. Furnish information to ENGINEER on characteristics of finish materials proposed for use and ensure compatibility with prime coats used. Provide barrier coats over incompatible primers or remove and repaint as required. Notify ENGINEER in writing of anticipated problems using specified painting systems with surfaces primed by others. Reprime equipment primed in factory and other factory-primed items that are damaged or scratched.

C. Related Sections:

1. Section 07 92 00, Joint Sealants.

D. Work Not Included: The following Work is not included as painting Work, or are included under other Sections:

1. Shop Priming: Shop priming of structural metal, miscellaneous metal fabrications, other metal items and fabricated components such as shop-fabricated or factory-painted process equipment, plumbing equipment, heating and ventilating equipment, electrical equipment, and accessories shall conform to applicable requirements of this Section but are included under other Sections or in other contracts.
2. Pre-finished Items:
 - a. Items furnished with such finishes as baked-on enamel, porcelain, and polyvinylidene fluoride shall only be touched up at Site by CONTRACTOR using manufacturer's recommended compatible field-applied touchup paint.
 - b. Items furnished with finishes such as chrome plating or anodizing.
3. Concealed Surfaces: Non-metallic wall or ceiling surfaces in areas not exposed to view, and generally inaccessible areas, such as furred spaces, pipe chases, duct shafts, and elevator shafts.
4. Concrete surfaces, unless otherwise shown or specified.
5. Concrete floors, unless specifically shown as a surface to be painted.
6. Face brick, glazed structural tile, and prefaced, ground-faced or split-faced concrete unit masonry.
7. Exterior face of architectural precast concrete.
8. Collector bearings, shafts and chains, wood flights, wood stop logs, and wood or fiberglass baffles.

9. Corrosion-Resistant Metal Surfaces: Where the natural oxide of item forms a barrier to corrosion, whether factory- or Site-formed, including such materials as copper, bronze, muntz metal, terne metal, and stainless steel.
 10. Operating Parts and Labels:
 - a. Do not paint moving parts of operating units, mechanical and electrical parts such as valve and damper operators, linkages, sensing devices, interior of motors, and fan shafts.
 - b. Do not paint over labels required by governing authorities having jurisdiction at Site, or equipment identification, performance rating, nameplates, and nomenclature plates.
 - c. Cover moving parts and labels during the painting with protective masking. Remove all protective masking upon completion of Work. Remove all paint, coatings, and splatter that comes in contact with such labels.
 11. Structural and miscellaneous metals covered with concrete need not receive primers, intermediate, or finish coats of paint.
- E. Description of Colors and Finishes:
1. Color Selection:
 - a. A maximum of three different colors will be selected by ENGINEER in addition to color coding of pipelines, valves, equipment, ducts, and electrical conduit.
 - b. ENGINEER reserves the right to select non-standard colors for paint systems specified within ability of paint manufacturer to produce such non-standard colors. Provide such colors at no additional expense to OWNER.
 2. Color Coding of Pipelines, Valves, Equipment, and Ducts:
 - a. In general, color-coding of pipelines, valves, equipment and ducts shall comply with applicable standards of ANSI A13.1, ANSI Z535.1 and 40 CFR 1910.144. Provide color-coding for pipelines per Table 09 91 00-B, Pipeline Color Table.
 - b. For equipment on roofs or exposed to view, such as on exterior building facades and in offices and lobbies, color shall be selected by ENGINEER.
 3. Color Coding of Pipelines and Equipment:
 - a. Finish coats of paint for pipelines and equipment shall be coded in basic colors. Colors shall be brilliant, distinctive shades matching the following safety and pipeline colors per ANSI Z535.1, Recommended Standards for Water Works; Recommended Standards for Wastewater Facilities, color specifications for safety colors and other primary colors:

<u>Color</u>	<u>Designation*</u>
Aqua	Aqua Sky; 10GN
Black	Black; 35GR
Blue	True/Safety Blue; 11SF
Brown	Terra Cotta; 07RD
Charcoal	Deep Space; 34GR
Dark Blue	Academy Blue; 35BL
Dark Brown	Medium Bronze; 85BR

Dark Gray	Slate Gray; 31GR
Gray	Gray-ANSI 61; 33GR
Green	Spearmint/Safety Green; 09SF
Light Blue	Fontain Bleau; 25BL
Light Brown	Twine; 68BR
Light Gray	Light Gray; 32GR
Light Green	Margarita; 38 GN
Olive	Clover; 110GN
Orange	Tangerine/Safety Orange; 04SF
Red	Candy Apple/Safety Red; 17SF
White	White; 11WH
Yellow	Lemon/Safety Yellow; 02SF

* Color designations are provided per Tnemec Company, Inc. paint color numbers and are provided as a standard of quality; equivalent colors matching these colors are acceptable. Provide with Shop Drawing submittal direct color comparisons of color numbers available from manufacturer submitted.

b. General Color Code: Unless otherwise specified, use the following color code:

**TABLE 09 91 00-B
PIPELINE COLOR TABLE**

<u>Pipeline</u>	<u>Color</u>
<u>CHEMICALS</u>	
Fluoride	Light Blue/Red Bands
Sodium Hypochlorite	Yellow

- c. Color of final coats shall match as closely as possible, without custom blending, color tabulated for specific pipeline service.
4. After approval by ENGINEER of colors and Shop Drawings and prior to commencing painting Work, ENGINEER will furnish color schedules for surfaces to be painted.

F. Abbreviations and Symbols:

1. Abbreviations and symbols used in painting systems are explained in Article 2.2 of this Section and provide information on generic composition of required materials, manufacturers, number of coats and dry mil film thickness per coat (DMFTPC), and coverage for determining required number of gallons for the Work.

1.2 REFERENCES

A. Referenced Standards: Standards referenced in this Section are:

1. ANSI A13.1, Scheme for Identification of Piping Systems.
2. ANSI Z535.1, Safety Color Code.
3. ANSI/NSF Standard 60, Drinking Water Treatment Chemicals - Health Effects.
4. ANSI/NSF Standard 61, Drinking Water System Components – Health Effects.

5. ASTM D16, Terminology for Paint, Related Coatings, Materials and Applications.
6. ASTM D2200, Pictorial Surface Preparation Standards for Painting Steel Surfaces.
7. ASTM D4258, Practice for Surface Cleaning Concrete for Coating.
8. ASTM D4259, Practice for Abrading Concrete.
9. ASTM D4262, Testing Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
10. ASTM D4263, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
11. ASTM D4285, Test Method for Indicating Oil or Water in Compressed Air.
12. ASTM D4417, Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
13. ASTM D4541, Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion-Testers.
14. ASTM E329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
15. AWWA C652, Disinfection of Water-Storage Facilities.
16. AWWA D102, Coating Steel Water-Storage Tanks.
17. California Air Resources Board (CARB) Revised Suggested Control Measure (SCM)
18. 29 CFR 1910.144, Safety Color Code for Marking Physical Hazards.
19. 40 CFR, Subpart D-2001, National Volatile Organic Compound Emission Standards for Architectural Coatings.
20. South Coast Air Quality Management District (SCAQMD) Rule 1113,
21. Green Seal, Inc. Paint, (GS-11).
22. Maricopa County, Arizona Architectural Coatings Rule 335.
23. National Association of Piping Fabricators, NAPF 500-03, Surface Preparation Standard For Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings And/or Special Internal Linings.
24. Ozone Transport Commission, (OTC), OTC Model Rule for Architectural and Industrial Maintenance Coatings.
25. Resource Conservation and Recovery Act of 1976 (RCRA).
26. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
27. SSPC SP 1, Solvent Cleaning.
28. SSPC SP 3, Power Tool Cleaning.
29. SSPC SP 6, Commercial Blast Cleaning.
30. SSPC SP 10, Near-White Blast Cleaning.
31. SSPC SP 11, Power Tool Cleaning To Bare Metal.
32. SSPC VIS 1, Visual Standard for Abrasive Blast Cleaned Steel.
33. SSPC VIS 2, Method of Evaluating Degree of Rusting/Painted Steel Surfaces.
34. SSPC Volume 2, Systems and Specifications.

1.3 DEFINITIONS

- A. Standard coating terms defined in ASTM D16 apply to this Section, including:
1. Paint: Pretreatment and all painting system materials, such as primer, emulsion, enamel, organic/inorganic polymer coating, stain sealer and filler, and other applied materials whether used as prime, filler, intermediate, or finish coats.
 2. Exposed: All items not covered with cement plaster, concrete, or fireproofing. Items covered with these materials shall be provided with specified primer only, except where specified as a surface not to be painted. Exposed-to-view surfaces include areas visible after permanent or built-in fixtures, convector covers, ceiling tile, covers for finned tube radiation, grilles, and similar covering products are in areas scheduled to be painted.
 3. LEED Compliant: As defined by the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED), means interior field-applied coatings that shall have a maximum volatile organic compound (VOC) and chemical content as listed in Green Seal, Inc. Paints (GS-11).
 4. Low VOC: All interior and exterior field-applied coatings that have maximum VOC content as listed in OTC Model Rule for Architectural and Industrial Maintenance Coatings.
 5. OTC: Ozone Transport Commission, which recommends standard VOC content levels in several Northeastern and Mid-Atlantic states.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications:
1. Engage a single applicator that regularly performs installation of paint materials, with documented skill and successful experience in installing types of products required and that agrees to employ only trained, skilled tradesmen who have successful experience in installing types of products specified.
 2. Submit name and qualifications to ENGINEER along with following information for at least three successful, completed projects:
 - a. Names and telephone numbers of owner and design professional responsible for project.
 - b. Approximate contract cost of paint products.
 - c. Amount of area painted.
 3. Submit to ENGINEER proof of acceptability of applicator by manufacturer.
- B. Testing Agency Qualifications: Provide an independent testing agency for testing specified in this Section. Testing agency shall be selected by OWNER and paid for by CONTRACTOR. When requested, submit documentation demonstrating to satisfaction of ENGINEER, that testing agency has experience and capability to satisfactorily conduct testing required without delaying the Work, in accordance with ASTM E329.
- C. Source Quality Control:
1. Obtain materials from manufacturers that will provide services of a qualified manufacturer's representative at Site at commencement of painting Work, to advise

on products, mock-ups, installation, and finishing techniques and, at completion of Work, to advise ENGINEER on acceptability of completed Work and during the course of the Work as may be requested by ENGINEER.

2. Certify long-term compatibility of all coatings with surfaces.
3. Do not submit products that decrease number of coats, surface preparation, or generic type and formulation of coatings specified. Products exceeding VOC limits and chemical content specified will not be approved.
4. ENGINEER may review manufacturers' recommendations concerning methods of installation and number of coats of paint for each painting system. CONTRACTOR shall prepare construction costs based on painting systems, number of coats, coverage's and installation methods specified.
5. Submit "or equal" products, when proposed, with direct comparison to products specified, including information on durability, adhesion, color and gloss retention, percent solids, VOC's grams per liter, and recoatability after curing.
6. "Or equal" manufacturers shall furnish same color selection as manufacturers specified, including intense chroma and custom pigmented colors in all painting systems.
7. Color Pigments: Provide pure, non-fading, applicable types to suit surfaces and services to be painted. Comply with:
 - a. Lead and Chromate: Lead and chromate content shall not exceed amount permitted by authorities having jurisdiction.
 - b. Areas subject to hydrogen sulfide fume exposure will be identified by ENGINEER. Through CONTRACTOR, paint manufacturer shall notify ENGINEER of colors that are not suitable for long-term color retention in such areas.
 - c. Manufacturer shall identify colors that meet the requirements of authorities having jurisdiction at Site for use in locations subject to contact with potable water or water being prepared for use as potable water.
 - d. Comply with paint manufacturer's recommendations on preventing coating contact with levels of carbon dioxide and carbon monoxide that may cause yellowing during application and initial stages of curing of paint.
8. Obtain each product from one manufacturer. Multiple manufacturing sources for the same system component are unacceptable.
9. Certify product shelf life history for each product source for materials manufactured by the same manufacturer, but purchased and stored at different locations or obtained from different sources.
10. Constantly store materials to be used for painting Work between 60 degrees F and 90 degrees F, and per paint manufacturer's written recommendations, for not more than six months. Certify to ENGINEER that painting materials have been manufactured within six months of installation and have not, nor will be, subjected to freezing temperatures.

D. Regulatory Requirements:

1. Painting systems for surfaces in contact with potable water, or water being treated for potable use, shall not impart any taste or odor to the water or result in any organic or inorganic content in excess of the maximum allowable contaminant level

established by authorities having jurisdiction at Site. Such painting systems shall be approved by the regulatory agency. Revise painting systems specified herein to provide manufacturer's regulatory agency approved painting system(s) where required.

2. Comply with VOC content limits of OTC Model Rule for Architectural and Industrial Maintenance Coatings:
 - a. Industrial Maintenance Coatings: 340 grams per liter.
 - b. Interior and Exterior Non-Flat Coatings: 150 grams per liter.
3. Comply with the following:
 - a. 29 CFR 1910.144, Safety Color Code for Marking Physical Hazards.
 - b. 40 CFR, Subpart D-2001, National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - c. Resource Conservation and Recovery Act of 1976 (RCRA).
 - d. SW-846, Toxic Characteristic Leaching Procedure (TCLP).
4. Comply with authorities having jurisdiction at Site for blast cleaning, confined space entry, and disposition of spent abrasive and debris.

E. Mock-ups:

1. Demonstrate installation of specified painting systems on actual wall surfaces and building components at locations selected by ENGINEER.
2. Provide 4-foot by 8-foot stepped-down sample area for each painting system. Prior to application of painting system, but after ENGINEER's approval of the components of each painting system, apply a 4-foot wide sample of each operation and application step required by this Section and specified manufacturer's written application recommendations. Show each application step as a 2-foot long section that shall remain exposed to demonstrate work performed in that step. Continue application procedures until topcoat is provided. Topcoat shall be a minimum of two feet long. When completed, finished mock-up for each paint system shall reveal each step and each coat of paint required for paint system with 2-foot wide strips revealing Work performed to prepare surface and apply each coat. Lengthen overall mock-up as required to completely demonstrate each painting system. Use tinted shades differing from coat to coat for each component of each painting system.
3. ENGINEER may approve or disapprove each component of each painting system on an individual component basis.
4. Painting Work that does not meet standard approved on sample areas shall be removed and replaced.
5. Painting Work advanced without approved mock-ups shall stop, and mock-ups prepared for approval by ENGINEER.

F. Pre-painting Conference:

1. Prior to installing painting systems, arrange a meeting at Site with painting applicator and its foreman, paint manufacturer's technical representative, installers of other work in and around painting that must follow painting Work, ENGINEER, and other representatives directly concerned with performance of painting Work. Record discussions of conference and decisions and agreements and disagreements

and furnish a copy of record to each party attending. Review foreseeable methods and procedures relating to painting Work including:

- a. Review Project requirements including Contract Documents, approved Shop Drawings, pending and approved Change Orders, requests for information that submitted by CONTRACTOR to ENGINEER, and other pertinent documents.
 - b. Review required samples and submittals, both completed and to be completed.
 - c. Review status of surfaces including drying, surface preparations, and similar considerations.
 - d. Review availability of materials, tradesmen, equipment, and facilities required for progress, to avoid delays, and to protect Work from damage.
 - e. Review required inspection, testing, certifying, and quality control procedures.
 - f. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions. Supplemental heating sources required to for working in low-temperature conditions, shall be operating and acceptable to paint applicator and ENGINEER.
 - g. Review methods for complying with regulations of authorities having jurisdiction at Site, such as compliance with environmental protection, health, safety, fire, and similar regulations.
 - h. Review laws and procedures covering removal and disposal of blast debris.
2. Reconvene meeting at earliest opportunity if additional information must be developed to conclude the required topics of the meeting.
 3. Record revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:
 - a. Copies of manufacturer's technical information and test performance data, including paint analysis, VOC and chemical component content in comparison to maximum allowed by the Contract Documents, and application instructions for each product proposed for use.
 - b. Submit proof of acceptability of proposed application techniques by paint manufacturer selected.
 - c. Copies of CONTRACTOR's proposed protection procedures in each area of the Work explaining methods of protecting adjacent surfaces from splatter, for confining application procedures in a manner that allows other work adjacent to surface preparation and painting Work to proceed safely and without interruption, and for maintaining acceptable application, curing, and environmental conditions during and after painting systems application.
 - d. List each material and cross-reference to the specific painting system and application, including a list of site-specific surfaces to which painting system will be applied. Identify by manufacturer's catalog number and general classification. State number of gallons of each product being purchased for delivery to Site and square foot area calculated to be covered by each painting system specified based on theoretical loss of 20 percent. Where actual area to

be covered by paint system exceeds area submitted to ENGINEER for that system, proof of additional material purchase shall be provided to ENGINEER. Calculated coverage shall be as specified for each component of each painting system specified. This requirement does not take precedence over CONTRACTOR's responsibility to provide dry film thickness required for each component of each painting system.

- e. Identify maximum exposure times allowable for each paint system component before next coat of paint can be applied. Submit proposed methods for preparing surfaces for subsequent coats if maximum exposure times are exceeded.
 - f. Information on curing times and environmental conditions that affect curing time of each paint system component and proposed methods for accommodating variations in curing time. Identify this information for each painting system in the Work.
 - g. Specification for spray equipment with cross-reference to paint manufacturer's recommended equipment requirements.
2. Samples:
- a. Copies of manufacturer's complete color charts for each coating system.
 - b. Mock-ups specified for the Site.

B. Informational Submittals: Submit the following:

- 1. Certificates:
 - a. Certificate from paint manufacturer stating that materials meet or exceed Contract Documents requirements.
 - b. Evidence of shelf life history for all products verifying compliance with the requirements of the Contract Documents.
 - c. CONTRACTOR shall provide notarized statement verifying that all painting systems are compatible with surfaces specified. All painting systems components shall be reviewed by an authorized technical representative of paint manufacturer for use as a compatible system. Verify that all painting systems are acceptable for exposures specified and that paint manufacturer is in agreement that selected systems are proper, compatible, and are not in conflict with paint manufacturer's recommended specifications. Show by copy of transmittal form that a copy of letter has been transmitted to paint applicator.
- 2. Test Reports:
 - a. Certified laboratory test reports for required performance and analysis testing in compliance with ASTM E329.
 - b. Adhesion testing plan and procedures.
 - c. Results of adhesion testing on existing surfaces containing paints or other coatings to be topcoated with paint systems specified. Prior to adhesion testing, submit a testing plan establishing methods, procedures and number of tests in each area where existing coatings are to remain and become substrate for painting Work. Based on results of adhesion testing, recommend methods, procedures, and painting system modifications, if necessary, for proceeding with Work.

- d. Locations of and test methods for soil sampling before beginning Work and after Substantial Completion.
 - e. Proposed methods for testing, handling, and disposal of waste generated during Work.
 - f. Results of alkalinity and moisture content tests performed in accordance with ASTM D4262 and ASTM D4263.
 - g. Results of tests of film thickness, holidays, and imperfections.
 - 3. Manufacturer's Instructions: Provide paint manufacturer's storage, handling, and application instructions prior to commencing painting Work at Site.
 - 4. Manufacturer's Site Reports: Provide report of paint manufacturer's representative for each visit to Site by paint manufacturer's representative.
 - 5. Special Procedure Submittals:
 - a. Proposed protection procedures for each area of Work, explaining methods of protecting adjacent surfaces from splatter, for confining application procedures in a manner that allows other work adjacent to surface preparation and painting Work to proceed safely and without interruption.
 - b. Site-specific health and safety plan.
 - c. Procedures for maintaining acceptable application, curing and environmental conditions during and after painting systems application.
 - d. Procedures for providing adequate lighting, ventilation, and personal protection equipment relative to painting Work.
 - 6. Qualifications:
 - a. Applicator.
 - b. Testing laboratory
- C. Closeout Submittals: Submit the following:
- 1. Operations and Maintenance Data: Upon completion of the painting Work, furnish ENGINEER five copies of detailed maintenance manual including the following information:
 - a. Complete and updated product catalog of paint manufacturer's currently available products including complete technical information on each product. Identify product names and numbers of each product used in the painting Work.
 - b. Name, address, e-mail address and telephone number of manufacturer, local distributor, applicator and technical representative.
 - c. Detailed procedures for routine maintenance and cleaning.
 - d. Detailed procedures for light repairs such as dents, scratches and staining.
 - 2. Record Documentation: Statement of Application: Upon completion of the painting Work, submit a notarized statement to ENGINEER signed by CONTRACTOR and painting applicator stating that Work complies with requirements of the Contract Documents and that application methods, equipment, and environmental conditions were proper and adequate for conditions of installation and use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Product Delivery Requirements: Deliver products to Site in original, new, and unopened packages and containers, accurately and legibly and accurately labeled with the following:
 - 1. Container contents, including name and generic description of product.
 - 2. Manufacturer's stock number and date of manufacture.
 - 3. Manufacturer's name.
 - 4. Contents by volume, for major pigment and vehicle constituents.
 - 5. Grams per liter of volatile organic compounds.
 - 6. Thinning instructions, where recommended.
 - 7. Application instructions.
 - 8. Color name and number.
- B. Product Storage Requirements:
 - 1. Store acceptable materials at Site.
 - 2. Store in an environmentally controlled location as recommended in paint manufacturer's written product information. Keep area clean and accessible. Prevent freezing of products.
 - 3. Store products that are not in actual use in tightly covered containers.
 - 4. Comply with health and fire regulations of authorities having jurisdiction at Site.
- C. Product Handling Requirements:
 - 1. Handle products in a manner that minimizes the potential for contamination, or incorrect product catalyzation.
 - 2. Do not open containers or mix components until necessary preparatory work has been completed and approved by ENGINEER and painting Work will start immediately.
 - 3. Maintain containers used in storing, mixing, and applying paint in a clean condition, free of foreign materials and residue.

1.7 SITE CONDITIONS

- A. Site Facilities:
 - 1. Supplemental heat sources, as required to maintain both ambient and surface temperatures within range recommended by paint manufacturer for paint system application, are not available at Site.
 - 2. Provision of supplemental heat energy sources, power, equipment, and operating, maintenance and temperature monitoring personnel is responsibility of CONTRACTOR.
 - 3. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas being painted. Properly locate and vent such heat sources to exterior such that paint systems are unaffected by exhaust.

B. Existing Conditions:

1. Existing surfaces to receive painting Work shall be surface-prepared to meet requirements of painting systems specified. Prior to commencing painting Work, perform adhesion tests on existing surfaces to be painted. Perform testing per ASTM D4541 or other method acceptable to ENGINEER. Number and location of tests shall be sufficient to determine condition of existing coatings and suitability of existing coatings to remain to provide acceptable substrate for new coatings. Submit testing plan prior to testing and provide ENGINEER a copy of adhesion test results.
2. Provide abrasive blasting, scraping, or other abrading or surface film removal, or preparatory techniques accepted by ENGINEER.
3. Before commencing painting in an area, surfaces to be painted and floors shall be cleaned of dust using commercial vacuum cleaning equipment equipped with high-efficiency particulate air (HEPA) filters and dust containment systems.

C. Environmental Requirements:

1. Apply water-base paints when the temperature of surfaces to be painted and ambient air temperatures are between 55 degrees F and 90 degrees F, unless otherwise permitted by paint manufacturer's published instructions.
2. Surfaces to be painted shall be at least 5 degrees F above dew point temperature and be dry to the touch. Apply paint only when temperature of surfaces to be painted, paint products, and ambient air temperatures are between 65 degrees F and 95 degrees F, unless otherwise permitted by paint manufacturer's published instructions.
3. Apply paint system within shortest possible time consistent with manufacturer's recommended curing instructions for each coat. If chemical, salt, or other contamination contacts paint film between coats, remove contamination per SSPC SP 1 and restore surface before applying paint.
4. Do not paint tanks or pipelines containing fluid without specific permission of ENGINEER and only under conditions where "sweating" of outside surface of vessel being painted is not likely to occur within 24 hours of paint application.
5. Do not apply epoxy paints if ambient temperature is expected to go below 50 degrees F within twelve hours of application. Follow manufacturer's instructions when manufacturer's published recommendations require a higher minimum ambient temperature.
6. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent. Do not apply paint to damp or wet surfaces or when surfaces will reach dew point due to falling or rising temperatures and humidity conditions during course of paint application, unless otherwise permitted by paint manufacturer's published instructions.
7. Do not paint unacceptably hot or cold surfaces until such surfaces can be maintained within temperature and dew point ranges acceptable to paint manufacturer. Arrange for surfaces to be brought within acceptable temperature and dew point ranges as part of painting Work.
8. Moisture content of surfaces shall be verified to ENGINEER as acceptable prior to commencement of painting using methods recommended by paint manufacturer.

9. Painting may be continued during inclement weather only if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer for application and drying.
10. Provide adequate illumination and ventilation where painting operations are in progress.

D. Protection:

1. Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently, or not to be painted.
2. During surface preparation and painting, facility shall remain in operation. Use procedures that prevent contamination of process or cause or require facility shutdown.
3. Coordinate and schedule surface preparation and painting to avoid exposing personnel to hazards associated with painting Work. Provide required personnel safety equipment per requirements of authorities having jurisdiction at Site.
4. Submit protection procedures to be employed. Do not begin surface preparation and painting Work until ENGINEER accepts protection techniques proposed by CONTRACTOR.
5. When working with flammable materials, provide fire extinguishers and post temporary signs warning against smoking and open flame.

1.8 MAINTENANCE

- A. Extra Materials: Furnish, tag, and store an additional one percent by volume of all coatings and colors installed. Provide a minimum of one gallon of each coating and color. Store in unopened containers as specified until turned over to OWNER.

PART 2 - PRODUCTS

2.1 PAINTING SYSTEM MANUFACTURERS

- A. Products and Manufacturers: Where referenced under painting systems provide products manufactured by the following:
 1. Tnemec Company, Inc. (TCI).
 2. The Carboline Company, part of StonCor Group, an RMP Company (TCC).
 3. Sherwin-Williams Company (SWC).
 4. Benjamin Moore & Company (BMC).
 5. Duron Inc. (DI).

2.2 PAINTING SYSTEMS

Surface/ Exposure	Surf. Prep.	Primer/Surfacer	(Coats) DFT (Mils) Max VOC g/l (EPA)	Intermediate	(Coats) DFT (Mils) Max VOC g/l (EPA)	Finish	(Coats) DFT (Mils) Max VOC g/l (EPA)
		System Type % Solids		System Type % Solids		System Type % Solids	
Cast-In-Place Concrete Walls (except walls within height of chemical containment wall areas), Columns, Underside of Roof Slabs and Beams, Architectural Precast Concrete, except as noted.							

TABLE 09 91 00-A							
Moderate Corrosion and Abrasion; Non- Submerged; Interior.	1.5.B.1. 3.2.A. 3.2.B.3. 3.2.B.5. 3.2.B.6. 3.2.B.7.	-Series 218 Mortar Clad (TCI) -Carboguard 501/510 (TCC) Epoxy Modified Cement 100%	Patch to 2" deep; 1/16" cont. 40	-Series 1224 (TCI) -Sanitile 555 (TCC) Water-Based Epoxy 44%	(1) 3-5 151	-Series 1224 (TCI) -Sanitile 555 (TCC) Water-Based Epoxy 44%	(1) 3-5 151

Concrete Unit Masonry							
TABLE 09 91 00-B							
Aggressive and Moderate Corrosion and Abrasion; High Gloss; Non- Submerged ; Interior	1.5.A.2. 3.2.A. 3.2.B.1. 3.2.B2. 3.2.B..8.	-Series 130 Envirofill (TCI) -Sanitile 500 TG (TCC) Acrylic 53%	(1) 10- 14 71	<u>Primer</u> -Series L69 Epoxoline II (TCI) - Carboguard 890 VOC (TCC) Epoxy 66%	(1) 5-20 214	-Series L69 Epoxoline II (TCI) -Carboguard 890VOC (TCC) Epoxy 66%	(2) 6-8 H (2) 4-6 V 214

Ferrous Metals, Structural Steel, Exterior Surfaces of Valves and Piping, Hollow Metal Doors and Frames

TABLE 09 91 00-C

Low VOC Content; Non-Submerged; Interior	1.5.A.2. 3.2.A. 3.2.C.1. 3.2.C.2.	-Series L69 Epoxoline II (TCI) -Carboguard 890 (TCC) Epoxy 66%	(1) 2-10 234	<u>Field Primer & Touch Up</u> -Series V69 Epoxoline II (TCI) -Carboguard 954 HB (TCC) Epoxy 69%	(1) 2-10 228	-Series V69 Epoxoline II (TCI) -Carboguard 954 HB (TCC) Epoxy 69%	(1) 2-10 H (1) 4-6 V 228

TABLE 09 91 00-D - Hollow Metal Doors and Frames

Non-Submerged; VOC Compliant; Semi-Gloss; Exterior	1.5.A.2. 3.2.A. 3.2.C.1. 3.2.C.2. 3.2.D. 3.2.E. 3.2.F.	<u>Ferrous Metal, Galvanized, and Non-Ferrous Metal Primer</u> -Series V69 Epoxoline II (TCI) -Carboguard 890 (TCC) Epoxy 67%	(1) 4-6 234	<u>Ferrous Metal Touch Up Low Temperature</u> - Series V69 Epoxoline II (TCI) -Carboguard 890 LT (TCC) Epoxy 69% <u>Ferrous Metal Touch Up Warm Temperature</u> - Series V69 Epoxoline II (TCI) -Carboguard 890 (TCC) Epoxy 69%	(1) 10 228 (1) 228	-Series 1095 (TCI) -Carbothane 133 LH (TCC) Polyurethane 71%	(2) 2-4 220

TABLE 09 91 00-E

Aluminum in Contact With Dissimilar Materials; Low VOC Content; Interior and Exterior.	1.5.A.2. 3.2.A. 3.2.D.	-Series 22 (TCI) -Carboguard 954 HB (TCC) Epoxy 100%	(1) 12-16 10			-Series 22 (TCI) -Carboguard 954 HB (TCC) Epoxy 100%	(1) 12-16 10

2.3 CALKING AND SEALANTS

- A. Refer to Section 07 92 00, Joint Sealants.

2.4 INSTRUMENTS

- A. Instruments:
 - 1. Provide one new dry-film thickness gauge for checking film thickness, one holiday detector to detect holidays or holes in the coating, and one set of visual standards to check surface preparation. Calibrate dry film thickness gauge at Site using Bureau of Standards standard shim blocks.
 - 2. Products and Manufacturers: Provide the following:
 - a. Film Thickness Testers: Model FM-III manufactured by Mikrotest, or equal.
 - b. Holiday detector shall be Model M-1 as manufactured by Tinker & Rasor, or equal.
 - c. Visual Standards: ASTM D2200, Swedish Standards, SSPC VIS 1.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which painting Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film capable of performing in accordance with claims made in paint manufacturer's product literature for surfaces and conditions encountered.
- C. Do not paint over existing paint where there is no assurance that existing paint will provide an acceptable surface for long-term adherence and durability of painting systems specified or where paint manufacturer requires removal of all existing paint to recommend use of specified painting system.

3.2 SURFACE PREPARATION

- A. General:
 - 1. Test for moisture content of surfaces before commencement of painting Work. Test for moisture in concrete in compliance with ASTM D4263. Report results to ENGINEER before commencing Work.
 - 2. Prepare existing surfaces to be painted as specified for new surfaces. Submit substitute methods of preparing existing surfaces, when proposed,

with Shop Drawing submittal. ENGINEER's acceptance of substitute surface preparation methods does not relieve CONTRACTOR of performance required under the Contract Documents. To provide surfaces acceptable for application of painting system specified:

- a. Clean and roughen surfaces of existing paint and other decorative or protective toppings on surfaces to remain that are to receive a painting system under this Section.
 - b. Where existing surfaces to be painted have corrosion, peeling paint, or unacceptably adhering coatings, remove all topcoats, primers, and intermediate coats of paint, and other protective or decorative coatings.
 3. Perform preparation and cleaning procedures as specified herein and in strict accordance with paint manufacturer's approved instructions for each surface and atmospheric condition.
 4. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items already in place that do not require field painting, or provide effective surface-applied protection prior to surface preparation and painting.
 5. Remove as necessary items that must be field-painted where adjacent surfaces cannot be completely protected from splatter or overspray. Following completion of painting of each space or area, the removed items shall be reinstalled by workers skilled in the trades involved.
 6. Clean surfaces to be painted before applying painting system components. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning.
 7. Prepare surfaces that were improperly shop-painted and abraded or rusted shop-painted surfaces as specified.
- B. Cast-In-Place Concrete, Precast Concrete and Masonry Surfaces:
1. Prepare surfaces of concrete unit masonry to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and other contamination using soap and water. Surfaces shall be clean and dry at time of paint system application.
 2. Concrete unit masonry that cannot be adequately cleaned using soap and water shall be acid etched with a commercial solution of 15 percent muriatic acid.
 3. Prepare and clean cast-in-place concrete and precast concrete surfaces per ASTM D4259 to provide a uniform and continuous anchor profile of approximately one mil. Provide mechanical abrading and abrasive blasting per ASTM D4259. Use 40 to 80-mesh abrasive and clean, dry, compressed air. Compressed air cleanliness shall be per ASTM D4285. Pressure at blasting nozzle shall not exceed 80 pounds per square inch. Do not concentrate blast on surface; instead, move at a fairly rapid rate to provide a surface free of laitants and contaminants. Provide post-surface preparation cleaning per ASTM D4258 to remove loose material. Surface preparation shall open all surface air holes by removing laitance shoulders surrounding air holes. Vacuum surfaces to remove dust and sand, and wash with potable water.

4. Where paint system is for chemical containment barrier protection, repair cracks and expansion joints in concrete and provide 2-inch radiused cove base fillets at equipment pads and containment walls as part of complete chemical containment paint system Work. Use materials and techniques recommended by manufacturers of the paint and concrete repair products.
5. Remove from cast-in-place concrete fins, projections, and other surface irregularities that would protrude above level of finished intermediate fillers and surfacers. Remove by chipping and scarification by mechanical abrasion.
6. Using specified filler and surfacer, patch cast-in-place concrete and precast concrete surfaces as required to completely fill surface air holes and honeycombing. Level all protrusions, grind filler and surfacing compounds smooth, and level with adjacent surfaces.
7. Perform tests per ASTM D4262 and ASTM D4263 to verify alkalinity and moisture content of surfaces to be painted, and report findings to ENGINEER. If, in ENGINEER's opinion, surfaces are sufficiently alkaline to cause blistering and burning of paint, correct the condition before applying paint. Provide suitable testing materials for alkalinity and moisture tests. Do not paint surfaces where the moisture content exceeds eight percent.
8. Where a concrete unit masonry block filler is specified, spot patch holes and cracks with a putty knife using specified block filler. Apply to large surfaces by airless spray and backroll uniformly using a roller with a synthetic nap cover. Follow with a rubber squeegee to provide a smooth finish.

C. Ferrous Metals:

1. Ferrous Metals Except Ductile and Cast Iron:
 - a. Comply with paint manufacturer's recommendations for type and size of abrasive to provide a surface profile that meets manufacturer's painting system requirements for type, function, and location of surface. Verify that paint manufacturer-recommended profiles have been achieved on prepared surfaces. Report profiles to ENGINEER using Test Method C of ASTM D4417.
 - b. Clean non-submerged ferrous surfaces including structural steel and miscellaneous metal to be shop-primed, of all oil, grease, dirt, mill scale, and other contamination by commercial blast cleaning complying with SSPC SP 6 at time of paint system application, using SSPC VIS 1 as a standard of comparison.
 - c. Clean submerged ferrous surfaces including structural steel and miscellaneous metal to be shop-primed of all oil, grease, dirt, mill scale, and other contamination by near-white blasting complying with SSPC SP 10 at time of painting system application, using SSPC VIS 1 as a standard of comparison.
 - d. Clean non-submerged, ferrous surfaces that have not been shop-coated of all oil, grease, dirt, loose mill scale, and other contamination by

- commercial blasting complying with SSPC SP 6 at the time of painting system application, using SSPC VIS 1 as a standard of comparison.
 - e. Clean submerged ferrous surfaces that have not been shop-coated or that have been improperly shop-coated of all oil, grease, dirt, mill scale, and other contamination by near-white blasting complying with SSPC SP 10 at time of painting system application, using SSPC VIS 1 as a standard of comparison.
 - f. Touch-up shop-applied prime coats that have damaged or have bare areas with primer recommended by paint manufacturer after commercial blasting complying with SSPC SP 6 at the time of painting system application, using SSPC VIS 1 as a standard of comparison, to provide a surface profile of not less than one mil.
 - g. Power tool-clean per SSPC SP 3 to remove welding splatter and slag.
 - h. Remove all rust and contamination on existing ferrous metals to sound surfaces by power tool-cleaning complying with SSPC SP 11 to provide a surface profile of not less than one mil.
- D. Non-Ferrous Metal Surfaces: Prepare non-ferrous metal surfaces for painting by light whip blasting or by lightly sanding with 60- to 80-mesh sandpaper.

3.3 PROTECTION OF PROPERTY AND STRUCTURES

- A. Protect property and structures adjacent to the Work from waste residues resulting from cleaning, surface preparation and paint application.
- B. Use shrouding, vacuum blasting, or other approved methods for cleaning and surface preparation of exterior surfaces.
- C. During blast cleaning and surface preparation of interior and exterior surfaces, control discharge of dust and grit, using shrouding, negative-pressure containment/dust collection systems, or other means to protect adjacent property and structures and prevent dust/grit from escaping. Similarly control removal and temporary storage of residues to protect adjacent property and structures.
- D. For painting of exterior surfaces, use rollers, shrouding or other approved methods as required to protect adjacent property and structures from wind-blown paint residues.
- E. Submit proposed procedures for cleaning, surface preparation and paint application describing methods for protecting adjacent property and structures from residues. Do not proceed with cleaning, surface preparation or painting until proposed procedures are approved by ENGINEER.

3.4 MATERIALS PREPARATION

- A. General:

1. Mix and prepare paint products in strict accordance with paint manufacturer's product literature.
 2. Do not mix painting materials produced by different manufacturers, unless otherwise permitted by paint manufacturer's instructions.
 3. Where thinners are required, they shall be produced by paint system manufacturer unless otherwise permitted by paint manufacturer's product literature and submitted to and accepted by ENGINEER with Shop Drawings.
- B. Tinting:
1. Where multiple coats of the same material are to be provided, tint each undercoat a lighter shade to facilitate identification of each coat of paint.
 2. Tint undercoats to match color of finish coat of paint, but provide sufficient difference in shade of undercoats to distinguish each separate coat. Provide a code number to identify material tinted by manufacturer.
- C. Mixing:
1. For products requiring constant agitation, use methods in compliance with manufacturer's product literature to prevent settling during paint application.
 2. Mix in containers placed in suitably sized non-ferrous or oxide resistant metal pans to protect floors from slashes or spills that could stain the floor or react with subsequent finish floor material.
 3. Mix and apply paint in containers bearing accurate product name of material being mixed or applied.
 4. Stir products before application to produce a mixture of uniform density and as required during the application. Do not stir into the product film that forms on surface; instead, remove film and, if necessary, strain product before using.
 5. Strain products requiring such mixing procedures. After adjusting mixer speed to break up lumps and after components are thoroughly blended, strain through 35 to 50-mesh screen before application.

3.5 APPLICATION

- A. General:
1. Apply paint systems by brush, roller, or airless spray per manufacturer's recommendations and in compliance with Paint Application Specifications No. 1 in SSPC Volume 2, where applicable. Use brushes best suited for type of paint applied. Use rollers of carpet, velvet back, or high pile sheeps wool as recommended by paint manufacturer for product and texture required. Use air spray and airless spray equipment recommended by paint manufacturer for specific painting systems specified. Submit a list of application methods proposed, listing paint systems and location.
 2. Paint dry film thicknesses required are the same regardless of the application method. Do not apply succeeding coats until previous coat has completely dried.

3. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint, until paint film is uniform finish, color, and appearance, particularly for intense chroma primary colors. Ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a film thickness equivalent to that of flat surfaces.
4. Surfaces of items not normally exposed-to-view do not require the same color as other components of system of which they are part, but require the same painting system specified for exposed surfaces of system.
5. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint before final installation of registers or grilles.
6. Paint backs of access panels and removable or hinged covers to match exposed surfaces.
7. Paint aluminum parts in contact with dissimilar materials with specified paint system.
8. Paint tops, bottoms, and side edges of doors the same as exterior surfaces.
9. Omit field-applied primer on metal surfaces that have been primed in the shop. Touch-up paint shop-primed coats and pre-finished items only when approved by ENGINEER using compatible primers and manufacturer's recommended compatible field-applied finishes.
10. Welds shall be stripe-coated with intermediate or finish coat of paint after application of prime coat.

B. Minimum/Maximum Paint Film Thickness:

1. Apply each product at not less than, nor more than, manufacturer's recommended spreading rate, and provide total dry film thickness as specified.
2. Apply additional coats of paint if required to obtain specified total dry film thickness.
3. Maximum dry film thickness shall not exceed 100 percent of minimum dry film thickness, except where more stringent limitations are recommended by paint manufacturer for a specific product.

C. Scheduling Surface Preparation and Painting:

1. As soon as practical after preparation, apply first-coat material to surfaces that have been cleaned, pretreated, or otherwise prepared for painting. Apply first-coat material before subsequent surface deterioration due to atmospheric conditions existing at time of surface preparation and painting. Surfaces that have started to rust before first-coat application is complete shall be brought back to required standard by abrasive blasting.
2. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure and application of another coat of paint does not cause lifting or loss of adhesion to undercoat.
3. Scarify primers and other painting system components by brush-blasting if paint has been exposed for lengths of time or under conditions beyond manufacturer's written recommendations for painting systems required,

- intended use, or method of application proposed for subsequent coats of paint.
4. Schedule cleaning and painting so that dust and other contaminants from cleaning process do not fall on wet, newly painted surfaces.
- D. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects caused by insufficient sealing.
- E. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.
- F. Brush Application:
1. Brush out and work all brush coats onto surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections are unacceptable. Neatly draw all glass and color break lines.
 2. Brush-apply primer or first coats, unless otherwise permitted to use mechanical applicators.
- G. Mechanical Applicators:
1. Use mechanical methods for paint application when permitted by governing ordinances, manufacturer, and approved by ENGINEER.
 2. Limit roller applications, if approved by ENGINEER, to interior wall finishes for second and third coats. Apply each roller coat to provide the equivalent hiding as brush-applied coats.
 3. Where spray application is used, apply each coat to provide equivalent hiding of brush-applied coats. Do not double back with spray equipment for purpose of building up film thickness of multiple coats in one pass.
- H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint Work not in compliance with specified requirements as required by ENGINEER.

3.6 FIELD QUALITY CONTROL

- A. ENGINEER may invoke the following material testing procedure at any time for a maximum of five times during field painting Work:
1. CONTRACTOR shall engage service of an independent testing laboratory to sample paints used, as designated by ENGINEER. Samples of products delivered to Site shall be obtained, identified, sealed, and certified as to being products actually applied to surfaces in each area, in presence of CONTRACTOR.
 2. A testing laboratory selected by OWNER and paid for by CONTRACTOR shall perform appropriate tests for any or all of the following:
 - a. Abrasion resistance.
 - b. Apparent reflectivity.

- c. Flexibility.
 - d. Washability.
 - e. Absorption.
 - f. Accelerated weathering.
 - g. Dry opacity.
 - h. Accelerated yellowness.
 - i. Recoating.
 - j. Skinning.
 - k. Color retention.
 - l. Alkali resistance.
 - m. Quantitative materials analysis.
3. If test results show that products being used do not comply with specified requirements, CONTRACTOR may be directed to stop painting Work and remove non-complying paint, and shall prepare and repaint surfaces coated with rejected paint with material complying with the Contract Documents.
- B. Notify ENGINEER after completing each coat of paint. After inspection and checking of film thickness, holidays, and imperfections, and after acceptance by ENGINEER, proceed with succeeding coat. Perform testing using testing instruments specified in Article 2.4 of this Section.
- 1. ENGINEER will witness all testing and shall be notified of scheduled testing at least twenty-four hours in advance.
 - 2. Apply additional coats, if required, to produce specified film thickness and to correct holidays and to completely fill all surface air holes.
- C. For magnetic substrates, measure thickness of dry film nonmagnetic coatings following recommendations of SSPC PA-2. These procedures supplement manufacturers' approved instructions for manual operation of measurement gauges and do not replace such instructions.
- D. Record time, location, number of coats, dry film thickness, holidays, and other imperfections and submit testing results to ENGINEER.

3.7 PROTECTION OF NEW FINISHES

- A. Provide signs that read, "Wet Paint" as required to protect newly painted finishes. Remove temporary wrappings provided for protection of the Work after completion of painting.

3.8 ADJUSTING AND CLEANING

- A. Correct damages to work of other trades through cleaning, repairing or replacing, and repainting, as acceptable to ENGINEER.
- B. During progress of Work, remove from Site all discarded paint materials, rubbish, cans, and rags at end of each workday.

- C. Upon completion of painting, clean paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, while avoiding scratching or otherwise damaging finished surfaces.
- D. At completion of work of other trades, touch-up and restore damaged or defaced painted surfaces as determined by ENGINEER.

3.9 SCHEDULES

- A. The schedules listed below, following the “End of Section” designation, are a part of this Specification section.

1. Table 09 91 00-C, Painting Schedule.

**TABLE 09 91 00-C
PAINTING SCHEDULE**

Facility or Surface *	Room No.	Painting System **	Remarks
Fluoride Dosing Room & Sodium Hypochlorite Feed Room; Existing Concrete Floors		A	Includes 12” up the wall surfaces.
Fluoride Dosing Room & Sodium Hypochlorite Feed Room; existing CMU walls		B	From 12” AFF up to the ceiling.
Fluoride Dosing Room & Sodium Hypochlorite Feed Room; Existing Hollow Metal Doors and Frames		C	Inside and outside surfaces of the doors and frames. Do NOT paint over any door hardware or labels.
Mechanical Room and Water Softening Room; Existing Hollow Metal Doors and Frames		D	Inside and outside surfaces of the doors and frames. Do NOT paint over any door hardware or labels.
New Aluminum in Contact With Dissimilar Materials, Interior and Exterior		E	

* Refer to Drawings for facility locations and for facilities not listed above.

** Refer to Article 2.2 of this Section.

++ END OF SECTION ++

SECTION 10 14 00

SIGNAGE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install signage.
 - a. Contractor shall be responsible for all signage furnished under this Section for the entire Project in accordance with the Contract Documents.
2. Extent of signage is shown and specified.
3. Types of products required include the following:
 - a. Room identification, information, entry and directional signs.
 - b. Health, safety, warning, floor loading and fire extinguisher location signs.
 - c. Pipe markers, tags, and equipment nameplates.
 - d. Right-to-know labels, signs and tags.
 - e. Stainless steel fasteners, supports, very-high-bond high-performance mounting tape, primers and other accessories.

B. Coordination:

1. Coordinate adhesives and fasteners with mounting surfaces. Review other Sections to ensure compatibility of signage mounting accessories with various surfaces on which signage will be installed.
2. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before signage Work.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AA DSA-45, Designation System for Aluminum Finishes.
2. ASME A13.1 Scheme for the Identification of Piping Systems.
3. ANSI/ICC A117.1, Accessible and Usable Buildings and Facilities.
4. ANSI Z535.1, Marking Physical Hazards Safety Color Code.
5. ANSI Z535.2, Environmental and Facility Safety Signs.
6. ANSI Z535.3, Criteria for Safety Symbols.
7. ASTM B26/B26M, Specification for Aluminum-Alloy Sand Castings.
8. ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.
9. ASTM E527, Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS).

10. CDA, Properties of Cast Copper Alloys.
11. NFPA 704, System for the Identification of the Hazards of Materials for Emergency Response.
12. UL 924, Safety of Emergency Lighting and Power Equipment.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 1. Signage Manufacturers:
 - a. Engage firms specializing in producing types of products specified, in compliance with the Contract Documents, with documented record of successful in-service performance, and that possess sufficient production capacity to avoid delaying the Work.
 - b. Submit to Engineer name and experience record of manufacturers.
- B. Component Supply and Compatibility:
 1. Obtain each separate type of signage from a single Supplier and from a single manufacturer.
- C. Regulatory Requirements: Comply with applicable requirements of the following:
 1. OSHA, 29 CFR Part 1910.1200, Hazard Communication Standard.
 2. OSHA, 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances.
 3. OSHA, 29 CFR Part 1910.144, Safety Color Code for Marking Physical Hazards.
 4. OSHA, 29 CFR Part 1910.145, Specification for Accident Prevention Signs and Tags.
 5. United States Access Board, Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines.
 6. Americans with Disabilities Act (ADA), Public Law 101-36, 28 CFR Part 36, Appendix A, Accessibility Guidelines for Buildings and Facilities (ADAAG), relative to characters and symbols contrast only.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Schedule of all signage required for the Work, indicating signage type location, and other information to demonstrate compliance with the Contract Documents.
 - b. Fabrication and erection information for each type of signage
 - c. Valve schedule for small-diameter valves, in accordance with this Section.
 - d. Complete, camera-ready, color graphic layouts of custom-designed signs based on specified requirements and manufacturer recommendations.

- e. Complete selection of each specified manufacturer's standard and custom graphic layouts and pictograms, colors, and alphabetic/text styles.
- f. Full-size graphic layout drawings for plaques, individual dimensional letters and numbers, and other items where final graphic appearance is necessary prior to signage fabrication, incorporating all required graphic features specified or shown.
- g. Mounting and Installation Data:
 - 1) Drawings of and information on anchorages and accessory items.
 - 2) Submit location template drawings for items supported or anchored to permanent construction.
 - 3) Coordinate mounting position, method, and proposed mounting accessories and fasteners with actual Project conditions. Indicate required mounting accessories on plan drawings showing locations of required exit signs based on measurements taken at the Site. Show final location and identify type of mounting surface for each exit sign. Coordinate location of exit signs for non-interference with other Work and as required by authorities having jurisdiction.
- 2. Product Data:
 - a. Copies of manufacturer's technical data, including catalog information and specifications, for each product specified.
- 3. Samples:
 - a. Each color and finish of exposed materials and accessories required for signage.
 - b. Sample Signage:
 - 1) Full-size Sample of each type of permanent room and space identification sign, and informational and directional sign incorporating all features specified.
 - 2) Full-sized Sample of each type (such as snap-on, strap-on, and adhesive) of pipe marker proposed for use with mounting accessories.
 - 3) Full-sized Sample equipment nameplate, valve tag, pipe tag, and accessories. Stamp valve tag with information shown on valve schedules. When not indicated in the Contract Documents, information on the type of coding system will be furnished to Contractor by Engineer.
 - 4) Full-sized Sample right-to-know signs, labels and tags.
 - 5) Full-size representative sample of each individual-type letter and number specified, demonstrating alphabetic style/text type, material, color and finish specified.
 - c. Engineer's review of Samples will be for color and texture only. Compliance with other requirements is Contractor's responsibility.
- B. Informational Submittals: Submit the following:
 - 1. Manufacturer's Instructions:
 - a. Templates for anchorages to be installed in concrete or masonry.

- b. Manufacturer's instructions and recommendations for support and foundations of signs installed outdoors.
 - C. Closeout Submittals: Submit the following:
 - 1. Warranty Documentation:
 - a. General and special warranties required under this Section.
 - D. Maintenance Material Submittals: Submit the following:
 - 1. Extra Stock Materials:
 - a. Furnish extra stock materials from the same manufactured lot as the materials installed.
 - b. Submit documentation of actual quantities of signage installed for the Project and calculations indicating the required quantity of extra stock materials.
 - c. Furnish the following spare parts and accessories:
 - 1) For every 20 of each type (snap-on, strap-on, adhesive type) of pipe markers installed:
 - a) One complete mounting assembly.
 - 2) For every 20 equipment nameplates installed:
 - a) One complete nameplate mounting assembly.
 - 3) For every 20 valve tags and pipe tags installed:
 - a) One stainless steel cable and splice.

1.5 WARRANTY

- A. General Warranty: The special warranty specified for each type of sign in this Article shall not deprive Owner of other rights or remedies Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents. The obligations of Contractor under the Contract Documents shall not be limited in any way by the provisions of the specified special warranty.
- B. Special Warranty on Products:
 - 1. Provide each signage manufacturer's written warranty, running to the benefit of Owner, agreeing to correct, or at option of Owner, remove or replace materials specified in this Section found to be defective during a period of five years after the date of Substantial Completion.
 - 2. Special warranty shall cover defective Work that includes, but is not limited to, the following:
 - a. Deterioration of metal and polymer finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image colors and sign lamination.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. General:

1. Details shown or indicated for signage, such as alpha-numeric and text type representation, letter spacing, designs of borders, and other graphic features, are generic and intended only to establish text, general positions, and symbols.
2. Colors shall be brilliant, distinctive shades, matching the safety colors specified in ANSI Z535.1 and OSHA 1910.144.
3. Permanent rooms and spaces, and directional and informational signage where specified as accessible to people with disabilities, shall comply with ANSI/ICC A117.1 and ADA-ABA Accessibility Guidelines.
4. Accident prevention signs and tags shall comply with OSHA 1910.145.
5. Health, safety, and warning signs shall comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, OSHA 1910.144, and 1910.145, unless otherwise shown or indicated. Colors shall be as indicated in Table 1 of ANSI Z535.1. In addition to text, safety symbol pictograms shall be incorporated into each sign.

2.2 PANEL SIGNS – ROOM IDENTIFICATION, INFORMATION, ENTRY, AND DIRECTIONAL

A. Products and Manufacturers: Provide one of the following:

1. Graphic Blast MP and FG ADA System and Custom Design ADA Series, by Best Sign Systems, Inc.
2. Blast Etched Fiberglass and Blast Etched Melamine Signs, by Visigraph Corporation.
3. Or equal.

B. Panel Signs – Room Identification, Information, Entry, and Directional:

1. Product Description: Provide unframed signs, surface-etched, 1/32-inch raised tactile lettering and pictograms, sandblasted on an opaque sheet.
2. Materials:
 - a. Interior Signs: Three-ply, self-extinguishing melamine plastic.
 - b. Exterior Signs: One-piece fiberglass.
3. Size and Thickness: 0.125-inch thick; eight inches by eight inches with 1/2-inch radiused corners.
4. Graphics and Text: White, Standard Helvetica Medium characters and matching arrow type-face; upper and lower case letters, one-inch high capitals and, in addition, Grade 2 Braille alphabet for room designation, directional, entry, and information signs.
5. Colors and Contrast: Background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast by at least 70

percent with their background as determined by ADA formula in ADAAG Appendix A4.30.5.

2.3 PANEL SIGNS – HEALTH, SAFETY, WARNING, FLOOR LOADING, AND FIRE EXTINGUISHER LOCATION

- A. Product Description: Provide rigid fiberglass reinforced plastic signs with fade-resistant embedded graphics.
- B. Products and Manufacturers: Provide one of the following:
 - 1. Graphic Blast Word and Picture Series, by Best Sign Systems, Inc.
 - 2. Blast Etched Fiberglass Signs, by Visigraph Corporation.
 - 3. Or equal.
- C. General:
 - 1. Size and Thickness: 0.125-inch thick; 10 inches by 14 inches, unless otherwise shown or indicated.
 - 2. Graphics and Text: Standard Helvetica Medium characters and matching arrow type-face; upper and lower case, one-inch high capitals and, in addition, Grade 2 Braille alphabet message designations and other text.
 - 3. Exposure: As recommended by sign manufacturer for both indoor and outdoor use and with an upper service temperature limit of 190degrees F. Average durability for outdoor use shall be 15 years.
- D. Safety Instruction Signs: Standard color of sign background shall be white; panel shall be green with white letters and numbers. Letters and numbers used against white background shall be black.
- E. Caution Signs: Standard color of sign background shall be yellow; panel shall be black with yellow letters and numbers.
- F. Danger Signs: Standard color of sign background shall be white; panel shall be black with red insert with white letters and numbers. Letters and numbers used against white background shall be black.
- G. Warning Signs: Standard color of sign background shall be orange; panel shall be black with orange insert with black letters and numbers. Letters and numbers used against orange background shall be black.
- H. No Smoking Signs: Standard color of sign background shall be white. Letters and numbers used against white background shall be red.
- I. Biohazard Signs: Standard color of sign background shall be white; panel shall be black with white letters. Sign shall include red international biohazard pictogram on white background.

- J. Floor Loading Signs: Standard color of sign background shall be white; panel shall be blue with white letters and numbers. Letters and numbers used against white background shall be black.
- K. Fire Extinguisher Location Signs (surface-mounted units only): Standard color of sign background shall be red with white letters and numbers. Each sign shall include international fire extinguisher pictogram and directional arrow indicating location of fire extinguisher.
- L. Auxiliary Products:
 - 1. Mounting Brackets: Provide sign manufacturer's standard mounting brackets for installing projected or double-sided signs.

2.4 PIPE MARKERS

- A. Description:
 - 1. Provide pipe markers for each pipeline provided under the Contract, and for other piping indicated to receive pipe markers.
- B. Products and Manufacturers: Provide one of the following:
 - 1. Custom High Performance Pipe Markers (B-689), and SnapOn and StrapOn Pipe Markers (B-915), by Brady Worldwide, Inc., Signmark Division.
 - 2. Custom Ultra-Mark High Performance Pipe Markers, by Seton Identification Products, a Tricor Direct Company.
 - 3. Or equal.
- C. Pipe Markers:
 - 1. Lettering of Titles/Legend and Color Field Size:
 - a. Letter size and color field length shall be as indicated in Table 10 14 00-A of this Section:

**TABLE 10 14 00-A, PIPE MARKERS:
SIZE OF TEXT AND COLOR FIELD**

Outside Diameter of Pipeline or Covering* (inches)	Size of Text (Legend Characters)	Minimum Length of Color Field**
3/4 to 1.25	1/2-inch	8 inches
1.5 to 1-7/8	3/4-inch	8 inches
2 to 5-7/8	1.25-inch	12 inches
6 to 9-7/8	2.5-inch	24 inches
10 and Larger	3.5-inch	32 inches
*Outside diameter includes pipe diameter plus insulation and jacketing. **Length of sign and color field shall be as required to accommodate required legend, and shall not be less than minimum length indicated unless required otherwise by space constraints.		

- b. Text and symbols shall be Standard Helvetica Medium, all upper case. Pipe markers shall include text with separate arrow signs indicating direction of flow of pipeline contents. Pipe markers with arrows shall be located as specified in Part 3 of this Section.
 - c. Pipe markers indicating pipeline contents shall identify pipeline contents by complete name, as indicated in Table 10 14 00-B of this Section. Obtain from Engineer interpretation of required pipe marker text for pipelines provided under the Project that are not listed in Table 10 14 00-B of this Section.
- 2. Pipe Marker Materials:
 - a. General: The following are applicable to all types of pipe markers furnished under this Section:
 - 1) Provide pipe markers with ultraviolet light-resistant, sealed, subsurface color graphics, recommended by sign manufacturer, suitable for both indoor and outdoor use.
 - 2) Pipe markers shall be resistant to abrasion, chemical reagents, and physical agitation such as washdowns and wind.
 - 3) Provide manufacturer's full selection of standard and custom sizes and graphics.
 - 4) Where manufacturer has established minimum order quantities for custom units provide minimum order quantities at no additional cost to Owner.
 - b. Materials: Provide the following at Contractor's option, suitable for outside diameter of the associated pipe and pipe covering:
 - 1) Adhesive, Wrap-Around Pipe Markers: Adhesive pipe markers shall be coiled construction, 0.006-inch total thickness, PVF over laminated polyester, with peel-off backing. Suitable for service temperature ranging from -40 degrees F to 230 degrees F.
 - 2) Snap-on Pipe Markers: Snap-on pipe markers shall be cylindrically coiled, printed plastic sheets. Pipe marker total thickness for pipe and pipe covering from 3/4-inch to 2-3/8-inch outside diameter shall be not less than 0.020-inch. Pipe marker total thickness for pipe and pipe covering from 2.5-inch through six-inch outside diameter shall be not less than 0.030-inch. Suitable for service temperature ranging from -40 degrees F to 180 degrees F.
 - 3) Strap-on Pipe Markers: Provide strap-on pipe markers where pipe diameter is large enough to preclude overlap of pipe marker material around the circumference of the pipe. Strap-on pipe markers shall be flat, printed plastic sheets, not less than 0.020-inch total thickness, constructed to be attached to the pipe with bands. Suitable for service temperature ranging from -40 degrees F to 180 degrees F. Provide each pipe marker with two 1/4-inch wide band straps of nylon, plastic, or stainless steel, lengths as required by circumference of pipe and pipe covering. Provide manufacturer's recommended banding tools for banding.

3. Legend for Pipe Markers: Pipe markers shall have the text or abbreviations in the color combinations indicated in Table 10 14 00-B of this Section to identify the pipeline service hazard. Pipe marker colors shall comply with ASME A13.1, unless otherwise indicated.

TABLE 10 14 00-B, SCHEDULE OF PIPE MARKERS*		
Pipeline Legend	Lettering/Text Color	Background Color
<u>CHEMICALS</u>		
Fluoride	Black	Orange
Sodium Hypochlorite	Black	Orange

- * Where shown or specified, the legend for blowoff, drain, metering, sump, vent, and similar pipelines shall also include the equipment number or structure name, as applicable, served by the pipeline. Provide the number in the same color as the pipeline.

2.5 EQUIPMENT NAMEPLATES

A. Description:

1. Provide equipment nameplate for each equipment item furnished under the Contract, and for other equipment items indicated to receive nameplates. Equipment nameplates specified in this Article are in addition to equipment manufacturer's standard nameplate with manufacturer name, model number, serial number, and similar information.
2. Install equipment nameplates as indicated in Part 3 of this Section. Mechanically fasten equipment nameplates to the associated equipment item.

B. Products and Manufacturers: Provide one of the following:

1. Stainless Steel (HEET) Tags (B-748) custom engraved, by Brady Worldwide, Inc.
2. Custom Engraved Stainless Steel Nameplates, by Seton Identification Products, a Tricor Direct Company
3. Or equal.

C. Equipment Nameplates:

1. Material: Type 304 or Type 316 stainless steel, 26-gage, with rounded corners. Suitable for temperatures ranging from -40 to 89 degrees C.
2. Provide each equipment nameplate with not less than two holes, each approximately 3/16-inch diameter, for mechanically fastening nameplate to the associated equipment. Provide appropriate stainless steel fasteners.
3. Nameplate Size:

- a. Size shall be as required for required text, and shall be not less than one-inch by four inches.
4. Text Engraved on Nameplates:
 - a. Text Size: Equipment nameplate titles shall have text as large as possible to fit on nameplate; text shall be not less than 1/2-inch high. All text on a given nameplate shall be one size.
 - b. Text and symbols shall be Standard Helvetica Medium, all upper-case.
 - c. Left-justify multiple lines of text.
 - d. Where more than one item of the same type of equipment is furnished, consecutively number each associated equipment nameplates as shown or indicated; for example "Pump No. 1", "Pump No. 2", "Pump No. 3", and so on.
5. Legend for Nameplates:
 - a. Nameplates for equipment, including operating stands for valves and gates, shall be in accordance with the required text and colors indicated in Table 10 14 00-C.
 - b. Obtain interpretation from Engineer for equipment not included in Table 10 14 00-C.

TABLE 10 14 00-C, SCHEDULE OF EQUIPMENT NAMEPLATES*			
Legend		Color	
First Line	Second Line	Lettering/Text	Background
Chemical Metering Pumps	**		
Chemical Transfer Pumps	**		
Chemical Tanks	**		
Exhaust Fan	**		
Hot Water Heater Electric	**		
Motorized Damper	**		
Unit Heater-Electric	**		

* Where equipment is installed on roofs or where exposed to the public view such as in lobby or office areas, color will be selected by Engineer.

** The legend on the indicated nameplates shall also include the appropriate number designation for such equipment, including valve stands and gate operators as shown on the Process and Instrumentation Drawings or as indicated by Engineer.

2.6 VALVE AND PIPELINE TAGS

A. Products and Manufacturers: Provide one of the following:

1. Custom Engraved Stainless Steel Valve Tags, by Brady Worldwide, Inc.

2. Custom Stainless Steel Valve Tags, by Seton Identification Products, a Tricor Direct Company.
 3. Or equal.
- B. Metal Tags:
1. For each valve and for pipelines smaller than 3/4-inch outside diameter, provide permanently legible, round metal tags, each two-inch diameter, Type 304 or Type 316 stainless steel, with engraved lettering filled with black enamel. Provide tags with 3/16-inch diameter hole located that does not interfere with legend.
 2. Legend for Valve Tags:
 - a. Based on information provided on the Drawings, submit to Engineer not less than 21 days before system startup, a valve schedule indicating all required valves.
 - b. For each valve, the valve schedule shall indicate: location, valve type, valve number, words to identify valve's function, type of operator, and normal operating position.
 - c. Information presented in the valve schedules shall be coded on tags in a system provided by or acceptable to Owner. Each valve shall be coded and identified by Engineer utilizing a combination of up to twelve letters and numbers.
 3. Legend for Small Pipeline Tags: Comply with requirements for pipe markers relative to legend. Where legend is not indicated, obtain interpretation from Engineer.
 4. Miscellaneous Valve and Small Pipeline Tag Accessories:
 - a. Stainless Steel Wire: Nylon-coated; 0.048-inch outside diameter.
 - b. Clamps: Brass.
 - c. Lead Seals: Monel; four ply, 0.014-inch by 10 inches long; for attaching tags.
 - d. Hand Sealing Press: As recommended by tag manufacturer for crimping lead seals.

2.7 PANEL SIGNS – RIGHT-TO-KNOW LABELS, SIGNS, AND TAGS

- A. Products and Manufacturers: Provide one of the following:
1. Custom B-302 Pressure Sensitive Polyester Right-To-Know Labels, B-120 Fiberglass Chemical Tank Signs, Front No. 1/Back No. 1 B-851 Right-To-Know Accident Prevention Tags and Right-To-Know Pictograms, by Brady Worldwide, Inc.
 2. Right-to-Know & HazCom Signs, Labels, and Tags, by Seton Identification Products, a Tricor Direct Company.
 3. Or equal.
- B. General:

1. Right-to-know signs, labels, and tags shall use NFPA 704 “diamond” hazard identification systems and shall comply with OSHA 1910.1200 and OSHA Subpart Z.
- C. Tank Signs:
1. Provide quantity of signs shown or indicated, sized at 14 inches by 20 inches, identifying the chemical stored in the tank, chemical's hazards, required protective equipment in text and pictograms, first-aid for eyes, skin, ingestion and inhalation, information on confined space entry and NFPA 704-required hazard rating system information.
 2. Right-to-know fiberglass signs for storage tanks shall have pressure-sensitive adhesive backs and be provided with subsurface numbers, symbols, text, and legends. Labels shall indicate chemical name and chemical abstracts service number, fire and health hazard potential, reactivity, personal protection and target organ legends in compliance with NFPA 704 format and OSHA 1910.1200.
- D. Labels: Provide right-to-know polyester labels for each hazardous chemical container. Provide labels seven inches by ten inches with information pre-printed by manufacturer. Provide labels with two-mil polyester overlamine and with a complete line of all standard and custom pictograms.
- E. Tags: Provide 15-mil right-to-know vinyl tags with self-adhering clear polyester overlamine. Tags shall be laminated plastic and provided with nylon tie fasteners. Provide tags three inches by 5.75 inches with two chamfered corners with reinforced 3/16-inch diameter grommeted hole.

2.8 AUXILIARY MATERIALS

- A. Very-High-Bond High-Performance Bonding Tape:
1. Provide all surface-mounted signage with very-high-bond foam tape backing except where specified as requiring mechanical fasteners.
 2. Products and Manufacturers: Provide one of the following:
 - a. Scotch Brand (Very-High-Bond) 4942 VHB Double Coated Acrylic Foam Tape and No. 94 Acrylic Primer, by 3M Industrial Tape and Specialties Division.
 - b. Or equal.
 3. Provide a very-high-bonding pressure sensitive joining system consisting of double-coated conformable acrylic foam tape and release liners.
 4. Thickness: 0.045-inch.
 5. Tape Width: 1.5 inches.
 6. Color: Dark gray.
 7. Bonding Adhesive: Acrylic; very-high-bond, solvent and shear resistance.
 8. Primer: High-performance tape manufacturers recommended acrylic primer.

- B. Fasteners: Provide fasteners of non-magnetic stainless steel of size and type required and recommended by the associated individual signage manufacturer.
- C. Anchors and Inserts: Provide nonferrous metal or hot-dipped galvanized anchors and inserts. Provide toothed stainless steel or lead expansion bolts for drilled-in-place anchors.
- D. Mounting Brackets:
 - 1. Provide manufacturer's standard mounting brackets for each of the following sign types: hanging, projected, double-sided.
 - 2. Provide inserts, and mechanical and adhesive anchoring devices as specified in this Article for installation of signage.

2.9 FABRICATION

- A. Shop Assembly:
 - 1. Fabricate and preassemble items in the shop to the greatest extent possible.
 - 2. Disassemble units only to extent necessary for shipping and handling limitations.
 - 3. Clearly mark units for reassembly and coordinated installation.

2.10 SOURCE QUALITY CONTROL

- A. Fabrication Tolerances:
 - 1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within tolerance of plus or minus 1/16-inch measured diagonally across each sign.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine substrates and conditions under which signage will be installed and notify Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. General:
 - 1. Location:
 - a. Install signage and appurtenances at the locations shown or indicated. When locations are not shown or indicated, install signage at locations directed by Engineer.

- b. Provide exit signs at locations shown or indicated. Surface-mount signs above each point of egress, unless otherwise shown or indicated.
 - c. Lightly mark and locate position of each sign. Obtain Engineer's acceptance of marked locations before mounting.
 - 2. Installation – General:
 - a. Install signs level, plumb, and at proper height.
 - b. Signage shall be securely mounted with concealed, very-high-bond acrylic foam tape, specified adhesives, or mechanical fasteners where specified. Attach signs to surfaces in accordance with sign manufacturer's instructions, unless otherwise shown or indicated.
 - c. Provide very-high-bond acrylic foam tape on back of signage using a full perimeter of specified tape. Leave no gaps in tape perimeter at back of signage; peel off second release liner and press onto surfaces.
 - 3. Repair or replace damaged units.
- B. Panel Signs – Room Identification, Directional, and Information Signs:
 - 1. Where permanent identification is provided for rooms and spaces, install signs on the wall adjacent to the latch side of the door.
 - 2. Where there is no wall space on the latch side of the door, including at double leaf doors, install signs on the nearest adjacent wall.
 - 3. Mounting height shall be in accordance with ADA-ABA Accessibility Guidelines in areas accessible to disabled people. For other areas install signs five feet from the finished floor to centerline of sign. Mount such signage so that a person may approach within three inches of the sign without encountering protruding objects or, when reading sign, be forced to stand within the swing of a door.
- C. Pipe Markers, Equipment Nameplates, and Pipe and Valve Tags:
 - 1. Location of Pipe Markers and Pipe Tags:
 - a. Provide pipe markers with text (pipeline contents or service) and adjacent arrow indicating the direction of flow of pipeline contents on each piping system provided under the Project and other piping systems shown or indicated as to receive pipe markers.
 - b. Locations: Provide pipe markers at each of the following locations:
 - 1) At intervals of not more than 30 linear feet apart
 - 2) Directly adjacent to each side of each penetration by the pipeline of the following: wall, floor, ceiling, roof.
 - 3) Adjacent to each change in flow direction.
 - 4) On each branch where pipes connect together including but not limited to tees, wyes, and crosses.
 - 5) Adjacent to each side of each valve (including but not limited to check valves, isolation valves, control valves, and other valves), strainer cleanouts, and each equipment item along the pipeline.
 - 6) Comply with ASME A13.1.

- c. Provide flow-direction arrows at intervals not greater than 15 linear feet. Where flow may be bi-directional, provide arrows adjacent to each other to indicate both directions.
 - d. Pipe marker locations will be determined by Engineer, but in general place pipe markers where personnel view of label is unobstructed. When pipeline is overhead, install label on the two lower quarters of the pipe or pipe covering. Pipe markers shall be clearly visible from personnel operating positions, especially operating positions adjacent to valves and equipment.
 - e. Provide pipe tags, where specified, at locations as specified for pipe markers.
2. Location of Valve Tags and Valve Nameplates:
- a. Valve nameplates and valve signs for large valves shall be located on or adjacent to the valve.
 - b. For smaller valves, attach tags to valve bonnet or valve flange bolts.
 - c. For valves to receive equipment nameplates, as specified in this Section, install nameplate as required for other equipment nameplates.
 - d. Do not attach tags, nameplates, or signs to valve handwheels or other valve actuators.
3. Equipment Nameplates:
- a. Locate nameplates on equipment bases and on structures at readily visible elevation in such positions relative to the equipment and structures as to prevent damage to nameplate.
 - b. Position nameplate for ease of reading by operations and maintenance personnel.
- D. Panel Signs – Right-To-Know Signs, Labels, and Tags:
- 1. Locate tags at intervals of not more than 20 feet center-to-center along chemical pipelines and fill pipelines and on each side of locations where pipelines emerge from penetrations with other materials.
 - 2. Install tank signs on each tank shown or indicated to receive signage at quarter-points on tank circumference, five feet above finished floor.

3.3 PROTECTION AND CLEANING

- A. After installation, clean soiled signage surfaces in accordance with manufacturer's written instructions.
- B. Protect signage from damage until completion of the Work.

+ + END OF SECTION + +

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all fire protection specialties Work.
 - 2. Extent of fire protection specialties Work is shown and specified.
 - 3. Types of fire protection specialties Work required includes:
 - a. Dry chemical extinguishers.
 - b. Fire extinguisher cabinets.
 - c. Mounting accessories and miscellaneous fasteners.
- B. Coordination:
 - 1. Review installation procedures under other Sections and coordinate installation of items that must be installed with or before fire protection specialties.
- C. Related Sections:
 - 1. Section 10 14 00, Signage.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ASTM E814, Test Method for Fire Tests of Penetration Firestop Systems.
 - 2. FM Global, FM Approval Guide.
 - 3. NFPA 10, Portable Fire Extinguishers.
 - 4. UL Fire Classification Rating.

1.3 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Provide fire protection specialties products from one manufacturer.
- B. Certifications: Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.
 - 2. Provide fire extinguishers approved, listed, and labeled to comply with ASTM E814.
- C. Regulatory Requirements:

1. Provide fire protection specialties approved and labeled by UL.
2. Provide fire protection specialties conforming to NFPA 10 requirements.

1.4 SUBMITTALS

A. Action Submittals:

1. Product Data: Submit the following:
 - a. Manufacturer's technical data, certification of UL rating, and installation instructions for fire protection specialties.
 - b. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
 - c. Product Schedule: For fire extinguishers and fire protection cabinets. Coordinate final fire extinguisher and fire protection cabinet schedule to ensure proper fit and function.

B. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.
2. Warranty: Sample of special warranty.

1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. General: Provide manufacturer's standard mounting brackets for portable fire extinguishers size as specified.
- B. Multi-Purpose Dry Chemical Fire Extinguishers:
1. Ten-pound capacity, enameled steel container with pressure-indicating gauge,

- for Class A, Class B, Class C fires, UL rating 4A-60 B:C.
2. Products and Manufacturers: Provide one of the following:
 - a. Cosmic Model 10E by J.L. Industries, a division of Activar Construction Products Group.
 - b. MP 10 Series by Larsen's Manufacturing Company.
 - c. Or equal.
- C. Fire Extinguisher Cabinets:
1. For each exterior fire extinguisher provided under this Contract, provide a fire extinguisher cabinet. Coordinate size of recessed fire extinguisher cabinets required with extinguisher selected, for complete system integration.
 2. Provide cabinets with concealed hinges and handles with manufacturer's standard door roller catches. Provide all features typically furnished with specified unit.
 3. Provide two-hour fire-rated cabinets, ASTM E814 .
 4. Cabinets shall have 302/304 stainless steel doors with No. 4 finish. Provide specified manufacturer's minimum gages for all material.
 5. Cabinet shall have 1/4-inch thick, clear tempered glass vision panel.
 6. Product and Manufacturer: Provide products of one of the following:
 - a. Embassy 5734 V17 (fire-rated) with No. 4 Stainless Steel Tub and with glass with Fire-FX option with vertical fire extinguisher decal by J.L. Industries, a division of Activar Construction Products Group.
 - b. Flame Shield SS Series by Larsen's Manufacturing Company.
 - c. Or equal.
- D. Identification: Refer to Section 10 14 00, Signage.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine substrates and conditions under which fire protection specialties will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to ENGINEER.

3.2 INSTALLATION OF FIRE EXTINGUISHERS

- A. When exact locations of fire protection specialties are not shown on Drawings, locate as directed by ENGINEER.
- B. Securely fasten products to structure, square and plumb, per Supplier's instructions. Mounting heights shall be:
 1. Install fire extinguishers with gross weight greater than 40 pounds with top of fire extinguisher no more than 3.5 feet above finished floor.
 2. Install fire extinguishers with gross weight less than 40 pounds with top of fire

- extinguisher no more than 4.0 feet above finished floor.
3. Clearance between bottom of fire extinguisher and finished floor shall be at least four inches.
- C. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semi-recessed fire protection cabinets.
 2. Provide inside latch and lock for break-glass panels.
 3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
- D. Identification Devices: Refer to Section 10 14 00, Signage.
- E. Recharge fire extinguishers provided under this Contract so that most recent inspection date coincides as nearly as possible with date of Substantial Completion. Inform OWNER in writing of next required inspection and recharging date.

3.3 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

3.4 FIRE EXTINGUISHER SCHEDULE

- A. Dry chemical, wall mounted.
1. Fluoride Dosing Room: Provide one (1).
 2. Sodium Hypochlorite Feed Room: Provide one (1).
- B. Dry chemical, with cabinet.
1. Sodium Hypochlorite Area: Provide one (1).
 2. Hydrofluorosilicic Acid Area: Provide one (1).

++ END OF SECTION ++

SECTION 13 34 23

PRE-ENGINEERED SHELTER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all professional services, labor, materials, tools, equipment and incidentals as shown, specified and required to design, furnish, and install pre-engineered shelter, capable of withstanding specified structural loads and exposure to weather without excessive deflection, as shown on the Drawings and in accordance with the Specifications.
2. Included are:
 - a. Coordinate and incorporate into the pre-engineered shelter all required items necessary to accommodate Work under this Section and other related Sections. Provide required openings, closures, escutcheons, sleeves, supports, fasteners, attachments, and other appurtenances that are not specifically provided under other Sections.
3. Extent and basic layout of pre-engineered shelter work as shown on the Drawings.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, the pre-engineered shelter.
2. Coordinate the locations of equipment, piping, heating and ventilating ductwork, electrical conduit, and similar items in order to provide required clearances and supports for such items without modification of pre-engineered shelter components at the Site.

C. Related Sections:

1. Section 03 00 05, Cast-In-Place Concrete
2. Section 05 05 33, Anchor Systems
3. Section 05 12 00, Structural Steel Framing
4. Section 05 50 13, Miscellaneous Metal Fabrications

1.2 REFERENCES

A. Referenced standards cited in this Specification refer to the current referenced standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited. Standards referenced in this Section are:

1. American Institute of Steel Construction (AISC):
 - a. 325 – Steel Construction Manual
 - b. 360 – Specification for Structural Steel Buildings

2. ASTM International (ASTM):
 - a. ASTM A992-Standard Specification for Structural Steel Shapes
 - b. ASTM A36-Standard Specification for Carbon Structural Steel
 - c. ASTM A500-Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 - d. ASTM F1554-Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
 - e. ASTM A 325-Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - f. ASTM F3125-Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength
 - g. ASTM C881 Type IV, Grade 3, Class A, B & C.- Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - h. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
3. American Welding Society (AWS).
 - a. D1.1, Structural Welding Code - Steel.
4. ASCE 7 Minimum Design Loads for Buildings and other Structures

1.3. QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. The pre-engineered shelter should be the latest standard product of a building supplier regularly engaged and having at least ten (10) years of experience in pre-engineered shelter engineering, design, supply, and installation.
 - b. Alternate building suppliers shall demonstrate that they have designed, engineered, produced, delivered, and constructed, at a minimum, ten (10) other functioning site built shelters of similar type. Project completion date and a reference contact from the owner of each project must be provided.
 - c. Alternate building suppliers must also disclose all instances of any prior municipal or engineer's rejection of the same or similar product as an "or equal" to the specified basis of design building package.
 - d. Contractors wanting to propose an "or equal" building supplier are required to submit a complete submittal package with full sealed plan sets, calculations, and all pre-engineered structural items, ten (10) calendar days prior to the bid opening date. Any products proposed as "or equal" that are not as specified must be specifically listed and accompanied by the manufacturer's data sheets for review. This will be approved or denied prior to the bid opening. Incomplete submittals will be rejected and returned to the bidder
2. Professional engineer:
 - a. Contractor or pre-engineered shelter manufacturer shall retain a registered professional engineer legally qualified to practice in the same state as the Site.

Professional engineer shall have at least five years' experience in designing pre-engineered shelter systems.

b. Responsibilities include:

- 1) Reviewing pre-engineered shelter performance and design criteria stated in the Contract Documents.
- 2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to Engineer by Contractor.
- 3) Preparing or supervising preparation of design calculations and related Shop Drawings.
- 4) Signing and sealing all design calculations and Shop Drawings.
- 5) Certifying that:
 - a) Design of pre-engineered shelter has been performed in accordance with performance and design criteria stated in the Contract Documents, and
 - b) Design conforms to all applicable local, state, and federal Laws and Regulations, and to prevailing standards of practice.

B. Component Supply and Compatibility:

1. Obtain all pre-engineered shelter components through a single source and from a single manufacturer.
2. Pre-engineered shelter manufacturer shall review and approve, or prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by pre-engineered shelter manufacturer.

C. Regulatory Requirements:

1. Fabricate and label pre-engineered shelter to comply with material verification and special inspection requirements of the governing Building Code and Authorities Having Jurisdiction at the Site.
2. Manufacturer shall submit a copy of quality control manuals and fabrication procedures that provide a basis for control of materials and workmanship, with periodic auditing of fabrication and control practices by an independent testing agency.

1.4 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Submit foundations loads and anchor bolt plans.
 - 1) Complete fabrication and erection plans and procedures giving full information on aspects of the erection which will affect alignment, plumb and dimensional accuracy of the structure
 - 2) Connections including size and spacing of bolts and welds.
 - 3) Indicate profiles, sizes, spacing, and locations of structural members, openings, camber and attachments. Indicate welded connections with AWS welding symbols. Indicate net weld lengths. Details of welding materials, equipment, sequence and technique to be used. Shop and erection details

incorporating any seismic critical welds shall include explicit references to corresponding weld procedure specifications.

- 4) Drawings showing all vertical and horizontal reactions on foundation. Include direction and location of each load application.
 - 5) Include diameter, projection, concrete embedment, and a plan showing location relative to column center line of all anchor bolts required to attach pre-engineered shelter to foundation.
 - 6) The Subcontractor shall survey, review and confirm as-built conditions prior to developing shop drawings. Field modifications to suit as-built conditions shall be at the Subcontractor's expense.
- b. Completely dimensioned plans, elevations and cross-sections of the pre-engineered shelter completely coordinated with all required equipment and building service clearances. All details shall be drawn at a scale of not less than 1-1/2 inches equal to 12 inches. Accurately locate, show and dimension all required roof penetrations.
 - c. Contractor shall note Work not supplied by pre-engineered shelter manufacturer and who is to supply such Work.
2. Product Data:
 - a. Manufacturer's complete product information, specifications and installation instructions for components and accessories. Include material descriptions, dimensions and profiles of individual system components.
 - b. All submittals shall be approved by the Engineer prior to delivery and/or fabrication.
 3. Samples:
 - a. Manufacturer's full selection of standard colors showing the full range of colors available for each type of product included in the pre-engineered shelter that incorporates a factory-applied color finish, for initial color selection by Engineer.

B. Delegated Design Submittals:

1. Design Data: Submit the following:
 - a. Design Calculations:
 - 1) Complete calculations as one package with the Shop Drawings. Structural calculations shall include all specified performance criteria, required load cases and load combinations used in the design and resulting member forces, reactions, deflections, story drift, and other anticipated movements in the metal building system.
 - 2) Design calculations shall be signed, sealed, and dated by Contractor's professional engineer. State of professional engineer's registration, registration number, and name on seal shall be clearly legible.

C. Informational Submittals: Submit the following:

1. Certificates.
 - a. Certification by professional engineer that metal building system design is in accordance with performance and design criteria stated in the Contract Documents, and that design conforms to applicable local, state, and federal Laws and Regulations, and to prevailing standards of practice.

2. Quality Control Plan:
 - a. Submit a copy of quality control manuals and fabrication procedures per Article 1.3.C of this Section.
3. Manufacturer's Instructions: Provide the following:
 - a. Indicate preparation requirements and assembly sequence.
 - b. Installation and maintenance manual.
 - c. Instructions for handling, start-up, and troubleshooting.
4. Qualification Statements: Submit qualifications for the following:
 - a. Manufacturer.
 - b. Professional engineer.

1.5 WARRANTY

- A. The building and all its associated components shall be warranted against defects in materials and workmanship for a period of not less than one (1) year from date of final acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Romtec, Inc.
- B. Mitchell Metals
- C. Peachtree Protective Covers
- D. Or approved equal.

2.2 PRE-ENGINEERED SHELTER

- A. Pre-engineered shelter structure dimensions shall match what is indicated on Drawings. Contractor shall notify Engineer of any discrepancies before construction. Provide factory-built, pre-engineered structures and shelters complying with the following:
 1. Style: Steel 4-post or 6-post shelters, as shown on Drawings.
 2. Steel truss system with HSS 4" x 4" minimum steel columns.
 3. Steel components to be powder coated. Color to vary by site:
 - a. Sodium Hypochlorite canopies at Crosstown: White

2.3 STRUCTURAL FRAMING MATERIALS

- A. Hollow Structural Sections: ASTM A500/A500M, Grade B.
- B. Sized to meet or exceed specific project design load requirements.
- C. Pipe: ASTM A53, Type E or S, Grade B.

- D. Shear Stud Connectors: ASTM A108 ($f_u=60$ KSI).
- E. Anchor Rods: ASTM F1554, GRADE 55.
- F. Threaded Stud Connectors: ASTM A36.
- G. Bolts and Nuts: Bolts in structural steel connections shall be provided in accordance with ASTM A325. Nuts shall be provided in accordance with ASTM A563 Grade C or DH.
- H. Welding Materials: Filler metals shall conform to Table 4.1 of AWS D1.1. Electrodes and equipment settings shall be as recommended by the filler metal manufacturer for the position, thickness and conditions of use. Use E-70XX Electrodes.
- I. Washers shall be flat and either circular, square or rectangular conforming to ASTM F436 Type 1. The finish of washers is to match the nut. A325 bolts shall have washers under the head.
- J. Anchor bolts shall comply with Section 05 05 33, Anchor Systems.

2.4 CONNECTIONS

- A. Shop connections shall be welded and field connections, except moment connections, shall be bolted. Weld only in accordance with approved welding procedures.
- B. Bolted connections shall be 3/4-inch diameter A325-N; connections shall have a minimum of two bolts. Shoulder bolts with hex nut and lock washers shall be used in slotted connections with the washer covering the slot in positions.
- C. Column base plate shall be minimum 3/4-inch thick A36 type.
- D. The Registered Professional Engineer submitting the shop drawings and calculations as stated in Section 1.4.B is responsible for the design of connections.
- E. All elements of a connection shall be designed to resist specified structural loads and exposure to weather without excessive deflection, as shown on the Drawings and in accordance with the Specifications.
- F. All bolted connections shall have a minimum of two bolts.
- G. Gusset plates connecting horizontal and vertical bracing to beams and/or columns shall be connected to both adjacent members. Where this is not practical, provisions shall be made for the moment induced by the eccentricity of the load to the work point of the connection. Gusset plates for horizontal bracing shall be located within the top two rows of bolts of beam connection angles, unless otherwise noted on the drawings. The minimum thickness of gusset plates in single shear shall be 3/8-inch for bolts in single shear and 3/8-inch for bolts in double shear.
- H. Anchor bolts for each column shall be furnished with a 1/8" thick sheet metal template.

2.5 ROOFING

- A. Roofing shall be Fabral, 26-gauge GrandRib3 roof panels with exposed fasteners. Provide inside and outside foam closures, matching trim (eaves, gables and ridge) and fasteners, sheet metal flashing (all sides), and 30# felt (under metal).
- B. Roofing color to be selected by the owner from the manufacturer's standard color chart. Colors to be similar to those listed above under 2.2.
- C. Gutters and downspouts: Refer to Section 07 71 00, Roof Specialties.

2.6 CAST IN-PLACE CONCRETE

- A. All equipment, labor, trades and materials shall be supplied by Contractor.

PART 3 - EXECUTION

3.1 SPECIAL INSPECTION

- A. If required, special inspection shall be owner supplied.
- B. If special inspection is required per the building department or other regulatory agencies, then the building supplier can assist but NOT provide this service.

3.2 INSTALLATION

- A. All components to be installed according to the plan sets and/or manufacturer's instructions.

3.3 OPERATION & MAINTENANCE MANUALS

- A. Upon installation, do not throw away the Operations & Maintenance manuals that are provided by some manufacturers in their packaging. Requests for additional copies from the *building supplier* will result in subsequent charges.

++ END OF SECTION ++

SECTION 22 05 27

PIPE SLEEVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install pipe sleeves, other wall pieces, and escutcheons complete with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the pipe sleeves Work.
- C. Related Sections:
 - 1. Section 03 00 05, Concrete.
 - 2. Section 07 92 00, Joint Sealants.
 - 3. Section 22 11 16, Domestic Water Piping.
 - 4. Section 22 13 16, Sanitary Waste and Vent Piping.
 - 5. Section 22 14 13, Storm Drainage Piping.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American National Standards Institute, (ANSI).
 - a. ANSI A21.4, Cement-Mortar Lining for Cast-Iron and Ductile Iron Pipe and Fittings.
 - b. ANSI A21.6, Cast-Iron Pipe Centrifugally Cast in Metal Molds.
 - c. ANSI A21.10, Cast-Iron and Ductile Iron Fittings, 2 thru 48-inches in Water.
 - d. ANSI A21.11, Rubber Gasket Joints for Cast-Iron and Ductile Iron Pressure Pipe.
 - e. ANSI A21.15, Flanged Cast-Iron and Ductile Iron.
 - f. ANSI A21.51, Ductile Iron Pipe Centrifugally Cast in Metal Molds.
 - g. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
 - 2. American Water Works Association, (AWWA).
 - a. AWWA C104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - b. AWWA C106, Cast-Iron Pipe Centrifugally Cast in Metal Molds.
 - c. AWWA C110, Ductile-Iron and Gray-Iron Fittings for Water.
 - d. AWWA C111, Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - e. AWWA C115, Flanged Ductile-Iron Pipe or Gray-Iron Threaded Flanges.
 - f. AWWA C151, Ductile-Iron Pipe, Centrifugally Cast for Water.

1.3 QUALITY ASSURANCE

- A. Installers' Qualifications:
 - 1. Engage a single installer regularly engaged in pipe sleeves and mechanical seals installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit names and qualifications to ENGINEER.
 - 2. Engage a single installer for the entire pipe sleeves and mechanical seals system with undivided responsibility for performance and other requirements.
- B. Component Supply and Compatibility:
 - 1. Obtain all products included in this Section regardless of the component manufacturer from a single pipe sleeves and mechanical seal manufacturers.
 - 2. The pipe sleeves and mechanical seal manufacturers to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the pipe sleeves and mechanical seal manufacturers.
- C. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. Local and State Building Codes and Ordinances.

1.4 SUBMITTALS

- A. Shop Drawings: Submit the following:
 - 1. Manufacturer's literature, illustrations, specifications and engineering data.
 - 2. Details of installation.
 - 3. Detailed drawings showing all pipe sleeves and mechanical seals for each piping system. Drawings shall show location, installation and material of all pipe sleeves and mechanical seals.
 - 4. Other technical data related to the specified material and equipment as requested by ENGINEER.
 - 5. Installer's Qualifications.
 - 6. Deviations from Contract Documents.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
- B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
- C. Acceptance at Site:
 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

- A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
- B. The Drawings show an indication of the arrangement of equipment, piping, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. Piping, equipment, piping, etc. found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.
- C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each case, adequately provide for expansion and circulation and minimize the amount of space required for the same.
- D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval by the ENGINEER.
- E. The Drawings do not show all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others", to complete the systems to the true extent of the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe Sleeves:
FCWS Crosstown WTP
Chemical Upgrades

1. Ferrous and Plastic Pipe: Use standard weight galvanized steel pipe, unless otherwise shown.
 2. Copper Pipe: Use standard weight galvanized steel pipe with mechanical link seals as spacers, unless otherwise shown.
- B. Cast Wall Sleeves:
1. Material: Cast-iron furnished with integral wall collar.
 2. Dimensions: As required for mechanical joint or calked joint pipe to pass through sleeve. Length as required.
- C. Mechanical Seals: Provide link type mechanical seals with adjusting bolts suitable for 20 psi working pressure where shown or required.
1. Manufacturers: Provide products of one of the following:
 - a. Advance Products & Systems, Inc., Innerlynx.
 - b. GPT Division of Enpro Industries, Link-Seal.
 - c. The Metraflex Company, Metraseal.
 - d. Or equal.
 2. Materials: Mechanical seals through non-fire rated walls or floors:
 - a. Pressure Plate: Glass reinforced nylon plastic.
 - b. Bolt and Nut: 18-8 stainless steel.
 - c. Sealing Element: EPDM rubber.
 3. Materials: Mechanical seals through fire rated walls or floors; two independent mechanical seal assemblies required for each penetration:
 - a. Pressure Plate: Low carbon steel, zinc galvanized plated or stainless steel.
 - b. Bolt and Nut: Low carbon steel zinc galvanized.
 - c. Sealing Element: Silicone rubber.
 - d. Fire rating: Three-hour.
- D. Wall, Floor and Ceiling Escutcheon Plates:
1. Manufacturers: Provide products of one of the following:
 - a. McGuire Manufacturing, Inc.
 - b. Pegasus Manufacturing, Incorporated.
 - c. Or equal.
 2. Bare Pipes Passing Through Walls, Floors and Ceilings in any Room: Provide escutcheon plates of cast brass or stamped steel, chrome plated, hinged with setscrews.
 3. Insulated Pipes Passing Through Walls, Floors and Ceilings in Finished Rooms: Provide plated escutcheon plates of stamped steel or cast brass, chrome plated, hinged with setscrews.
- E. Exterior Walls or Floors: Below grade:
1. Manufacturers: Provide products of one of the following:
 - a. GPT Division of Enpro Industries, Century-Line.
 - b. SIGMA Corporation, Omni-Sleeve.
 - c. Or equal.
 2. Type: Thermoplastic sleeve for use in new construction where sleeves are exposed to liquid or on exterior walls or floors exposed to backfill only.

3. Integral reinforcing ribs, anchor and waterstop collar textured surface for adhesion to concrete.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install all items as shown, specified, and as recommended by the manufacturer.
2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
3. Present conflicts to ENGINEER, in writing, who will determine corrective measures to be taken.
4. Do not modify structures to facilitate installation of pipe sleeves, mechanical seals, and accessories, unless specifically approved by ENGINEER.
5. Installation to conform to requirements of all local and state codes.
6. Protection: Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

B. Pipe Sleeves:

1. Use sleeves wherever pipes pass through walls, partitions, floors and roofs, unless otherwise shown.
2. All sleeves through floor slabs in finished areas shall extend a maximum of 1/4-inch above finished floor.
3. Anchor sleeves to concrete and masonry walls as shown or otherwise accepted.
4. Sleeves through walls shall be flush with wall face.
5. Calk and seal annular space between pipe and sleeve.
6. All pipe joints and annular spaces in exterior walls or walls subjected to hydrostatic pressure shall be completely watertight.
7. All vertical pipes through sleeves shall be installed with Link Seal "Pyro-Pacs" to maintain 2-hour fire rating between the two fire areas.
8. Size Sleeves to provide annular space as recommended by the mechanical seal manufacturer and as follows:

Sleeve ID Minus Pipe

<u>Pipe Size</u>	<u>or Insulation OD</u>
Less than 2-in.	1/2-in. to 3/4-in.
2-in. to 4-in.	3/4-in. to 1-1/4-in.
6-in. to 12-in.	1-1/4-in. to 2-in.

9. For mechanical link seals, size sleeves to provide space required to suit link type seals provided.
10. Do not install sleeves and pipes through structural members unless specifically required due to coordination or obstructions, each sleeve condition shall be submitted for approval.

3.2 FIELD QUALITY CONTROL

FCWS Crosstown WTP

Chemical Upgrades

22 05 27-5

- A. Inspection:
 - 1. Examine areas to receive pipe sleeves, mechanical seals, escutcheons and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances for pipe sleeves, mechanical seals, escutcheons and accessories.
 - c. Start the Work only when conditions are satisfactory.
 - 2. The ENGINEER reserves the right to reject or authorize replacement of pipe sleeves, mechanical seals, escutcheons and accessories found to be defective.

3.3 ADJUSTING AND CLEANING

- A. Adjusting:
 - 1. Adjust all materials for proper settings.
- B. Cleaning:
 - 1. Thoroughly clean all pipe sleeves, mechanical seals, escutcheons and accessories prior to installation.
 - 2. Remove all dirt, rust, dust, etc. from all pipe sleeves, mechanical seals and escutcheons in preparation for required painting.
 - 3. Remove and dispose of all debris and waste from the Site resulting from installation.

+ + END OF SECTION + +

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install hangers and supports complete with accessories for plumbing piping and equipment.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the hangers and supports for plumbing piping and equipment Work.

C. Related Sections:

1. Section 05 05 33, Anchor Systems.
2. Section 05 12 00, Structural Steel Framing.
3. Section 05 50 13, Miscellaneous Metal Fabrications.
4. Section 09 91 00, Painting.
5. Section 22 11 16, Domestic Water Piping
6. Section 22 13 16, Sanitary Waste and Vent Piping
7. Section 22 14 13, Storm Drainage Piping

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American National Standards Institute, (ANSI).
 - a. ANSI B1.1, Unified Inch Screw Threads. (ASME B1.1).
2. American Society for Testing and Materials, (ASTM).
 - a. ASTM A 36/A 36M, Specification for Carbon Structural Steel.
 - b. ASTM A 47/A 47M, Specification for Ferritic Malleable Iron Castings.
 - c. ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - d. ASTM A 575, Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
 - e. ASTM A 668/A 668M, Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
3. Federal Specifications, (FS).
 - a. FS WW-H-171, Hangers and Supports, Pipe.
4. Manufacturer's Standardization Society, (MSS).

- a. MSS SP 58, Pipe Hangers and Supports - Materials, Design and Manufacture.
- b. MSS SP 69, Pipe Hangers and Supports - Selection and Application.
- c. MSS SP 89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- d. MSS SP 90, Guidelines on Terminology for Pipe Hangers and Supports.

1.3 QUALITY ASSURANCE

- A. Installer's Qualifications:
 - 1. Engage a single installer regularly engaged in hangers and supports installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
 - 2. Engage a single installer for the entire plumbing pipe and equipment hangers and supports system with undivided responsibility for performance and other requirements.
 - 3. Requirements for seismic restraints and vibration isolation for plumbing piping and equipment shall be as described in Section 40 05 96, Vibration, Seismic, and Wind Controls.
- B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. Local and State Building Codes and Ordinances.
 - 2. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.
- C. Component Supply and Compatibility:
 - 1. Obtain all products included in this Section regardless of the component manufacturer from a single plumbing pipe and equipment hangers and supports manufacturer.
 - 2. The plumbing piping and equipment hangers and supports manufacturer shall review and approve all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the plumbing piping and equipment hangers and supports manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Details of installation.
 - b. Detailed drawings showing all hangers and supports for each piping system. Drawings shall show location, installation, material, loads, forces, stresses and deflections of all hangers and supports.

2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications and engineering data.
 - b. Other technical data related to the specified material and equipment as requested by ENGINEER.

B. Informational Submittals: Submit the following:

1. Qualifications Statements:
 - a. Installer's Qualifications.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

- A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
- B. The Drawings show an indication of the arrangement of equipment, piping, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. Piping, equipment, etc. found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.
- C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit

the requirements of each case, adequately provide for expansion and circulation and minimize the amount of space required for the same.

- D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval by the ENGINEER.
- E. The Drawings do not show all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others", to complete the systems to the true extent of the Contract Documents.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Components of hangers and supports shall conform to the following:
 - 1. Materials:
 - a. Bolts: ASTM A 307, Grade A, unless otherwise specified below.
 - b. Forgings: ASTM A 668/A 668M.
 - c. Malleable Iron: ASTM A 47/A 47M.
 - d. Rods and Bars: ASTM A 575.
 - e. Threads: Unified Screw Threads, Class 2A and 2B, ANSI B1.1.
 - f. Structural Steel: ASTM A 36/A 36M.
 - 2. Finish:
 - a. Steel or Malleable Iron Items: Hot-Dipped Galvanized, unless otherwise specified or as shown.
 - b. Steel or Malleable Iron Materials Used for the Support of Uninsulated Copper Piping: Copper plated.
 - c. Framing Members and Fittings: Dip painted with corrosion resistive primer as specified in Section 09 91 00, Painting.
 - d. All hangers, rods, bolts, nuts, inserts, washers located in the corrosive areas shall be Type 316 stainless steel.
- B. Pipe Attachments: The following types of pipe attachments shall be considered acceptable:
 - 1. Adjustable Steel Clevis: FS WW-H-171E, Type 1.
 - 2. Steel Double Bolt Pipe Clamp: FS WW-H-171E, Type 3.
 - 3. Steel Pipe Clamp: FS WW-H-171E, Type 4.
 - 4. Adjustable Swivel Pipe Ring: FS WW-H-171E, Type 6.
 - 5. Adjustable Steel Band Hanger: FS WW-H-171E, Type 7.

6. Riser Clamp: FS WW-H-171E, Type 8.
7. Light-Duty Clevis Hanger: FS WW-H-171E, Type 12.
8. Long Clips: FS WW-H-171E, Type 26.
9. Offset J-Hooks: FS WW-H-171E, Type 27.
10. Steel Pipe Covering Protection Saddle: FS WW-H-171E, Type 40A.
11. Insulation Protection Shield: FS WW-H-171E, Type 41.
12. Pipe Saddle Support: FS WW-H-171E, Type 37.
13. Pipe Stanchion Saddle: FS WW-H-171E, Type 38.
14. Pipe Saddle Support with Base: FS WW-H-171E, Type 36.
15. Adjustable Roller Hanger: FS WW-H-171E, Type 42.

C. Structural Attachments: The following types of structural attachments shall be considered acceptable:

1. Side Beam Clamp: FS WW-H-171E, Type 20.
2. Center I-Beam Clamp: FS WW-H-171E, Type 21.
3. Welded Steel Bracket: FS WW-H-171E, Types 32 and 33.
4. Side Beam Bracket: FS WW-H-171E, Type 35.
5. Malleable Iron with Hot-Dipped Galvanized Finish Concrete Insert: FS WW-H-171E, Type 18. The use of steel concrete inserts is prohibited and NOT acceptable.

D. Hanger Rod Attachments: Use as required to complete assembly:

1. Forged Steel Clevis: FS WW-H-171E, Type 14.
2. Adjustable Turnbuckle: FS WW-H-171E, Type 15.
3. Forged Steel Welders Eye Nut: FS WW-H-171E, Type 17.

E. Expansion Joints:

1. Manufacturers: Provide products of one of the following:
 - a. Flex-Hose Co., Inc.
 - b. The Metraflex Company
 - c. Or equal.
2. 2-1/2-inch and Smaller Copper Tubing:

Construction: Free flexing expansion joints with stainless steel corrugated members, NSF 372 certified lead-free for use in domestic water systems.

 - a. End Connections: Male and female solder end fittings or screwed ends with adaptors for screwed to sweat ends.
3. 3-inch and Larger:
 - a. Construction: Free flexing expansion joints with stainless steel corrugated members, NSF 372 certified lead-free for use in domestic water systems.
 - b. End Connections: Welded ends with flanges.

F. Alignment Guides:

1. Type: Semi-steel spider with four guiding fingers and guiding cylinder with base.
2. Manufacturers: Provide products of one of the following:
 - a. Flex-Hose Co., Inc.

- b. The Metraflex Company
 - c. Or equal.
- G. Connection Bolts: Materials shall be as specified in other Sections of these Specifications or as shown. Where materials are not specified or shown, they shall be of Type 304 stainless steel with Monel nuts.
- H. Toggle Bolts:
 - 1. Provide zinc plated spring wing toggle bolts of the size required for secure anchorage of individual items, but not less than 1/4-inch diameter, of length required.
 - 2. Products and Manufacturers: Provide products by one of the following:
 - a. Cooper B-Line Division of Eaton Corp.
 - b. Powers Fasteners
 - c. Or equal.
- I. CONTRACTOR shall furnish and install all necessary supports, angle iron stands, miscellaneous steel, inserts, anchor bolts and hangers required for all equipment furnished under this Contract, unless otherwise noted. All supports shall meet the requirements of the applicable Sections of Division 05, Metals.

2.2 PAINTING

- A. All pipe hangers, supports and restraints shall be painted as required in accordance with the requirements of Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install all items as shown, specified, and as recommended by the manufacturer.
 - 2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
 - 3. Present conflicts to ENGINEER, in writing, who will determine corrective measures to be taken.
 - 4. Do not modify structures to facilitate installation of pipe hangers, supports and restraints, unless specifically approved by ENGINEER.
 - 5. Installation to conform to requirements of all local and state codes.
 - 6. Protection: Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.2 FIELD QUALITY CONTROL

- A. Inspection:

1. Examine areas to receive plumbing piping and equipment hangers and supports and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances for pipe hangers, supports and restraints and accessories.
 - c. Start the Work only when conditions are satisfactory.
2. The ENGINEER reserves the right to reject or authorize replacement of pipe hangers, supports and restraints and accessories found to defective.

3.3 ADJUSTING AND CLEANING

- A. Adjusting:
 1. Adjust all materials for proper settings.
- B. Cleaning:
 1. Thoroughly clean all pipe hangers, supports and restraints and accessories prior to installation.
 2. Remove all dirt, rust, dust, etc. from all pipe hangers, supports and restraints in preparation for required painting.
 3. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 MATERIAL SCHEDULES

- A. Hangers, Supports and Restraints for Horizontal Piping:
 1. Space supports and hangers for all piping no farther apart than shown below, unless otherwise shown:
 - a. Copper Tube:
 - 1) All Pipes: 6 feet-0 inch on center.
 - b. Steel Pipe:
 - 1) Pipes up to 1-inch: 6 feet-0 inch on center.
 - 2) Pipes 1-1/4-inch to 6-inch: 8 feet-0 inch on center.
 - c. Cast-Iron Pipe:
 - 1) Two supports per length, maximum 5 feet-0 inches on center.
 - d. Plastic Pipe:
 - 1) 3 feet-0 inch on center for all sizes, unless otherwise recommended by manufacturer for 100°F ambient temperature.
 2. Additional supports are to be provided at all changes of direction, at all no-hub fittings and couplings for cast iron pipe, and at all valves or other in-line devices installed in piping.
 3. Rigid support sway bracing shall be provided at all changes of direction for piping 4" diameter and larger.
 4. Mechanical restraints shall be installed at all fittings for changes of direction in drainage piping 4" and larger in accordance with the CISPI installation guidelines.

B.

Hanger Rods: Size hanger rods according to the schedule below, unless noted otherwise.

<u>Nominal Pipe (Inches)</u>	<u>Rod Diameter (Inches)</u>
1/2 through 2	3/8
2-1/2 through 3-1/2	1/2
4 through 5	5/8
6	3/4

- C. Supports for Vertical Piping:
1. Provide riser clamp placed under hub, fitting or coupling with approved solid bearing on steel sleeve at each floor level.
 2. Where riser clamps are used with plastic piping they shall be modified so as not to exert any compressive forces on the pipe.
 3. Support spacing shall not exceed code requirements.
 4. Piping support intervals shall not exceed those listed in Paragraph 3.4.A., above.
 5. Additional supports shall be placed immediately adjacent to any change in piping direction, and on both sides of valves and couplings.
 6. Accurately locate inserts for hanger rods in forms before concrete is placed.
 7. Use Type 304 stainless steel expansion anchor assemblies of the capsule polyester resin adhesive type and only to support rods, hangers and brackets for piping 1-inch and smaller no other type will be considered and only if the expansion anchors are designed to carry 100 percent of the full load, hanger, and/or bracket and pipe load.
- D. Supports for water meters and backflow preventers: Provide pipe saddle supports with base anchored to floor.
- E. Structural members shall conform to Section 05 12 00, Structural Steel Framing.
- F. Anchor bolts, expansion anchors and concrete inserts shall conform to Section 05 05 33, Anchor Systems.
- G. Miscellaneous metal fabrications shall conform to Section 05 50 13, Miscellaneous Metal Fabrications.
- H. Allow clearances for expansion and contraction of piping.
- I. Anchors shall be designed to prevent any pipe movement at pipe anchorage points. Anchors shall be securely fastened to the construction directly or indirectly through structural framing:
1. Piping 2-1/2-inches and Smaller: Anchor horizontal runs over 50 feet to midpoint to allow expansion toward expansion compensators (anchor intervals shall not exceed 30 feet) or elbows.
 2. Piping 3-inches and Larger: Anchor horizontal runs over 100 feet at mid-points to force expansion toward expansion compensators.

3. Provide alignment guides in accordance with expansion compensator manufacturer recommendations.
- J. Provide expansion compensators where necessary to absorb expansion and contraction in heating lines and as follows:
 1. Thirty feet on center of copper piping.
 2. Fifty feet on center of steel piping.
 - K. Locate first set of alignment guides within four pipe diameters of the anchor or expansion compensator, the second set of pipe alignment guides shall be located within fourteen pipe diameters of the first guides.

+ + END OF SECTION + +

SECTION 22 05 53

IDENTIFICATION OF PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install pipe labels, stencils, valve tags, equipment plates, and other identification specified herein.
- B. Related Sections:
 - 1. Section 22 07 19, Plumbing Piping Insulation.
 - 2. Section 22 11 16, Domestic Water Piping.
 - 3. Section 22 13 16, Sanitary Waste and Vent Piping.
 - 4. Section 22 33 00, Domestic Water Heaters.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American National Standards Institute (ANSI):
 - a. ANSI Z535.1, Safety Color Code
 - 2. American Society of Mechanical Engineers (ASME):
 - a. ASME A13.1, Scheme for the Identification of Piping Systems.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience. Submit names and qualifications to ENGINEER.
- B. Installer's Qualifications: Contractor specializing in performing work of this section with minimum five years documented experience. Submit names and qualifications to ENGINEER.
- C. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. Local and State Building Codes and Ordinances.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.

- B. Provide the following project specific information:
 - 1. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for plumbing equipment, piping and valve identification.
 - 2. Equipment Label Schedule: Provide a schedule of all equipment to be labeled with the proposed content for each label.
 - 3. Pipe Label Schedule: Provide a schedule of each piping systems indicating a proposed nomenclature and location of all pipe markers.
 - 4. Valve Tag Schedule: Provide a proposed valve numbering scheme and schedule for each piping system. Tabulate valve number, piping system, system abbreviation as shown on tag, room or space location of valve, normal-operating position (open, closed, or modulating), and variations for identification. Mark valves intended for emergency shut-off and similar special uses.
- C. Closeout Submittals: Record actual as built locations of valve tags and update schedules accordingly.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect packaged materials from corrosion and deterioration.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

- A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
- B. The Drawings show an indication of the arrangement of equipment, piping, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. Piping, equipment, piping, etc. found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.

- C. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval by the ENGINEER.
- D. The Drawings do not show all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others", to complete the systems to the true extent of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide products of one of the following:
 - 1. Brady North America
 - 2. Brimar Industries, Inc.
 - 3. Marking Services, Inc.

2.2 PIPE MARKERS

- A. General:
 - 1. Vinyl or vinyl cloth with permanent, pressure-sensitive adhesive.
 - 2. Provide labels and adhesives of long lasting materials, resistant to moisture, oils, solvents, and weathering.
 - 3. Provide separate flow directional arrows that conform with the above criteria.
- B. Piping Labels: Include the full service identifier.

2.3 VALVE TAGS

- A. Construction:
 - 1. Material: Brass.
 - 2. Size: 1-1/2-inch diameter.
 - 3. Chain: Brass.
 - 4. Lettering Size: 1/4-inch black filled letters over 1/2-inch high black filled numbers.
- B. Legend:
 - 1. C.W. - Cold Water.
 - 2. H.W. - Hot Water.
 - 3. N.P.W. - Non Potable Water
 - 4. P.W. – Potable Water
 - 5. T.W. – Tepid Water

2.4 VALVE CHARTS

- A. General:
 - 1. Two required; 1/8-inch sheet acrylic in 8-1/2 by 11-inch extruded aluminum frame.
 - 2. Charts: Typed or inked on mylar with the following information for each valve.
 - a. Valve identification number.
 - b. Valve location.
 - c. Valve use.
 - d. Valve size.
 - e. Manufacturer's name and model number.
 - 3. Submit sample valve tag with lettering.

2.5 EQUIPMENT NAMEPLATES

- A. General: Equipment and motors to be furnished with stainless steel engraved nameplate by manufacturer. In addition, provide an engraved multi-layered plastic laminated nameplate for all plumbing equipment purchased for this project. Provide an additional engraved nameplate for each disconnect and controller connected to the plumbing equipment.
- B. Mechanical Equipment: Provide a 1/16" thick black nameplate with white letters for all mechanical equipment. The nameplate shall be a minimum of 3" high x 6" wide. The nameplate shall be engraved with the Equipment Tag as shown on the mechanical drawings and schedules. The minimum letter height shall be 3/4". If necessary, enlarge the size of the plate to accommodate the 3/4" characters. Do not reduce the letter height. The nameplate shall be installed with either double faced adhesive or with stainless steel screws.
- C. Disconnects and Controllers: Provide a 1/16" thick black nameplate with white letters for each disconnect or controller connected to the mechanical equipment. The nameplate shall be a minimum of 2" high x 4" wide. Coordinate the information to be engraved on each plate so that it exactly matches the nameplate on the equipment. The minimum letter height shall be 1/2". Install these nameplates with 2 mil. Permanent double-faced acrylic adhesive covering the entire surface of the nameplate.
- D. Access Panels: Provide a 1/16" thick white nameplate with black letters to identify access to concealed valves or equipment such as those found above acoustical ceilings tiles. The nameplate shall be 3/4" high x 2 1/2" wide. Coordinate the information to be engraved on each plate so that it exactly matches the valve tag or equipment nameplate. The minimum letter height shall be 1/4". Install these nameplates on the ceiling support to the right of the tile that would provide access. Nameplates should be installed using double faced 2 mil. permanent acrylic adhesive.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install all items as shown, specified, and as recommended by the manufacturer.
2. Clean and prepare all surfaces for attachment of identification and apply adhesive appropriate to the environment.
3. Pipe labels are to be installed over insulation in a visible location for insulated piping.
4. Attach labels on horizontal runs to lower quarter of piping. Labels are to be visible when viewed from below.
5. Install separate flow directional arrows with each pipe label.
6. Identify piping where it is not permanently concealed by the structure:
 - a. At each valve.
 - b. On both sides of wall, floor, and ceiling penetrations.
 - c. At roof penetrations.
 - d. On each riser.
 - e. On each leg of a tee.
 - f. At connections to equipment.
 - g. At least every 30-feet along continuous runs of exposed piping. and piping in ceiling spaces that are is accessible through ceiling tiles shall be identified every 10 feet. The distance shall be measured center to center.
 - h. At least every 20-feet along continuous runs of compressed gas piping systems. Compressed gas piping systems in ceiling spaces that are accessible through ceiling tiles shall be identified every 10 feet. The distance measured shall be center to center.
7. Securely attach valve tags with brass chain at each valve.
8. Install equipment nameplate at each piece of equipment and at all panels.

3.2 FIELD QUALITY CONTROL

A. Inspection:

1. Examine all runs of piping, all valves, and all equipment to ensure that all piping, valves and equipment are provided with identification described herein.
2. Wherever identification is damaged, defective, or illegible, it is to be repaired or replaced.

3.3 CLEANING

A. Cleaning:

1. Thoroughly clean all labels, tags, and nameplates prior to completion of work.
2. Remove and dispose of all debris and waste from the Site resulting from installation.

Identification of Plumbing Piping and Equipment

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SECTION 22 05 93

DISINFECTION OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1SUMMARY

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as specified, and required to complete all plumbing system disinfection Work.
- B. Coordination:
 - 1. Review the extent of plumbing systems to be disinfected to ensure that all items have been installed in sufficient time to allow the disinfection Work to proceed.
- C. Related Sections:
 - 1. Section 22 11 16 Domestic Water Piping.
 - 2. Section 22 33 00 Domestic Water Heaters.

1.2REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American National Standards Institute, (ANSI).
 - 2. American Society for Testing and Materials, (ASTM).
 - 3. American Water Works Association, (AWWA).
 - a. AWWA C651, Disinfecting Water Mains.
 - b. AWWA C652, Disinfection Water Storage Facilities and Equipment.

1.3QUALITY ASSURANCE

- A. Contractor's Qualifications:
 - 1. Contractor regularly engaged in potable water piping and equipment disinfections and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
- B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. Local and State Building Codes and Ordinances.
 - 2. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.

1.4SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Testing Plans, Procedures, and Testing Limitations:

Disinfection of Plumbing Systems

- a. Description of the forms of chlorine, dosages, and proposed methods of disinfection.
- B. Informational Submittals: Submit the following:
 - 1. Site Quality Control Submittals:
 - a. Bacteriological test reports formatted according to requirements of authorities having jurisdiction.
 - 2. Qualification Statements:
 - a. Contractor's Qualifications.

PART 2 - PRODUCTS

2.1GENERAL

- A. Provide all necessary equipment and materials, including chemicals, to perform the disinfecting operations.

PART 3 - EXECUTION

3.1DISINFECTION

- A. General:
 - 1. All water handling equipment items that are part of the potable water distribution system shall be disinfected in the same manner as described herein for the pipelines.
 - 2. The method to be followed shall be that prescribed by the local authorities or in accordance with the procedures recommended by AWWA C651 and C652, except as specified below.
 - 3. Before application of chlorine, flush the piping system at a velocity of not less than 2.5 feet per second. Do not flush the system if the tablet method, as specified in the above standard is used.
 - 4. After the applicable retention period, flush the system using potable water.

3.2FIELD QUALITY CONTROL

- A. Testing: Perform bacteriological tests in accordance with AWWA C651.

+ + END OF SECTION + +

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install plumbing piping insulation complete with accessories.
2. The Contract Documents show the general arrangement and extent of the Work under this Section. Exact location and arrangement of all parts of the Work under this Section will be determined as the Work progresses. Exact location of the Work under this Section will be governed in part by building layout and conditions at the Site.
3. The Drawings do not show all offsets, fittings, accessories and details, for which insulation Work may be required. After examining the Contract Documents and conditions at the Site for conditions that affect the plumbing piping insulation Work, shall arrange the Work accordingly, providing all items required for such conditions that are not included under other Sections or other contracts to complete the systems.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before plumbing piping insulation Work.

C. Related Sections:

1. Section 22 11 16 Domestic Water Piping.
2. Section 22 14 13, Storm Drainage Piping.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI A117.1, Guidelines for Accessible and Usable Buildings and Facilities.
2. ASTM C449/C449M, Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finish Cement.
3. ASTM D1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
4. Federal Specification (FS) SS-C-160, Cement, Insulation, Thermal.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Installer:
 - a. Engage installer regularly engaged in plumbing piping insulation installation and with experience installing the types of materials required; and employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
 - b. Engage a single plumbing piping insulation installer for entire piping insulation system, with undivided responsibility for performance and other requirements.
- B. Component Supply and Compatibility:
 1. Obtain all products included in this Section regardless of component manufacturer, from a single piping insulation Supplier.
 2. Plumbing piping insulation Supplier shall review and approve or prepare all Shop Drawings and other submittals for components furnished under this Section.
 3. Components shall be suitable for specified service conditions and shall be integrated into overall assembly by plumbing piping insulation Supplier.
- C. Regulatory Requirements: Comply with the following.
 1. Americans with Disabilities Act (ADA).
 2. Applicable building codes and ordinances as listed in Section 01 42 00, References.

1.4SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, and engineering data.
 - b. Other technical data related to specified materials as requested by ENGINEER.
- B. Informational Submittals: Submit the following:
 1. Manufacturer's Instructions:
 - a. Manufacturer's recommended installation instructions.
 2. Qualifications Statements:
 - a. Installer.

1.5DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 1. Deliver products to Site to ensure uninterrupted progress of the Work.
 2. Inspect all boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.
 3. Conform to Section 01 65 00, Product Delivery Requirements.
- B. Storage and Protection:

1. Keep all products off ground using pallets, platforms, or other supports, in covered storage. Protect materials from damage and deterioration.
2. Prevent condensation in materials and packaging in accordance with manufacturer's recommendations for long-term storage
3. Conform to Section 01 66 00, Product Storage and Handling Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fiberglass Insulation:

1. Products and Manufacturers: Provide one of the following:
 - a. Owens-Corning Fiberglass Corporation, Fiberglass SSL II with ASJ Max Fiberglass.
 - b. Johns Manville Division of Berkshire Hathaway, Micro-Lok HP
 - c. Or equal.
2. Type: Heavy-density pre-formed fiberglass sectional pipe insulation with factory-applied indoor foil or polymer jacketing with self-sealing lap.
3. Thermal Conductivity: 0.25-0.29 Btu-inch per hour per square foot per degree F at 125 degrees F mean temperature. Insulation thicknesses shall be as indicated in manufacturer's installation guidelines, except that in no case shall insulation thicknesses be less than required by ASHRAE 90.1.
4. Fire Hazard Classification:
 - a. Flame Spread: 25.
 - b. Fuel Contributed: 50.
 - c. Smoke Developed: 50.
5. Density: Three pounds per cubic foot (pcf) minimum.
6. Fittings: Molded fiberglass.
7. Jointing Materials: Manufacturer's recommended adhesives and tape.
8. Valve Insulation: Miter cut nesting size covering segments of same thickness as pipeline, for insulation of valves.

B. Cellular Glass Thermal Insulation

1. Products and Manufacturers: Provide one of the following:
 - a. Foamglass One HS, Pittsburg Corning Corporation
 - b. Or approved equal
2. Type: Prefabricated Cellular Glass Thermal Pipe Insulation
 - a. Material: Cellular Glass.
 - b. Type: Ridge Block.
 - c. Flame Spread Index: 0
 - d. Smoke Developed Index: 0
 - e. Maximum thermal conductivity: 0.28 Btu-in./h degree F ft² at 50-degree F and 0.31 Btu-in./h degree F ft² at 100-degree F.
 - f. Provide all necessary and additional requirements as recommended by Manufacturer.

C. Flexible Elastomeric Insulation:

1. Products and Manufacturers: Provide one of the following:
 - a. AP Armaflex, by Armacell, LLC
 - b. Aerocel by Aeroflex, USA, Inc.
 - c. Or equal.
2. Type: Flexible elastomeric thermal insulation for direct burial applications of water piping.
3. Fire Hazard Classification:
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
4. Thermal Conductivity: 0.25-0.29 Btu-inch per hour per square foot per degree F at 125 degrees F mean temperature. Insulation thicknesses shall be as indicated in manufacturer's installation guidelines, except that in no case shall insulation thicknesses be less than required by ASHRAE 90.1.
5. Water Absorption: Five percent by weight.
6. Fittings: Miter cut and glued in accordance with manufacturer's recommendations.
7. Jointing Materials: Manufacturer's recommended adhesives and tape.
8. Valve Insulation: Miter cut nesting size covering segments of same thickness as pipeline, for insulation of valves.
9. Protection: Encase piping in protective conduit such as properly sealed PVC pipe, corrugated drainpipe, or poured concrete for long-term service

D. PVC Pipe Jacketing, Valve and Fitting Covers:

1. Manufacturers: Provide products of one of the following:
 - a. Proto Corporation
 - b. Speedline Corporation.
 - c. Zeston by Johns Manville.
 - d. Or equal.
2. Type: PVC Jacketing (for insulated piping and appurtenances located indoors, unless otherwise shown or indicated):
 - a. 25/50 PVC, conforming to ASTM D1784, Class 16354-C and C-585
 - b. Thickness: 20 mils.
 - c. Color: White.
 - d. Finish: Glossy.
 - e. Temperature: Suitable for 150 degrees F, minimum.
 - f. Provide insulation adhesive or other means of sealing jacketing per manufacturer insulation instructions.

E. Weatherproof SS Jacketing and Valve & Fittings Covers

1. Manufacturers: Provide products of one of the following:
 - a. Great Lakes Textiles Products
 - b. Insultherm
 - c. Shur-Fit Products
 - d. Or approved equal

2. Weatherproof Jacket (for insulated piping and appurtenances located outdoors, and where shown or indicated):
 - a. Type: Smooth-embossed, Type 316 stainless steel jacket.
 - b. Thickness: 0.016 inches.
 - c. Moisture Barrier: Polycraft.
 - d. Fastening: Pre-formed "Z"-lock seam with two-inch butt strap with waterproof sealant.
 - e. Bands: 1/2-inch Type 316 stainless steel bands with wing seals.
 - f. Fittings: Pre-fabricated Type 316 stainless steel fittings, 0.016-inch thickness.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 1. Piping systems to be insulated and associated insulation thicknesses are specified in the schedule at the end of this Section.
 2. Thoroughly clean all piping, insulation, and accessories prior to installation.
 3. Remove from piping all dirt, rust, dust, and other materials detrimental to proper installation of insulation.
 4. Install items as shown, specified, and as recommended by manufacturer.
 5. Request interpretation from ENGINEER if there is conflict between manufacturer's recommendations and the Contract Documents.
 6. Do not modify structures to facilitate installation of piping insulation unless approved by ENGINEER.
 7. Installation of plumbing piping insulation shall conform to Laws and Regulations.
 8. Surfaces of piping, valves, and fittings shall be clean and dry before applying insulation.
 9. Install piping insulation after associated piping system has been successfully tested.
 10. Provide high-density insulation pipe support inserts at each hanger and shield extending halfway up the pipe insulation cover and extending along pipe at least six inches on each side of hanger. Securely fasten shield with pipe straps at each end. Insulate pipe anchors adequately to prevent moisture condensation problems.
 11. Cover insulated surfaces of outdoor piping with stainless steel jacketing neatly fitted and firmly secured. Lap the seams at least two inches. Apply over vapor barrier, where applicable.

12. Protection: Piping insulation materials applied each day shall have vapor barrier applied the same day and exposed ends shall be temporarily protected with moisture barrier and sealed to pipe.

3.3 ADJUSTING

- A. Adjusting:
 1. Adjust or replace, as required, poorly-fitted joints.

3.4 SCHEDULES

- A. Piping Insulation Schedule: Insulate plumbing piping as specified below, unless otherwise specified or shown:
 1. All indoor hot, cold, tempered, tepid and recirculation piping 2.5-inch diameter and smaller: Fiberglass insulation thickness shall be one-inch minimum.
 2. All indoor hot, cold, tempered, tepid and recirculation piping three-inch diameter and larger: Fiberglass insulation thickness shall be 1.5-inch minimum.
 3. All outdoor or buried hot, tempered, or tepid water piping use Foam Cellular Glass insulation with Stainless Steel Jacketing.
 4. All horizontal storm drainage piping: Minimum 1-inch thick fiberglass insulation with PVC jacketing.

++ END OF SECTION ++

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SECTION 22 10 53

INSTALLATION OF PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install plumbing piping systems complete with accessories.
2. All plumbing piping extending outside of the building for connection to required utility services or site piping and appurtenances shall terminate five (5) feet, measured from the building exterior wall unless otherwise indicated on the Contract Drawings.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the installation of plumbing piping Work.

C. Related Sections:

1. Section 09 91 00, Painting.
2. Section 22 05 29, Hangers and Supports for Plumbing Piping and Equipment
3. Section 22 11 16, Domestic Water Piping.
4. Section 22 14 13, Storm Drainage Piping.
5. Section 22 13 16, Sanitary Waste and Vent Piping

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American National Standards Institute, (ANSI).
 - a. ANSI B13.1, Code for Pressure Piping.
 - b. ANSI B31.1, Power Piping.
2. American Society for Testing and Materials, (ASTM).
3. American Welding Society, (AWS).
 - a. AWS D10.9, Welding Procedures and Welders for Piping and Tubing.
4. Institute of Electrical and Electronic Engineers, (IEEE).
5. National Electrical Code, (NEC).
6. National Electrical Manufacturers' Association, (NEMA).
7. National Fire Protection Association, (NFPA).
8. Underwriters' Laboratories, Incorporated, (UL).

1.3QUALITY ASSURANCE

- A. Installer's Qualifications:
 - 1. Engage a single installer regularly engaged in plumbing piping installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
 - 2. Engage a single installer for the entire plumbing piping system with undivided responsibility for performance and other requirements.
- B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. Local and State Building Codes and Ordinances.
 - 2. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.
- C. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single installation of plumbing piping manufacturer.
 - 2. The installation of plumbing piping manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the installation of plumbing piping manufacturer.

1.4SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. 1/4-inch scale piping layouts, dimensioned to show length of piping runs, pipe sizes, support spacing and expansion provisions.
 - b. Details of installation, including piping supports.
 - c. Submit pipe schedule with laminate construction, sizes, thickness, vacuum pressure, weight per foot pressure, spans, joint type and flange data.
 - 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications and engineering data.
 - b. Flexible connections.
 - c. Other technical data related to the specified material and equipment as requested by ENGINEER.
 - d. Gasket material.
- B. Informational Submittals: Submit the following:

1. Qualifications Statements:
 - a. Installer's qualifications.
- C. Closeout Submittals: Submit the following:
 1. Record Drawings:
 - a. During progress of the Work keep an up-to-date set of the Drawings showing field and Shop Drawing modifications. Immediately upon completion of the piping Work submit CADD drawings showing the actual in-place installation of all piping and equipment installed under this Section at a scale satisfactory to the OWNER. The Record Drawings shall show all piping on plans and in sections, with all reference dimensions and elevations required for complete Record Drawings of the piping systems. Two paper prints shall also be furnished. The prints and electronic copies of the CADD files shall be furnished no later than 30 days after completion of the Contract and prior to final payment.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
- B. Storage and Protection:
 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

- A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
- B. The Drawings show an indication of the arrangement of equipment, piping, valves, etc., and are as nearly correct as can be determined in advance of the actual

construction of the Work. The piping, equipment, ducts, etc. found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.

- C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged as to fully and best suit the requirements of each particular case, adequately provide for expansion and perfect circulation and minimize the amount of space required for the same.
- D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval by ENGINEER.
- E. The Drawings do not show all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others," to complete the systems to the true extent of the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials for piping system shall be specified under Section 22 11 16 Domestic Water Piping, and Section 22 13 16 Sanitary Waste and Vent Piping

2.2 PAINTING

- A. All equipment and accessories shall be painted in accordance with the requirements of Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install all items as shown, specified, and as recommended by the manufacturer.
 - 2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.

3. Present conflicts to ENGINEER, in writing, who will determine corrective measures to be taken.
4. Do not modify structures to facilitate installation of piping, unless specifically approved by ENGINEER.
5. Installation to conform to requirements of all local and state codes.
6. Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.
7. All connections between ferrous and non-ferrous piping material shall be made with dielectric couplings.
8. Provide shutoff valves, located for easy access, to each piece of equipment furnished.

B. Piping:

1. Wherever changes in sizes of piping occur, changes shall be made with reducing fittings. The use of bushings is not permitted unless otherwise shown.
2. All pipes passing through ceilings, floors and walls in finished rooms, and all supplies to fixtures shall have escutcheon plates.
3. Install straight runs true to line and elevation.
4. Install vertical piping tight to walls, columns and truly plumb leaving clearance for vertical supports only.
5. Install piping parallel or perpendicular to building walls. Piping at odd angles and 45 degrees runs across corners will not be accepted unless specifically shown.
6. Install small diameter piping generally as shown on the Drawings when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, etc.
7. Remove all cuttings and foreign matter from the inside of pipes and tubing before installation.
8. Provide a union downstream of each valve with screwed connections.
9. Use eccentric reducers where shown and where air or water pockets would otherwise occur in mains because of a reduction in pipe size.
10. Install hangers and supports in accordance with Section 220529, Hangers and Supports for Plumbing Piping and Equipment

C. Valves and Accessories:

1. Provide supports for large valves, flow meters and other heavy items as shown or otherwise required.
2. Install floor stands as shown on the Drawings and as recommended by the

2. Install floor stands as shown on the Drawings and as recommended by the manufacturer.manufacturer.
3. Provide lateral restraints for extension bonnets and extension stems as shown and as recommended by the manufacturer.

3.2FIELD QUALITY CONTROL

A. Field Tests:

1. Fill all systems and fully test all equipment, valves, piping, etc. in operation.
2. Check for excessive vibration while all systems are operating.
3. Installed systems and components will not be released to OWNER unless all systems have been tested and approved by the ENGINEER.

B. Inspection:

1. Examine areas to receive piping, valves and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances for piping, valves and accessories.
 - c. Start the Work only when conditions are satisfactory.
2. The ENGINEER reserves the right to reject or authorize replacement of piping and accessories found to be defective.

3.3ADJUSTING AND CLEANING

A. Adjusting:

1. While system is operable, balance all equipment, valves, etc. to achieve design conditions.

B. Cleaning:

1. Thoroughly clean all piping, fittings, valves, and accessories prior to installation.
2. Remove all dirt, rust, dust, etc. from piping in preparation for painting.
3. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 MATERIAL SCHEDULES

- #### A. Material Schedule shall be as specified under Section of Division 22, Plumbing.

++ END OF SECTION ++

SECTION 22 10 63

TESTING OF PLUMBING PIPING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to complete all testing of the plumbing piping systems.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the testing of plumbing piping systems Work.
- C. Related Sections:
 - 1. Section 09 91 00, Painting.
 - 2. Section 22 11 16 Domestic Water Piping.
 - 3. Section 22 13 16 Sanitary Waste and Vent Piping.
 - 4. Section 22 14 13, Storm Drainage Piping.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American National Standards Institute, (ANSI).
 - 2. American Society for Testing and Materials, (ASTM).
 - 3. Institute of Electrical and Electronics Engineers, (IEEE).
 - 4. National Electrical Code, (NEC).
 - 5. National Electrical Manufacturers' Association, (NEMA).
 - 6. National Fire Protection Association, (NFPA).
 - a. NFPA 54, National Fuel Gas Code.
 - b. NFPA 99, Standard for Health Care Facilities.
 - 7. Underwriters' Laboratories, Incorporated, (UL).

1.3 QUALITY ASSURANCE

- A. Installer's Qualifications:
 - 1. Contractor regularly engaged in testing of plumbing piping systems and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
- B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. Local and State Building Codes and Ordinances.
 - 2. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Product Data:
 - a. Submit manufacturer's literature and samples for the valve tags.
 - 2. Testing Plans, Procedures, and Testing Limitations:
 - a. Description of proposed testing method, procedures, and apparatus to the ENGINEER for approval at least 48 hours in advance of testing.
- B. Informational Submittals: Submit the following:
 - 1. Site Quality Control Submittals:
 - a. Submit a test report for each test to the ENGINEER certifying the test pressure, duration of test, and test performance of all installed piping.
 - 2. Qualifications Statements:
 - a. Installer's qualifications.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide all necessary equipment and materials, including gages and pumps, to perform the testing operations.

PART 3 - EXECUTION

3.1 GENERAL

- A. Conduct water, air and smoke tests as required, on all piping systems as specified below.
- B. Conduct all tests in the presence of, and in a manner approved by ENGINEER, all state and local authorities having jurisdiction. Repeat test for these authorities if requested by them.
- C. Repair and retest all lines, which do not pass the tests as specified herein.
- D. Inspect all valves, joints, and specialties for tightness and for proper operation while under test pressure.
- E. Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through the testing. Piping shall be tightly covered and protected against contamination.

3.2 FIELD QUALITY CONTROL

- A. Water Tests:
 - 1. Drainage and Vent system piping:

Testing of Plumbing Piping Systems

- a. Perform tests either on the entire system or on successive sections of the system.
 - b. Tightly close all openings, except the highest opening of the system or section to be tested.
 - c. Fill the system or section with water to the point of overflow.
 - d. Test with a head of at least ten feet of water, except for the uppermost ten feet of the system.
 - e. Allow water to stand in the system for at least 15 minutes before inspecting.
 - f. Inspect the system or section for leaks, and repair any leaks found.
2. Water Piping:
- a. Water piping shall be tested and proved tight under a pressure not less than 1-1/2 times the working pressure under which it is to be used, but not less than 100 psig for 30 minutes with no loss of pressure.
 - b. Potable water shall be used for testing potable water systems. Non-potable water shall be used for testing non-potable water systems.

+ + END OF SECTION + +

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SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install domestic water piping systems complete with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the domestic water piping systems Work.
- C. Related Sections:
 - 1. Section 09 91 00, Painting.
 - 2. Section 22 05 27, Pipe Sleeves for Plumbing
 - 3. Section 22 05 29, Hangers and Supports for Plumbing Piping and Equipment
 - 4. Section 22 05 93, Disinfection of Plumbing Piping
 - 5. Section 22 07 19, Plumbing Piping Insulation
 - 6. Section 22 10 53, Installation of Plumbing Piping
 - 7. Section 22 10 63, Testing of Plumbing Piping

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. ADA Accessibility Guidelines (ADAAG)
 - 2. ANSI A13.1, Scheme for Identification of Piping Systems.
 - 3. ANSI A21.1, Practice Manual, Computation Strength, Thickness.
 - 4. ANSI A21.4, Cement-Mortar Lining/Cast and Ductile Iron Pipe and Fittings (AWWA C105).
 - 5. ANSI A21.10, Cast-Iron and Ductile Iron Fittings, 2-inches through 48-inches, for Water (AWWA C110).
 - 6. ANSI A21.11, Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings (AWWA C111).
 - 7. ANSI A21.51, Ductile-Iron Pipe Centrifugally Cast, in Metal Molds (AWWA C151).
 - 8. ANSI A112.1.2, Air Gaps in Plumbing System.
 - 9. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 150 and 800.
 - 10. ANSI B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.

11. ANSI B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (ASME B16.22).
12. ANSI B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, 150 and 300 lbs (ASME B16.24).
13. ANSI B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
14. ANSI B16.39, Malleable Iron Threaded Pipe Unions.
15. ANSI B16.42, Ductile Iron Pipe Flanges and Flanged Fittings.
16. ANSI B40.1, Gages - Pressure Indicating Dial - Elastic Element.
17. ANSI H 23.1, Seamless Copper Water Tube, (ASTM B 88).
18. ANSI Z358.1, Emergency Eyewash and Shower Equipment.
19. American Society of Sanitary Engineers (ASSE), ASSE 1001, Performance Requirements for Atmospheric Type Vacuum Breakers.
20. ASSE 1013, Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
21. ASSE 1018, Trap Seal Primer Valves – Water Supply Fed.
22. ASSE 1020, Performance Requirements for Pressure Vacuum Breaker Assembly.
23. ASTM A 126, Specification for Gray Iron Casting for Valves, Flanges and Pipe Fittings.
24. ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
25. ASTM B 32, Specification for Solder Metal.
26. ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
27. ASTM B 88, Specification for Seamless Copper Water Tube.
28. ASTM D 1330, Specification for Rubber-Sheet Gaskets.
29. AWWA C511, Reduced-Pressure Principle Backflow Prevention Assembly.
30. FS O-F-506, Flux, Soldering: Paste and Liquid.
31. FS WW-U-516, Unions, Brass or Bronze, Threaded Pipe Connections and Solder-Joint Tube Connections.
32. Plumbing and Drainage Institute (PDI), PDI WH 201, Water Hammer Arresters.
33. NSF 61: Drinking Water System Components – Health Effects
34. NSF 372: Drinking Water System Components – Lead Content
35. The United States Safe Drinking Water Act

1.3 QUALITY ASSURANCE

A. Installer's Qualifications:

1. Engage a single installer regularly engaged in domestic water piping installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
2. Engage a single installer for the entire domestic water piping system with undivided responsibility for performance and other requirements.

- B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. Local and State Building Codes and Ordinances.
- C. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single domestic water piping systems manufacturer.
 - 2. The domestic water piping systems manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the domestic water piping systems manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. 1/4-inch scale piping layouts, dimensioned to show length of piping runs, pipe sizes, support spacing and expansion provisions.
 - b. Details of installation, including piping supports.
 - c. Submit pipe schedule with laminate construction, sizes, thickness, vacuum pressure, weight per foot pressure, spans, joint type and flange data.
 - 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications and engineering data.
 - b. Pipes and fittings.
 - c. Valves.
 - d. Backflow Preventers.
 - e. Flexible connections.
 - f. Other technical data related to the specified material and equipment as requested by ENGINEER.
 - g. Gasket material.
- B. Informational Submittals: Submit the following:
 - 1. Qualifications Statements:
 - a. Installer's qualifications.
- C. Project Closeout Submittals: Submit the following:
 - 1. Record Documentation:
 - a. During progress of the Work keep an up-to-date set of the Drawings showing field and Shop Drawing modifications. Immediately upon completion of piping Work, submit CADD drawings showing the actual in place installation of all piping and equipment installed under this

Section at a scale satisfactory to the OWNER. The drawings shall reflect all of the piping Work on plans and in sections, with all reference dimensions and elevations required for complete Record Drawings of the piping systems. Two paper prints shall also be furnished. The prints and electronic copies of the CADD files shall be furnished no later than 30 days after completion of the Contract and prior to final payment.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

- A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.

- B. The Drawings show an indication of the arrangement of equipment, ducts, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. Piping, equipment, ducts, etc. found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions, without additional cost to the OWNER.
- C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each case, adequately provide for expansion and perfect circulation and minimize the amount of space required for the same.
- D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval by the ENGINEER.
- E. The Drawings do not show, all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others", to complete the systems to the true extent of the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. General Requirements:
 - 1. All piping, couplings and fittings to be used in the potable domestic water distribution system shall be certified NSF 61 Annex G/NSF 372 lead-free.
 - 2. All piping and fittings to be used for domestic water shall comply with the current requirements of the United States Safe Drinking Water Act.
- B. Copper Water Tube:
 - 1. Tube:
 - a. Reference: ANSI H23.1, ASTM B 88.
 - b. Type: K or L.
 - c. Temper: Harddrawn or softannealed.

2. Fittings:
 - a. Reference: ANSI B16.22.
 - b. Reference: ANSI B16.26.
 - c. Reference: ANSI B16.18.
 3. Joints:
 - a. Sweat:
 - 1) Solder Metal: ASTM B 32, Type 95-5TA.
 - 2) Flux: FS O-F-506, Type 1.
 - b. Flanged:
 - 1) Flanges: ANSI B16.24, 150 lb. class.
 - 2) Gaskets: Red rubber, ASTM D 1330, Grade 1, 1/8-inch thick.
 - 3) Nuts and Bolts: ASTM A 307.
 4. Unions:
 - a. Reference: FS WW-U-516.
 - b. Material: Bronze.
 - c. Rating: 250 lb. W.O.G.
- C. Dielectric Couplings:
1. Manufacturers: Provide products of one of the following:
 - a. Hart Industrial Unions, LLC
 - b. SSP Corporation
 - c. Watts
 - d. Mueller Industries.
 - e. Or equal.
 2. Type: Union or flange.
 3. Ratings:
 - a. Unions: 250 psi, ANSI B16.39.
 - b. Flanges: 175 psi, ANSI B16.42 (Iron), ANSI B16.24 (Bronze).
 4. Reference: NSF/ANSI 61-G.

2.2 VALVES

- A. General Valves Requirements:
1. All valves, strainers and appurtenances to be used in the potable domestic water distribution system shall be certified NSF 61 Annex G/NSF 372 lead-free. Where specified products are third-party certified lead-free, uncertified products shall not be acceptable equals for substitution.
 2. All valves, strainers and appurtenances to be used for domestic water shall comply with the current requirements of the United States Safe Drinking Water Act.

B. Bronze Body Check Valves:

1. Products and Manufacturers: Provide one of the following:
 - a. Apollo Valves Division of Conbraco Industries, Inc., 161S-LF Series
 - b. Milwaukee Valve, Fig. No. UP1502
 - c. Or equal.
2. Type: Swing, bronze disc, screw-in cap.
3. Materials: Lead-free Brass and bronze.
4. Rating: 200 PSI CWP
5. End Connections: Solder joint.

C. Bronze Body Ball Valves:

1. Products and Manufacturers: Provide one of the following:
 - a. Apollo Valves Division of Conbraco Industries, Inc., 77FLF-200 Series
 - b. Milwaukee Valve, Fig. No. UPBA150S
 - c. Or equal.
2. Type: Non-blowout stem, two-piece, quarter turn, full port ball valve.
3. Materials:
 - a. Body: Lead-free bronze or brass.
 - b. Ball: Chrome plated brass.
 - c. Packing and Seats: Teflon.
4. Rating: 200 PSI CWP.
5. End Connections: Soldered End.

D. Strainers:

1. Manufacturers: Provide products of one of the following:
 - a. Watts
 - b. Zurn Industries
 - c. Or equal.
2. Type: Self-cleaning wye body with blow-off cock.
3. Construction:
 - a. Basket: Perforated stainless steel basket.
 - b. Perforations: 0.045-inches diameter, minimum.
 - c. Free Area: Four times, cross sectional area of connecting pipe, minimum.
4. Strainers 2-1/2-inch and smaller:
 - a. Materials:
 - 1) Body: Cast bronze, ASTM B 62.
 - b. Pressure Rating: 250 psi steam at 425°F temperature.
 - c. End Connections: Solder ends or screwed ends with adapters for screw to sweat ends.
 - d. Blowoff Connection: Unplugged, NPT blowoff connection.

E. Tepid Water Mixing Valve (TWMV-1):

1. Manufacturers: Provide products of one of the following:

- a. Haws Corporation, Model No. TWBS.H
- b. Powers, Model No. LFMM431.
- c. Leonard, Model No. TM-5125-STSTL-EXP.
- d. Or equal.
2. Type: Thermostatically operated water-blending device.
3. Materials:
 - a. Body: Brass.
 - b. Vanes: Brass.
 - c. Cabinet: Stainless steel.
4. Thermostatic element to be located in main body of valve.
5. Outlet dial thermometer.
6. Locking temperature regulator set at 85°F.
7. Internal cold water bypass and temperature override protection.
8. Maximum Supply Pressure: 125 psi.
9. Maximum Flow: 30 GPM
10. Maximum Supply Temperature: 180°F.
11. References: ANSI Z358-1.

2.3 EQUIPMENT

- A. Hose Bibbs, Pipe Drains:
 1. Products and Manufacturers: Provide one of the following:
 - a. Acorn Engineering Company, Model 8121-LF
 - b. Champion-Arrowhead by Sunlight Media, Model 363LF
 - c. Or equal.
 2. Valve:
 - a. Type: Indoor/non-freeze area boiler drain globe valve, chrome plated.
 - b. Materials: Bronze body, screwed bonnet, renewable composition disc.
 - c. End Connections: Hose thread outlet, NPT thread inlet.
 - d. Rating: 125 lbs. WOG.
 3. Vacuum Breaker:
 - a. Type: Non-removable, atmospheric.
 - b. Materials: Brass body, stainless steel trim, silicone rubber diaphragm and disc.
 - c. End Connections: Hose thread inlet and outlet.
 4. Reference: NSF 61/NSF 372, ASSE 1011
- B. Pipe Labels:
 1. Type: Self adhering, temperature resistant, waterproof, corrosion resistant.
 2. Marker size, marker color, legend size, and legend color shall conform to ANSI A13.1.
- C. Flexible Connections:
 1. Manufacturers: Provide products of one of the following:
 - a. Flex Hose Co., Inc.

- b. The Metraflex Company
 - c. Or equal.
- 2. Type: Flexible connections for piping 2-1/2-inches and smaller.
- 3. Construction:
 - a. Hose: 316 Stainless Steel
 - b. Braid: 316 Stainless Steel
- 4. Pressure Ratings: 190 psig working pressure at 250°F temperature.
- 5. End Connections: Threaded or flanged pipe connection.
- 6. References: NSF 61/NSF 372

D. Automatic Air Vents:

- 1. Manufacturers: Provide products of one of the following:
 - a. Armstrong Fluid Technologies.
 - b. Bell and Gossett.
 - c. Or equal.
- 2. Type: Automatic vent air eliminator with built-in air chamber.
- 3. Construction:
 - a. Body: Bronze.
 - b. Finish: Chrome plated exterior.
 - c. Overflow Connector: Provide connection for 1/4-inch OD copper tubing.
- 4. Ratings: 75 psig working pressure.
- 5. References: NSF 61/NSF 372

E. Thermometers:

- 1. Manufacturers: Provide products of one of the following:
 - a. H.O. Trerice Company.
 - b. Weksler Instruments Division of Ashcroft, Inc.
 - c. Or equal.
- 2. Range: 30°F to 240°F temperature range in maximum of 2°F increments.
- 3. Type: Adjustable Angle Column Type Thermometer.
 - a. Construction:
 - 1) Scales and Lens: Nine-inch high satin finish aluminum scales, black numerals, front reading tubes for non-mercury fluid.
 - 2) Wells: Insertion well with brass separable sockets.
 - 3) Neck: 2-1/2-inch extension neck.
 - 4) Case: Cast aluminum.
 - 5) Window: Glass or clear acrylic plastic.

F. Pressure Gages:

1. Manufacturers: Provide products of one of the following:
 - a. H.O. Trerice Company.
 - b. Weksler Instruments Division of Ashcroft, Inc.
 - c. Or equal.
2. Reference ANSI B40.1 for Grade AA gages.
3. Type: Direct mounted, dial type pressure gage.
4. Construction:
 - a. Case: Six-inch diameter cast aluminum, flangeless with black finish and bottom 1/4-inch N.P.T.
 - b. Ring: Chrome plated close type.
 - c. Dial: White face, black numbers and graduations.
 - d. Window: Glass or clear acrylic plastic.
 - e. Pointer: Micrometer type, black finish, red tip.
 - f. Movement: Stainless steel, rotary type, delrin sector and bushings.
 - g. Bourdon Tube: Type 316 stainless steel
 - h. Socket and Tip: Forged brass, alloy steel and Type 316 stainless steel.
5. Accuracy: One percent minimum.
6. Gage Cocks: Provide brass tee handle isolation cock before each gage.
7. All gauges are to be filled with non-mercury organic fluids.

I. Vacuum Breakers:

1. Pressure Type: PVB:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Conbraco Industries, Incorporated, Series SVB 4ALF
 - 2) Watts, Series LF8003)
 - 3) Or equal.
 - b. Type: An assembly containing an independently operating internally loaded check valve and an independently operating loaded air inlet valve located on the discharge side of the check valve. The assembly shall also be equipped with test cocks and shut off valves on the inlet and outlet of the assembly.
 - c. Materials:
 - 1) Springs: Stainless steel.
 - 2) Bonnet: Glass filled PPO
 - 3) Vent Disc: Silicone rubber.
 - 4) Disc Holder Float: Polypropylene.
 - 5) Check Valve Disc: Silicone rubber.
 - 6) Check Valve Seat: NORYL
 - 7) Body: Lead-free copper alloy

- d. Accessories:
 - 1) Ball valves on inlet and outlet on the assembly.
 - 2) Ball valve test cocks on the assembly.
 - e. Reference: ASSE 1020, NSF 61/NSF 372.
 - f. Working Pressure: 150 psi.
 - g. Installation: Vertical, minimum 12-inches above fixture vacuum breaker serves.
2. Atmospheric Type: AVB:
- a. Products and Manufacturers: Provide one of the following:
 - 1) Apollo Valves Division of Conbraco Industries, Inc, Series 38LF-100
 - 2) Watts, Series LF288A.
 - 3) Or equal.
 - b. Type: An assembly containing an air inlet valve, a check seat and an air inlet port to prevent reverse flow of water and allow air into the water line to break a siphon.
 - c. Materials:
 - 1) Hood: Polished Chrome Finish
 - 2) Body: Lead-Free Bronze.
 - 3) Vent Disc: Silicone.
 - 4) Disc Holder Float: Polyethylene.
 - 5) Body: Lead-Free Bronze.
 - d. Reference: ASSE 1001.
 - e. Working Pressure: 210°F at 125°F.
 - f. Installation: Vertical, minimum 6-inches above fixture vacuum breaker serves.
- J. Emergency Shower and Eyewash Stations:
- 1. Emergency Eyewash and Shower (Corrosion Resistant, PVC):
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Haws Drinking Faucet Company, Model No. 8336.
 - 2) Speakman Company, Model SE-690-PVC.
 - 3) Or equal.
 - b. Type: Free standing, corrosion resistant, emergency eyewash and shower combination station with hand and foot operation.
 - c. Materials:
 - 1) Shower: 9-inch diameter ABS or cyclac plastic showerhead with 1-1/2-inch stay-open stainless steel ball valve and 24-inch rigid pull rod.
 - 2) Eye/Face-Wash: ABS or cyclac bowl with twin Buna-N covered ABS heads and stainless steel ball valve, stay open type.
 - 3) Pipe: All PVC parts shall be Schedule 80, epoxy coated.
 - 4) Supply: 1-1/4-inch IPS.
 - 5) Accessories: Foot control assembly.
 - d. References: ANSI Z358.1
 - 2. Emergency Eyewash and Shower Station (Freeze-proof):
 - a. Emergency Shower:

- 1) Products and Manufacturers: Provide one of the following:
 - a) The Bradley Corporation, Model S19-120HFP18
 - b) Haws Drinking Faucet Company, Model 8111FP.
 - c) Or equal.
- 2) Type: Thru-wall freeze-proof emergency shower station.
- 3) Materials:
 - a) Shower: Rough chrome plated brass.
 - b) Valve: Instant-open ball valve with large push-type plate. Valve remains open until manually closed. Extension shaft for valve handle designed to operate through 15-inch wall.
 - c) Supply: One-inch IPS.
 - d) Stainless steel pipe clamp and wall support with stainless steel rod.
 - e) Finish: Corrosion resistant coating.
- b. Eye Wash:
 - 1) Products and Manufacturers: Provide one of the following:
 - a) The Bradley Corporation, Model S19-220HFP
 - b) Haws Drinking Faucet Company, Model 7433 FP.
 - c) Or equal.
 - 2) Type: Thru-wall freeze-proof emergency eye/face wash station.
 - 3) Materials:
 - a) Receptor: Corrosion resistant stainless steel.
 - b) Heads: Buna-N covered ABS plastic designed to direct steady flow of water to eyes and ocular area of face.
 - c) Valve: Instant-open ball valve with large push type plate. Extension shaft for valve handle to operate through wall.
 - d) Wall Mounting: Bracket to be included.
 - e) Supply: 1/2-inch IPS.
 - f) Waste: 1-1/2-inch IPS tailpiece, spill onto floor, chrome plated.
 - g) Finish: Corrosion resistant coating.
- c. References: ANSI Z358.1
3. Emergency Eyewash and Shower Station (Freeze-proof): Free Standing:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Haws Drinking Faucet Company, Model 8300FP.
 - 2) Speakman Company, Model SE-609.
 - 3) Or equal.
 - b. Type: Free standing freeze-proof shower and eyewash combination station.
 - c. Materials:
 - 1) Shower Head: Stainless Steel.
 - 2) Valve: Instant-open ball valve with large push-type plate. Valve remains open until manually closed. Extension shaft for valve handle designed to operate below frost line.
 - 3) Receptor: 11-inch round stainless steel bowl.
 - 4) Heads: Stainless steel designed to direct steady flow of water to eyes and ocular area of face with dust covers.

- 5) Valve: Instant-open ball valve with large push type plate. Extension shaft for valve handle to operate below frost line.
- 6) Supply: 1-1/4-inch galvanized steel IPS for shower and eyewash with corrosion resistant epoxy paint finish.
- 7) Waste: 1-1/4-inch IPS tailpiece, spill onto floor.
- d. Tempering Valve: Provide emergency fixture tempering valve as specified below to produce 85°F water at minimum 33 gpm flow rate.
- e. References: ANSI Z358.1
- 4. Flow Switches, Audible and Visible Alarms:
 - a. Manufacturers: Provide products of one of the following:
 - 1) Haws Drinking Faucet Co.
 - 2) Speakman Company.
 - 3) Or equal.
 - b. Type: Single pole, double throw, NEMA4, UL listed paddle type flow switch. Contacts to be rated for five amps at 120 VAC.
 - c. Flow switches shall be furnished by the emergency eyewash and shower station's manufacturer to ensure compatibility and proper sensing of flows from eyewash, shower or combination of the two flows. CONTRACTOR shall assume complete responsibility for the proper operation of the flow sensing of the eyewash and shower units if flow switches other than furnished or recommended by the emergency shower and eyewash stations manufacturer are used.
 - d. Flow switches on combination emergency eyewash & shower stations shall sense flow for either shower or eyewash or combination of the two flows. Flow switches shall be full line size so as not restrict water flow in order to detect flow. Each individual emergency shower, eye/face wash, and combination station shall be equipped with a flow switch.
 - e. Visible alarm shall be an amber flashing light, UL listed.
 - f. Audible alarm shall be an intermittent signal rated at 85 dB at ten feet.
 - g. Each shower shall be furnished with a shower and eyewash test kit.
 - h. Coordinate electrical wiring and connection of flow switches and audible and visible alarms with Division 26, Electrical.
- 5. Safety Valve Lockout with Padlock:
 - a. Heavy-duty plastic, dielectric and chemical resistant valve lock.
 - b. Padlock with unique serial number, hardened steel shackle, and two brass keys with matching serial numbers for each padlock.
 - c. Manufacturers: Provide products of one of the following:
 - 1) Akron, Safety Products, Inc.
 - 2) Brady USA, Inc.
 - 3) Or equal.

K. Aquastats:

- 1. Manufacturers: Provide products of one of the following:
 - a. Honeywell.
 - b. Johnson Controls.
 - c. Or equal.

2. Type: Immersion type for regulating water temperature in hot water piping, tepid water piping, or hot water storage tanks.
3. Electrical Rating: 120 VAC.
4. Set point Range:
 - a. Domestic Hot Water: Make contacts on temperature drop below 112°F; break contacts on temperature rise above 120°F.
 - b. Tepid Water: Make contacts on temperature drop below 70°F; break contacts on temperature rise above 90°F.
5. Adjustment: Adjustable setpoint through knob on cover.
6. Differential: Adjustable 3°F to 10°F.
7. Accessories: Provide immersion well.

L. Pressure Reducing Valves:

1. Products and Manufacturers: Provide one of the following:
 - a. Cla-Val Company, Model 90-01 AB.
 - b. Watts, F114-2
 - c. Or equal.
2. Design Conditions: * Confirm with Engineer
 - a. Inlet Pressure (*) psig.
 - b. Outlet Pressure (*) psig.
 - c. Average Flow Rate (*) gpm
 - d. Valve shall automatically reduce a higher upstream pressure to a constant lower downstream pressure regardless of changing flow rate or varying inlet pressure.
3. Type: Hydraulically operated, direct acting, single seated, pilot controlled diaphragm type globe valve.
4. Adjustment: Pressure setting adjustment to be made with single screw.
5. Materials:
 - a. Main Body and Valve Cover: Cast-iron.
 - b. Main Valve Trim: Brass and bronze.
 - c. Pilot Control System: Cast bronze with stainless steel trim.
6. Adjustment Range: 4 to 5 psig outlet.
7. Pressure Rating: 150 class - 275 psi, maximum.
8. End Connections: Flanged, ANSI B16.1.
9. Reference: NSF 61/NSF 372

M. Hot Water Temperature Maintenance Heat Tracing:

1. Manufacturers: Provide products of one of the following:
 - a. Raychem Products Division of
 - b. Therman Manufacturing Company.
 - c. Or equal.
2. General: Furnish and install a complete UL listed system of heat trace cable(s) and components approved and designed specifically for maintaining various hot water temperatures ranging from 85 F, 110°F to 140°F. Hot water from

hot water heater(s) to plumbing fixtures and as shown, shall be electrically traced with self-limiting heaters. Manufacturer shall assist in selecting the correct tracer and develop Bill of Materials. All connections and equipment shall be moisture-proof.

3. The heater cable assembly shall consist of two No. 14 AWG parallel nickel-plated copper bus wires imbedded in a self-regulating core and covered in a cross-linked polyolefin insulating jacket. The heater assembly shall be covered with tinned copper metallic braid and an outer jacket of cross-linked polyolefin insulation, nominally of 40-mil thickness, and color-coded for easy identification.
4. The cable shall be rated for 120 or 208 Volt operation.
5. Pipe and heat trace shall be insulated with 1-1/2-inch thick fiberglass insulation as described in Section 22 07 19, Plumbing Piping Insulation.
6. For buried outdoor piping insulation refer to Section 22 07 19, Plumbing Piping Insulation.
7. Provide all splice power-to-tracing connectors, thermostats, end terminations, straps, ground fault circuit breakers, junction boxes, etc., as required.

2.4 PAINTING

- A. Piping and accessories shall be painted in accordance with Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 1. Install all items as shown, specified, and as recommended by the manufacturers.
 2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
 3. Present conflicts between piping systems and/or equipment and/or structures to ENGINEER, in writing, who will determine corrective measures to be taken.
 4. Do not modify structures to facilitate installation of piping, unless specifically approved by ENGINEER.
 5. Installation shall conform to requirements of all local and state codes.
 6. Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.
 7. Unless otherwise required by the tubing manufacturer or AHJ, copper tubing, fittings, couplings, and soldered joints shall be installed according to methods and procedures described in "The Copper Tube Handbook" reference publication by the Copper Development Association.

8. All valves and equipment are to be installed perfectly plumb and level, in horizontal runs of piping (except where specifically indicated for vertical piping installation).
9. All required access shall be provided for valves and equipment. Where valves or equipment are installed behind walls, above ceilings, or in otherwise inaccessible locations, 18"x18" access panels are to be provided by the general contractor at locations to be coordinated.
10. All fixtures are to be installed perfectly plumb and level with finished walls and floors, and are to be in perfect working condition.
11. All workmanship is to be neat, clean, and free of any visible defect or damage.

3.2 FIELD QUALITY CONTROL

A. Field Tests:

1. Fill all systems and fully test all equipment, valves, dampers, etc. in operation.
2. Check for excessive vibration while all systems are operating.
3. Installed systems and components will not be released to OWNER, unless all systems have been tested and approved by the ENGINEER.
4. Testing of piping system shall be in accordance with Section 22 10 63, Testing of Plumbing Piping Systems.

B. Inspection:

1. Examine areas to receive piping, valves and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances for piping, valves and accessories.
 - c. Start the Work only when conditions are satisfactory.
2. The ENGINEER reserves the right to reject or authorize replacement of piping and accessories found to defective.

3.3 ADJUSTING AND CLEANING

A. Adjusting:

1. Adjust all controls for proper settings.
2. While system is operable balance all equipment, valves, dampers, etc. to achieve design conditions.

B. Cleaning:

1. Thoroughly clean all piping, fittings, valves, and accessories prior to installation.
2. Remove all dirt, rust, dust, etc. from piping in preparation for painting.
3. Remove and dispose of all debris and waste from the Site resulting from installation.
4. Disinfection of piping and equipment shall be in accordance with Section 220593, Disinfection of Plumbing Systems.

3.4 MATERIAL SCHEDULES

A. Piping:

1. Use types of pipe and fittings as specified below, unless otherwise specified or shown.
2. All potable water supply, hot, cold, and tepid water piping 2 1/2-inches and smaller, run within the interior of a building, shall be harddrawn copper Type “L” with solder joints and connections.
3. All potable water piping 2-1/2-inches and smaller run underground shall be soft-annealed copper Type “K” copper tubing.
4. All exposed water piping and valves to plumbing fixtures shall be chrome-plated brass.
5. All valves for copper tubing less than 3 inches diameter shall be bronze bodied, unless otherwise specified.
6. Use “wrought copper” fittings for copper tubing.

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SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install sanitary waste and vent piping systems complete with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the sanitary waste and vent piping systems Work.
- C. Related Sections:
 - 1. Section 09 91 00, Painting.
 - 2. Section 22 05 29, Hangers and Supports for Plumbing Piping and Equipment.
 - 3. Section 22 10 53, Installation of Plumbing Piping.
 - 4. Section 22 10 63, Testing of Plumbing Piping Systems.
 - 5. Section 31 20 00, Earth Moving
 - 6. Section 33 05 05, Buried Piping Installation

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American Society of Sanitary Engineering, (ASSE).
 - 2. The American Society of Mechanical Engineers (ASME).
 - 3. American Society for Testing and Materials, (ASTM).
 - a. ASTM A 74, Specification for Cast-Iron Soil Pipe and Fittings.
 - b. ASTM A 518/A 518M, Specification for Corrosion-Resistant High-Silicon Iron Castings.
 - c. ASTM A 861, Specification for High-Silicon Iron Pipe and Fittings.
 - d. ASTM A 888, Specification for Hubless Cast-Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
 - e. ASTM C 564, Specification for Rubber Gaskets for Cast-Iron Soil Pipe and Fittings.
 - f. ASTM D 1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - g. ASTM D 2665, Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.
 - 4. Cast-Iron Soil Pipe Institute, (CISPI).

- a. CISPI 310 Specification for Couplings for Use in Connection with Hubless Cast-Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
 - b. CISPI HSN, Specification for Neoprene Rubber Gaskets for Hub and Spigot Cast-Iron Soil Pipe and Fittings.
- 5. Federal Specifications, (FS).
 - a. FS QQ-C-40, Calking Lead Wool and Lead Pig.
- 6. National Sanitation Foundation (NSF).
 - a. NSF 14: Plastic Piping System Components and Related Materials

1.3 QUALITY ASSURANCE

- A. Installer's Qualifications:
 - 1. Engage a single installer regularly engaged in sanitary piping installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
 - 2. Engage a single installer for the entire sanitary waste and vent piping system with undivided responsibility for performance and other requirements.
- B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. Local and State Building Codes and Ordinances.
 - 2. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.
- C. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single sanitary waste and vent piping systems manufacturer.
 - 2. The waste and vent piping systems manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the sanitary waste and vent piping systems manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. 1/4-inch scale piping layouts, dimensioned to show length of piping runs, pipe sizes, support spacing and expansion provisions.
 - b. Details of installation, including piping supports.

- c. Submit pipe schedule with laminate construction, sizes, thickness, vacuum pressure, weight per foot pressure, spans, joint type and flange data.
- 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications and engineering data.
 - b. Pipes and fittings
 - c. Flexible connections.
 - d. Other technical data related to the specified material and equipment as requested by ENGINEER.
 - e. Gasket material.
- B. Informational Submittals: Submit the following:
 - 1. Qualifications Statements:
 - a. Installer's Qualifications
- C. Record Documentation: Submit the following:
 - 1. Record Drawings:
 - a. During progress of the Work keep an up-to-date set of the Drawings showing field and Shop Drawing modifications. Immediately upon completion of piping Work, submit CADD drawings showing the actual in place installation of all piping and equipment installed under this Section at a scale satisfactory to the OWNER. The drawings shall reflect all of the piping Work on plans and in sections, with all reference dimensions and elevations required for complete Record Drawings of the piping systems. Two paper prints shall also be furnished. The prints and electronic copies of the CADD files shall be furnished no later than 30 days after completion of the Contract and prior to final payment.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
- B. Storage of Materials:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

- A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
- B. The Drawings show an indication of the arrangement of equipment, piping, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. Piping, equipment, etc., found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.
- C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each case and adequately provide for expansion and perfect circulation and minimize the amount of space required for the same.
- D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval by the ENGINEER.
- E. The Drawings do not show all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others", to complete the systems to the true extent of the Contract Documents.

PART 2 - PRODUCTS

2.1 PIPING

- A. Cast-Iron Pipe:
 1. Products and Manufacturers: Provide one of the following:
 - a. Charlotte Pipe & Foundry Company
 - b. Tyler Pipe Company

- c. Or equal
- B. Hub & Spigot Cast-Iron Soil Pipe and Fittings:
 - 1. Pipe and Fittings: ASTM A 74.
 - 2. Weight: Service Weight.
 - 3. Joints:
 - a. Compression:
 - 1) Gasket: Neoprene Rubber, ASTM C 564, CISPI HSN.
 - 2) Lubricant: As recommended by pipe manufacturer.
 - b. Calked:
 - 1) Lead: FS QQ-C-40, Type I, Grade AA.
 - 2) Jute Packing: FS HH-P-117, Type I.
- C. DWV Copper Tubing:
 - 1. Pipe: ASTM B306, hard-drawn, seamless, copper tubing.
 - 2. Weight: DWV.
 - 3. Fittings: ASME B16.29, DWV, Wrot Copper, solder-end fittings.
 - 4. Joints: 95-5 tin-antimony solder, soldered joints and fittings.
- D. Hubless Cast-Iron Soil Pipe and Fittings:
 - 1. Pipe and Fittings: ASTM A 888 & CISPI 301.
 - 2. Joints: CISPI 310 & ASTM C 1277
 - a. Heavy duty hubless couplings: ASTM C1540
 - b. Gaskets: ASTM C 564
- E. Chlorinated Polyvinyl Chloride (CPVC) Pipe and Fittings, Gravity Drainage:
 - 1. ASTM F2618, certified corrosive waste grade and stamped NSF-cw.
 - 2. Weight: Schedule 40
 - 3. Fittings: ASTM F2618, DWV, socket-weld type, certified corrosive waste grade and stamped NSF-cw.
 - 4. Joints: Solvent cement welded with cement formulated for chemical waste applications, conforming to ASTM F493, NSF certified for use in corrosive waste systems. Use ASTM F656 CPVC primer as recommended by manufacturer or required by local codes.
 - 5. Temperature: Rated for non-pressure use up to 220° F.
 - 6. Other References: NSF 14.

2.2 DRAINS AND CLEANOUTS

- A. Drains and Cleanouts:
 - 1. Floor Drain, acid and corrosion resistant, heavy-duty: (FD-1).
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Jay R. Smith, Fig. 2340-B-M with A.R.E. coating.
 - 2) Zurn Industries, Fig. Z-521-Y with A.R.E. coating.
 - 3) Or equal.
 - b. Materials:

- 1) Body: Enameled cast-iron.
 - 2) Collar: Enameled cast-iron.
 - 3) Top: Enameled cast-iron adjustable.
 - 4) Grate: Ductile iron, 11-1/2-inch diameter.
- c. Accessories: Sediment bucket.
- d. Rating: Heavy-duty.
- e. Outlet Connection: Bottom outlet, calk or no-hub, as required.
2. Cleanout Deck Plate (FCO-1):
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Jay R. Smith, Fig. No. 4258C.
 - 2) Zurn Industries, Fig. No. Z-1474.
 - 3) Or equal.
 - b. Materials: Cast-iron body, flanged housing, cast-iron cover with fitting device.
 - c. Outlet Connection: Calk outlet.

2.3 PAINTING

- A. All piping and accessories shall be painted in accordance with the requirements of Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 1. Install all items as shown, specified, and as recommended by the manufacturer.
 2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
 3. Present conflicts to Engineer, in writing, who will determine corrective measures to be taken.
 4. Do not modify structures to facilitate installation of piping, unless specifically approved by ENGINEER.
 5. Installation shall conform to requirements of all local and state codes.
 6. Installation of piping shall be in accordance with Section 22 10 53, Installation of Plumbing Piping.
 7. Installation of hangers and supports shall be in accordance with Section 22 05 29, Hangers and Supports for Plumbing and Piping Equipment.
 8. Protection: Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.2 FIELD QUALITY CONTROL

A. Field Tests:

1. Tests: Water or smoke test piping in accordance with Section 22 10 63, Testing of Plumbing Piping Systems.
2. Fill all systems and fully test all equipment, valves, etc. in operation.
3. Check for excessive vibration while all systems are operating.
4. Installed systems and components will not be released to OWNER, unless all systems have been tested and approved by the ENGINEER.

B. Inspection:

1. Examine areas to receive piping, valves and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances for piping, valves and accessories.
 - c. Start the Work only when conditions are satisfactory.
2. The ENGINEER reserves the right to reject or authorize replacement of piping and accessories found to defective, blistered, cracked or deviated from allowable tolerances as described above.

3.3 ADJUSTING AND CLEANING

A. Adjusting:

1. While system is operable, balance all equipment, valves, etc. to achieve design conditions.

B. Cleaning:

1. Thoroughly clean all piping, fittings, valves, and accessories prior to installation.
2. Remove all dirt, rust, dust, etc. from piping in preparation for painting.
3. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 MATERIAL SCHEDULES

A. Piping:

1. Use types of pipe and fittings as specified below, unless otherwise specified or shown.
2. All exposed gravity sanitary waste and vent piping 1-1/2-inches and larger run within the interior of a building shall be no-hub cast-iron.
3. All gravity sanitary waste and vent piping 1-1/2-inches and larger located in concrete slabs or underground to exterior limits as shown shall be service-weight cast-iron soil pipe with hub-and-spigot fittings.
4. CPVC chemical waste and vent piping may be used as required where use is allowable per local codes and authorities having jurisdiction.

++ END OF SECTION ++

SECTION 22 14 13

STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install storm drainage piping systems complete with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the storm drainage piping system Work.
- C. Related Sections:
 - 1. Section 09 91 00, Painting.
 - 2. Section 22 05 27, Pipe Sleeves for Plumbing.
 - 3. Section 22 05 29, Hangers and Supports for Plumbing Piping and Equipment.
 - 4. Section 22 07 19, Plumbing Piping Insulation.
 - 5. Section 22 10 53, Installation of Plumbing Piping.
 - 6. Section 22 10 63, Testing of Plumbing Piping Systems.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American National Standards Institute, (ANSI).
 - a. ANSI B16.12, Cast-Iron Threaded Drainage Fittings.
 - b. ANSI B125.2, Black/Hot-Dipped Zinc Coated Welded/Seamless Pipe.
 - 2. American Society of Sanitary Engineering, (ASSE).
 - 3. American Society for Testing and Materials, (ASTM).
 - a. ASTM A 74, Specification for Cast-Iron Soil Pipe and Fittings.
 - b. ASTM A 888, Specification for Hubless Cast-Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
 - c. ASTM C 564, Specification for Rubber Gaskets for Cast-Iron Soil Pipe and Fittings.
 - d. ASTM D 1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - e. ASTM D 2665, Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.
 - 4. Cast-Iron Soil Pipe Institute, (CISPI).

- a. CISPI 310 Specification for Couplings for Use in Connection with Hubless Cast-Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
- b. CISPI HSN, Specification for Neoprene Rubber Gaskets for Hub and Spigot Cast-Iron Soil Pipe and Fittings.
- 5. Federal Specifications, (FS).
 - a. FS QQ-C-40, Caulking Lead Wool and Lead Pig.
- 6. National Sanitation Foundation, (NSF).
 - a. NSF 14: Plastic Piping System Components and Related Materials

1.3 QUALITY ASSURANCE

- A. Installer's Qualifications:
 - 1. Engage a single installer regularly engaged in sanitary piping installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
 - 2. Engage a single installer for the storm drainage piping system with undivided responsibility for performance and other requirements.
- B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. National Sanitation Foundation, (NSF).
 - 2. Local and State Building Codes and Ordinances.
 - 3. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.
- C. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single storm drainage piping system manufacturer.
 - 2. The storm drainage piping systems manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the storm drainage piping systems manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. 1/4-inch scale piping layouts, dimensioned to show length of piping runs, pipe sizes, support spacing and expansion provisions.
 - b. Details of installation, including piping supports.
 - c. Submit pipe schedule with laminate construction, sizes, thickness, vacuum pressure, weight per foot pressure, spans, joint type and flange data.

2. Product Data:
 - a. Manufacturer's literatures, illustrations, specifications and engineering data.
 - b. Pipes and fittings.
 - c. Roof drains.
 - d. Cleanouts.
 - e. Flexible connections.
 - e. Other technical data related to the specified material and equipment as requested by ENGINEER.
 - f. Gasket material.
- B. Informational Submittals: Submit the following:
 1. Qualifications Statements:
 - a. Installer's Qualifications
- C. Record Documentation: Submit the following:
 1. Record Drawings:
 - a. During progress of the Work keep an up-to-date set of the Drawings showing field and Shop Drawing modifications. Immediately upon completion of piping Work, submit CADD drawings showing the actual in place installation of all piping and equipment installed under this Section at a scale satisfactory to the OWNER. The drawings shall reflect all of the piping Work on plans and in sections, with all reference dimensions and elevations required for complete Record Drawings of the piping systems. Two paper prints shall also be furnished. The prints and electronic copies of the CADD files shall be furnished no later than 30 days after completion of the Contract and prior to final payment.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
- B. Storage of Materials:
 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost

equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

- A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
- B. The Drawings show an indication of the arrangement of equipment, piping, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. Piping, equipment, etc., found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.
- C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each case and adequately provide for expansion and perfect circulation and minimize the amount of space required for the same.
- D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval by the ENGINEER.
- E. The Drawings do not show all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others", to complete the systems to the true extent of the Contract Documents.

PART 2 - PRODUCTS

2.1 PIPING

- A. Polyvinyl Chloride Pipe and Fittings:
 - 1. Pipe: ASTM D 1785, Type 2110.
 - 2. Weight: Schedule 40.
 - 3. Fittings: ASTM D 2665, drainage type.
 - 4. Joints: Solvent weld with manufactures recommended solvents.
 - 5. Reference: NSF 14.

2.2 DRAINS AND CLEANOUTS

- A. Combined Roof Drain and Overflow Drain (RD-1 & RD-2)
 - 1. Manufacturer: Provide products of one of the following:
 - a. Jay R. Smith, Fig. 1850-C-G-CIDG.
 - b. Zurn Industries Fig. Z-164-C-G-GD.
 - c. Or equal.
 - 2. Materials:
 - a. Body: Galvanized cast Iron.
 - b. Dome Top: Galvanized cast iron.
 - 3. Accessories:
 - a. Underdeck clamp.
 - 4. Outlet Connections: Threaded, caulk or no-hub as required.
- B. Cleanouts:
 - 1. Cleanout Deck Plates (FCO-1) (Finished Areas):
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Jay R. Smith, Fig. 4043S.
 - 2) Zurn Industries, Fig. No. Z-1400-K-BP.
 - 3) Or equal.
 - b. Materials: Cast-iron body and adjustable nickel bronze top.
 - c. Outlet Connection: Standard spigot.
 - d. Accessories:
 - 1) Square nickel bronze top.
 - 2) Cast bronze taper thread plug.
 - 2. Cleanout Deck Plate (FCO-2) (Traffic Areas):
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Jay R. Smith, Fig. No. 4258C.
 - 2) Zurn Industries, Fig. No. Z-1474.
 - 3) Or equal.
 - b. Materials: Cast-iron body, flanged housing, cast-iron cover with fitting device.
 - c. Outlet Connection: Caulk outlet.
- C. Downspout Nozzle:
 - 1. Products and Manufacturers: Provide one of the following:
 - a. Jay R. Smith, Fig. No. 1770.
 - b. Zurn Industries, Fig. No. Z-199.
 - c. Or equal.
 - 2. Materials: Cast bronze body and flange.
 - 3. End Connections: Screwed.

2.3 PAINTING

- A. All piping and accessories shall be painted in accordance with the requirements of Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install all items as shown, specified, and as recommended by the manufacturer.
2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
3. Present conflicts to Engineer, in writing, who will determine corrective measures to be taken.
4. Do not modify structures to facilitate installation of piping, unless specifically approved by ENGINEER.
5. Installation shall conform to requirements of all local and state codes.
6. Installation of pipe sleeves shall be in accordance with Section 22 05 27, Pipe Sleeves for Plumbing.
7. Installation of piping shall be in accordance with Section 22 10 53, Installation of Plumbing Piping.
8. Installation of hangers and supports shall be in accordance with Section 22 05 29, Hangers and Supports for Plumbing and Piping Equipment.
9. Protection: Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.2 FIELD QUALITY CONTROL

A. Field Tests:

1. Tests: Water or smoke test piping in accordance with Section 22 10 63, Testing of Plumbing Piping Systems.
2. Fill all systems and fully test all equipment, valves, etc. in operation.
3. Check for excessive vibration while all systems are operating.
4. Installed systems and components will not be released to OWNER, unless all systems have been tested and approved by the ENGINEER.

B. Inspection:

1. Examine areas to receive piping, valves and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances for piping, valves and accessories.
 - c. Start the Work only when conditions are satisfactory.
2. The ENGINEER reserves the right to reject or authorize replacement of piping and accessories found to defective, blistered, cracked or deviated from allowable tolerances as described above.

3.3 ADJUSTING AND CLEANING

- A. Adjusting:
 - 1. While system is operable, balance all equipment, valves, etc. to achieve design conditions.
- B. Cleaning:
 - 1. Thoroughly clean all piping, fittings, valves, and accessories prior to installation.
 - 2. Remove all dirt, rust, dust, etc. from piping in preparation for painting.
 - 3. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 MATERIAL SCHEDULES

- A. Piping:
 - 1. Use types of pipe and fittings as specified below, unless otherwise specified or shown.
 - 2. All exposed gravity storm drain piping run within the interior of a building shall be no-hub cast-iron.
 - 3. Mechanical restraints shall be provided on fittings and couplings for storm piping 4-inches diameter and larger.

++ END OF SECTION ++

SECTION 22 33 00

DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install domestic water heaters complete with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before domestic water heaters Work.
- C. Related Sections:
 - 1. Section 09 91 00, Painting.
 - 2. Section 22 05 29, Hangers and Supports for Plumbing Piping and Equipment.
 - 3. Section 22 11 16, Domestic Water Piping.
 - 4. Division 26, Electrical.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ASME Boiler and Pressure Vessel Code.
 - 2. ASME/ANSI Z21.22, Relief Valves for Hot Water Supply Systems.
 - 3. ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 4. NSF/ANSI 61, Drinking Water System Components – Health Effects.
 - 5. NSF/ANSI 372, Drinking Water System Components – Lead Content
 - 6. UL 1453, Electric Booster and Commercial Storage Tank Water Heaters.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Shall have minimum of five years experience producing equipment substantially similar to that required, and shall be able to document evidence of at least five installations in satisfactory operation for at least five years each.
- B. Component Supply and Compatibility:

1. Obtain each type of domestic water heater equipment included in this Section, regardless of component manufacturer, from one domestic water heater equipment manufacturer.
 2. Each domestic water heater manufacturer shall review and approve, or shall prepare, all Shop Drawings and other submittals for components furnished under this Section for the particular equipment type.
 3. Materials and equipment shall be suitable for the required service conditions and shall be integrated into each assembly by the associated domestic water heater manufacturer.
- C. Regulatory Requirements: Comply with Laws and Regulations, including the following.
1. Local and State Building Codes and Ordinances.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Schedule of domestic water heaters for the Project, indicating for each the installation location, model or type, and other distinguishing information.
 - b. Drawings showing fabrication methods, assembly, accessories, and installation details.
 - c. Detailed drawings of each equipment item's and component's wiring diagrams.
 - d. Detailed installation drawing of each individual component showing:
 - 1) Mounting requirements.
 - 2) Item locations, such as in a panel, installed on floor, or elsewhere.
 - 3) Piping and wiring connections labeled and coded.
 - 4) Data sheets.
 - e. Detailed description of each component.
 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
- B. Informational Submittals: Submit the following:
1. Manufacturer's Instructions:
 - a. Special shipping, storage and protection, and handling instructions.
 - b. Installation data for the equipment, including setting drawings, templates, and directions for installing anchorage devices.
 2. Source Quality Control Submittals:
 - a. Submit results of required factory tests and inspections.
 3. Qualifications Statements:
 - a. Manufacturer, when submittal of qualifications is required by ENGINEER.
- C. Closeout Submittals: Submit the following:

1. Operations and Maintenance Data:
 - a. Submit in accordance with Section 01 78 23, Operations and Maintenance Data.
 - b. Include maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.
 2. Comply with Section 01 65 00, Product Delivery Requirements.
- B. Storage and Protection:
 1. Store materials and equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
 2. Comply with Section 01 66 00, Product Storage and Handling Requirements.

1.6 QUALITY ASSURANCE

- A. All products are to be certified NSF 61 and NSF 372 lead-free, all electrical components are to be UL Listed for specific use, and all systems are to be third-party certified to all applicable equipment standards.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER HEATER

- A. Electric Water Heaters
 1. Heater Type: Electric with UL label.
 2. Service Conditions:
 - a. Nominal Capacity: See equipment schedule on the drawings.
 - b. Minimum Recovery Rate: See equipment schedule on the drawings.
 - c. Working pressure: 150 psig.
 3. Products and Manufacturers: Provide one of the following:
 - a. A.O. Smith, Model DVE.
 - b. Lochinvar Corporation, Model No. HSX.
 - c. Or equal.

4. Heater Style: Standard vertical.
5. Materials:
 - a. Tank: Welded steel.
 - b. Tank Lining: Glass-lining, fired to minimum temperature of 1,400 degrees F.
 - c. Outer Shell: Steel with baked enamel finish.
 - d. Insulation: Polyurethane foam.
 - e. Cathodic Protection Anode: High-density magnesium.
 - f. Water Connections: Brass.
 - g. Base and Legs: Steel or cast-iron.
6. Heaters shall not have:
 - a. Sharp edges.
 - b. Scratches on enameled surfaces.
 - c. Loose fasteners.
 - d. Loose panels.
 - e. Dents on outer jacket.
7. Electric Heat Source:
 - a. Heating Element and Operation: Immersion type.
 - b. Heating Elements: Heavy-duty with incoloy sheaths and ceramic terminal blocks.
 - c. Power Supply: 480-volt, three-phase, 60 Hertz.
8. Controls:
 - a. Fused transformer for 120-volt control circuit power.
 - b. Thermostat: Immersion type. 110 degrees F to 170 degrees F adjustable water temperature range, set at 140°F.
 - c. Element operation shall be simultaneous switched through individual magnetic contactors.
 - d. Manual reset high temperature cut-off. High limit energy cut-off to interrupt electrical current in event water inside heater tank exceeds 200 degrees F.
 - e. Local power disconnect switch to be provided under Division 26, Electrical.
9. Water Connections: 1.25-inch diameter inlet and outlet pipe nipples for connections to water piping system.
10. Drain Valve: Manufacturer's standard drain valve on front at tank bottom or lower side to completely drain tank.
11. Source Quality Control: Perform hydrostatic test on tank at the factory at 300 psi. Duration of test shall be manufacturer's standard. Criteria for acceptance: Zero leakage.
12. Standards: Comply with UL 1453, NSF 61, NSF 372, and ASHRAE 90.1.
13. Heater shall be ASME standard approved.

2.2 ACCESSORIES

- A. Temperature and Pressure Relief Valve: Provide one of the following on each storage-type water heater unit furnished:
 - 1. Valve: Temperature and pressure relief valve in accordance with ASME/ANSI Z21.22.
 - 2. Capacity and size of valve to relieve heater capacity at specified temperatures and pressure setting of domestic water heater tank.
 - 3. Settings:
 - a. Temperature Relief Setting: 210 degrees F.
 - b. Pressure Relief Setting: 150 psig.
- B. Cathodic Protection for Water Heaters with Tanks: Provide rigidly-supported anode rods in heater tank.
- C. Vacuum Breakers: Provide one for each storage-type water heater furnished:
 - 1. Products and Manufacturers: Provide one of the following:
 - a. Watts LFN36, Vacuum Relief Valve.
 - b. Cash Acme, VR-801, Lead-Free
 - c. Or equal.
- D. Pre-Pressurized Expansion Tank: Provide where shown or indicated on the Drawings:
 - 1. Type: Diaphragm type pre-pressurized expansion tank designed for potable hot water systems.
 - 2. Service Conditions:
 - a. Tank Volume: 4 gallons
 - b. Maximum Working Pressure: 125 psig.
 - c. Maximum Working Temperature: 200 degrees F.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. Amtrol, Incorporated, Therm-X-Trol, ST Series.
 - b. Watts Regulator, Model DET.
 - c. Or equal.
 - 4. Construction:
 - a. Shell: Welded carbon steel.
 - b. Diaphragm: Heavy-duty butyl rubber or comparable material for intended service. Schrader valve tapping.
 - c. Heads: Dished.
 - d. Polypropylene-lined water reservoir.
 - 5. Factory Charge: Precharged to 40 psig.
 - 6. Finish: Factory-applied primer coat, to be compatible with required field painting specified in Section 09 91 00, Painting.
 - 7. Standards: Equipment shall be listed in NSF/ANSI 61.

2.3 FINISHING

- A. Factory-paint ferrous surfaces in accordance with Section 09 91 00, Painting. Do not paint enameled surfaces, stainless steel, brass, chrome-plated, and other finished surfaces.

2.4 SOURCE QUALITY CONTROL

- A. All equipment shall be completely manufactured and pre-assembled in accordance with applicable reference standards indicated in this Section. Perform the following tests and inspections at factory before shipment:
 - 1. For each assembled unit, test and inspect equipment in accordance with UL requirements.
 - 2. Test and inspect in accordance with ASME Boiler and Pressure Vessel Code.
 - 3. Perform hydrostatic testing tanks as required in this Section for individual equipment items.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. General:
 - 1. Thoroughly clean materials, equipment, and accessories prior to installation.
 - 2. Install items as in accordance with the Contract Documents, Laws and Regulations, manufacturer's recommendations, and good practice. Obtain interpretation from ENGINEER if manufacturer's instructions or Laws or Regulations conflict with the Contract Documents.
 - 3. Do not modify structures or facilities to facilitate installation of equipment without approval of ENGINEER.
 - 4. Provide each domestic water heater with shut off valves for required water supplies.

3.3 FIELD QUALITY CONTROL

- A. Site Tests:
 - 1. ENGINEER shall witness field tests.
 - 2. Fill all systems and verify that equipment, valves, and appurtenances operate successfully and in accordance with the Contract Documents.
 - 3. Check for excessive vibration while systems are operating.
 - 4. For materials and equipment that do not successfully pass field tests, make repairs or modifications and retest until acceptable results are achieved.

- B. Manufacturer's Services: Provide a qualified, factory trained serviceman to perform the following:
1. Supervise installation of equipment.
 2. Instruct CONTRACTOR in installing equipment.
 3. Inspect and adjust equipment after installation and ensure proper operation.
 4. Instruct operations and maintenance personnel in operation and maintenance of the equipment.
 5. Manufacturer's technician shall make visits to the Site as follows:
 - a. First visit shall be for instructing CONTRACTOR in proper equipment installation, and assisting in installing equipment. Minimum number of hours on-Site: 4 hours.
 - b. Second visit shall be for checking completed installation, start-up of system; and performing field quality control testing. Minimum number of hours on-Site: 4 hours.
 - c. Third visit shall be to instruct operations and maintenance personnel.
 - 1) Furnish services of manufacturer's qualified, factory-trained specialists to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of equipment.
 - 2) Training requirements, duration of instruction, and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
 - 3) Number of hours on-Site shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
 - d. Technician shall revisit the Site as often as necessary until installation is acceptable.
 6. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.4 ADJUSTING AND CLEANING

- A. Adjusting:
1. Adjust controls for proper settings.
 2. While system is operable, balance all equipment, including valves, appurtenances, and similar equipment, to achieve specified service conditions.
 3. Adjust thermostats to desired water outlet temperature.
- B. Cleaning:
1. Upon completion of the Work, remove all non-permanent labels, and remove dirt, grease, markings, and other objectionable matter from equipment.
 2. In preparation for painting, remove dirt, rust, dust, and objectionable materials from materials and equipment.

+ + END OF SECTION + +

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SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC DUCTWORK, PIPING, AND
EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install hangers and supports complete with required appurtenances for HVAC ductwork, piping, and equipment.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the hangers and supports for HVAC ductwork, piping, and equipment Work.
- C. Related Sections:
 - 1. Section 03 60 00, Grouting.
 - 2. Section 05 05 33, Anchor Systems.
 - 3. Section 05 12 00, Structural Steel Framing.
 - 4. Section 05 50 13, Miscellaneous Metal Fabrications.

1.2 REFERENCES

- A. American National Standards Institute (ANSI).
 - 1. ANSI B1.1 – Unified Inch Screw Threads (ASME B1.1).
- B. American Society of Civil Engineers (ASCE).
 - 1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures.
- C. American Society for Testing and Materials (ASTM).
 - 1. ASTM A36/A36M – Standard Specification for Carbon Structural Steel.
 - 2. ASTM A47/A47M – Standard Specification for Ferritic Malleable Iron Castings.
 - 3. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - 6. ASTM A575 – Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.

7. ASTM A668/A688M – Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
- D. American Welding Society (AWS).
 1. AWS B2.1 – Specification for Welding Procedure and Performance Qualification.
- E. Federal Specifications (FS).
 1. FS WW-H-171 – Hangers and Supports, Pipe.
- F. Manufacturers Standardization Society (MSS).
 1. MSS SP 58 – Pipe Hangers and Supports-Materials, Design and Manufacture.
 2. MSS SP 69 – Pipe Hangers and Supports - Selection and Application.
- G. National Fire Protection Association (NFPA).
 1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
- H. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
 1. HVAC Duct Construction Standards – Metal and Flexible.
 2. Seismic Restraint Manual: Guidelines for Mechanical Systems.
 3. Thermoset FRP Duct Construction Manual.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 1. Manufacturer:
 - a. Minimum of five years of experience producing substantially similar equipment and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
 2. Installer:
 - a. Engage an experienced installer to perform the work of this Section who has specialized in installing hangers and supports for HVAC ductwork, piping, and equipment similar to that required for this Project and who is acceptable to manufacturer.
 - b. Submit name and qualifications to Engineer along with the following information on a minimum of three successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for projects.
 - 2) Approximate contract cost of the hangers and supports for HVAC ductwork, piping, and equipment.
 - 3) Amount of area installed.
 3. Welding:
 - a. Qualify processes and operators in accordance with AWS B2.1 as appropriate for material to be welded.

Hangers and Supports for HVAC Ductwork, Piping, and Equipment

- b. Provide certification that operators employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.
- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single hangers and supports for HVAC ductwork, piping, and equipment manufacturer.
 - 2. Require the hangers and supports for HVAC ductwork, piping, and equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the hangers and supports for HVAC ductwork, piping, and equipment manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, and installation details.
 - b. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
 - c. Drawings showing floor supported components and installation arrangement.
 - 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.
 - c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - f. Other technical data related to specified material and equipment as requested by Engineer.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Independent certification reports.
 - 2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 - 3. Source Quality Control Submittals:
 - a. Factory test reports.

4. Qualifications Statements:
 - a. Manufacturer, when requested by Engineer.
 - b. Installer, when requested by Engineer.
 - c. Welding, when requested by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of that Work.
 3. Comply with manufacturer's recommendations for rigging of equipment.
- B. Storage and Protection:
 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Design Criteria:
 1. Seismic Requirements:
 - a. All HVAC ductwork, piping, and equipment shall be provided with seismic restraints in accordance with the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, latest edition.
 - b. Seismic restraints shall be designed in accordance with the seismic provisions of the International Building Code (IBC) and ASCE 7 in conjunction with the current International Building Code to the extent that the most stringent provisions are utilized in developing the design seismic forces.
 - c. Refer to the Structural Drawings for site and structure specific seismic design criteria.
 2. Designs generally accepted as exemplifying good engineering practice and using stock or production parts shall be utilized wherever possible.

Hangers and Supports for HVAC Ductwork, Piping, and Equipment

3. Accurate weight balance calculations shall be made to determine the required force at each hanger and support location and the weight load at each force concentration point.
4. Hangers and supports shall be capable of supporting and restraining HVAC ductwork, piping, and equipment in all conditions of operation. They shall allow free expansion and contraction, and prevent excessive stress resulting from transferred weight being induced into the HVAC ductwork, piping, and equipment.
5. Hangers and supports shall be designed so that they cannot become disengaged by movements of the supported HVAC ductwork, piping, and equipment.
6. Rod length shall be limited to a maximum length of eight linear feet.
7. HVAC ductwork, piping, and equipment that cannot be hung by rod and hanger arrangement shall be floor or wall supported.
8. All structural components shall be designed based on static and dynamic loads imposed by the supported HVAC ductwork, piping, and equipment and shall include a safety factor of 2 for the yield strength. Minimum angle sizes shall be 2-inch x 2-inch x 1/4-inch.
9. Load ratings, materials and installation shall be consistent with the recommendations from the latest edition of MSS SP 58, MSS SP 69, and FS WW-H-171.

2.2 MANUFACTURERS

- A. Manufacturer: Provide product of one of the following:
 1. Erico International Corporation.
 2. Anvil International.
 3. Or equal.

2.3 DETAILS OF CONSTRUCTION

- A. Materials:
 1. Hangers, supports, restraints, and appurtenances located in corrosive areas shall be Type 316 stainless steel. Fiberglass reinforced plastic (FRP) hangers and supports shall be allowed for nonmetal ductwork only.
 2. Hangers, supports, restraints, and appurtenances located in non-corrosive or dusty areas shall be hot dipped galvanized steel in accordance with ASTM A123/A123M and ASTM A153/A153M.
 3. Hangers, supports, restraints, and appurtenances located outdoors shall be Type 316 stainless steel.
 4. Steel used for the support of uninsulated copper piping or plastic piping shall be PVC coated.
 5. Refer to the Corrosive and Non-Corrosive Area Designation Table shown on the Drawings for a list of these areas.
- B. Components of hangers and supports shall conform to the following:
 1. Bolts: ASTM A307, Grade A, unless otherwise specified below.
 2. Forgings: ASTM A668/A688M.

Hangers and Supports for HVAC Ductwork, Piping, and Equipment

3. Malleable Iron: ASTM A47/A47M.
 4. Rods and Bars: ASTM A575.
 5. Threads: Unified Screw Threads, Class 2A and 2B, ANSI B1.1.
 6. Structural Steel: ASTM A36/A36M.
- C. Hanger Attachments: The following types of attachments shall be considered acceptable:
1. Adjustable Steel Clevis: FS WW-H-171E, Type 1.
 2. Steel Double Bolt Pipe Clamp: FS WW-H-171E, Type 3.
 3. Steel Pipe Clamp: FS WW-H-171E, Type 4.
 4. Adjustable Swivel Pipe Ring: FS WW-H-171E, Type 6.
 5. Adjustable Steel Band Hanger: FS WW-H-171E, Type 7.
 6. Riser Clamp: FS WW-H-171E, Type 8.
 7. Light-Duty Clevis Hanger: FS WW-H-171E, Type 12.
 8. Long Clips: FS WW-H-171E, Type 26.
 9. Offset J-Hooks: FS WW-H-171E, Type 27.
 10. Steel Pipe Covering Protection Saddle: FS WW-H-171E, Type 40A.
 11. Insulation Protection Shield: FS WW-H-171E, Type 41.
 12. Pipe Saddle Support: FS WW-H-171E, Type 37.
 13. Pipe Stanchion Saddle: FS WW-H-171E, Type 38.
 14. Pipe Saddle Support with Base: FS WW-H-171E, Type 36.
 15. Adjustable Roller Hanger: FS WW-H-171E, Type 42.
- D. Structural Attachments: The following types of attachments shall be considered acceptable:
1. Side Beam Clamp: FS WW-H-171E, Type 20.
 2. Center I-Beam Clamp: FS WW-H-171E, Type 21.
 3. Welded Steel Bracket: FS WW-H-171E, Types 32 and 33.
 4. Side Beam Bracket: FS WW-H-171E, Type 35.
- E. Hanger Rod Attachments: Use as required to complete assembly:
1. Forged Steel Clevis: FS WW-H-171E, Type 14.
 2. Adjustable Turnbuckle: FS WW-H-171E, Type 15.
 3. Forged Steel Welders Eye Nut: FS WW-H-171E, Type 17.
- F. Concrete anchorage shall be provided in accordance with Section 05 05 33, Anchor Systems.
- G. Structural steel shall be provided in accordance with Section 05 12 00, Structural Steel Framing.
- H. Miscellaneous metal fabrications shall be provided in accordance with Section 05 50 13, Miscellaneous Metal Fabrications.

2.4 SOURCE QUALITY CONTROL

- A. Shop Tests:

Hangers and Supports for HVAC Ductwork, Piping, and Equipment

1. Equipment shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
 - a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label or equal.
 - b. Factory test equipment to ensure that the entire package has been properly fabricated and assembled, that the package meets the specified performance requirements including manufacturer's data report.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Surface Preparation:
 1. Attachment to hollow core slabs or double tee slabs shall be provided in accordance with details shown on the structural drawings to prevent damage to pre-stressing strands.

3.3 INSTALLATION

- A. General:
 1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 2. Install in accordance with Laws and Regulations.
 3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
 4. Installation to conform to requirements of all local and state codes.
- B. Ductwork:
 1. The construction and installation of hangers and supports for ductwork shall conform to the recommendations given in the SMACNA HVAC Duct Construction Standards, the SMACNA Seismic Restraint Manual, and the SMACNA Thermoset FRP Duct Construction Manual, except as specified.
 2. Hanger rods shall have threaded ends.
 3. All ductwork shall be supported from trapeze type hangers. No sheet metal duct hangers or straps will be allowed.

4. A pair of rods shall be provided at each duct support point.
5. For nonmetal ductwork, there shall be not less than a 1/4-inch buildup of FRP over the duct at each support. Each support shall be furnished with a 1/8-inch thick Teflon sheet to shield the duct from the support.

C. Piping:

1. Insulated pipes with vapor barriers shall have an insulation protection shield conforming to FS WW-H-171E, Type 41 tack-welded to hanger.
2. Insulated pipes without vapor barriers shall have a steel protection saddle conforming to FS WW-H-171E, Type 40A.
3. All uninsulated copper piping shall be supported by plastic coated steel pipe attachments.
4. All piping shall be braced as required, to prevent sway in any direction.
5. All insulated piping 3-inch diameter and larger shall be supported by roller hangers conforming to FS WW-H-171E, Type 42.
6. Additional supports shall be placed immediately adjacent to any change in direction.
7. Supports for Vertical Piping:
 - a. Provide riser clamp placed under hub, fitting or coupling with approved solid bearing on steel sleeve at each floor level.
 - b. Where riser clamps are used with plastic piping they shall be modified so as not to exert any compressive forces on the pipe.
 - c. Support spacing shall not exceed code requirements.
8. Allow clearances for expansion and contraction of piping.

D. Anchorages and Base Plates:

1. Provide anchorages in new or existing concrete, as applicable, in accordance with equipment manufacturer's recommendations and the Contract Documents. Install anchors in accordance with Section 05 05 33, Anchor Systems.
2. Where used, pour concrete bases up to one inch below equipment baseplate or support leg as applicable. Base with equipment mounted shall then be accurately shimmed to grade and spaces between filled with non-shrink grout in accordance with Section 03 60 00, Grouting. After grout has reached its initial set, exposed edges shall be neatly cut back 1/2 inch.

3.4 ADJUSTING

- A. Adjust all equipment for proper settings.

3.5 CLEANING

- A. Thoroughly clean all equipment and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from equipment and accessories after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

3.6 SCHEDULES

- A. Hangers and Supports for Ductwork:
 - 1. Spacing:
 - a. Ductwork shall be supported at distances not exceeding the spacing specified below:
 - 1) Metal Ductwork:
 - a) Maximum Spacing: 10 feet.
 - 2) Flexible and Other Factory-Made Ductwork (such as FRP):
 - a) Maximum Spacing: In accordance with the manufacturer's installation instructions.
 - 2. Hanger Rod Sizes:
 - a. Hanger rods shall be sized based on static and dynamic loads imposed by the supported ductwork and shall include a safety factor of 2 for the yield strength.
 - b. Rod load shall not exceed rod manufacturer's recommended capacity.
- B. Hangers and Supports for Piping:
 - 1. Spacing:
 - a. Piping shall be supported at distances not exceeding the spacing specified below or in accordance with MSS SP 58:
 - 1) Copper Tube:
 - a) Maximum Horizontal Spacing: 6 feet.
 - b) Maximum Vertical Spacing: 10 feet.
 - 2) Copper Pipe:
 - a) Maximum Horizontal Spacing: 12 feet.
 - b) Maximum Vertical Spacing: 10 feet.
 - 3) Steel Pipe:
 - a) Maximum Horizontal Spacing: 12 feet.
 - b) Maximum Vertical Spacing: 15 feet.
 - 2. Hanger Rod Sizes:
 - a. Hanger rods shall be sized based on static and dynamic loads imposed by the supported piping and shall include a safety factor of 2 for the yield strength.
 - b. Rod load shall not exceed rod manufacturer's recommended capacity.
- C. Hangers and Supports for HVAC Equipment:
 - 1. Provide spacing and hanger rod sizes in accordance with equipment manufacturer's installation instructions.

++ END OF SECTION ++

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to perform the testing, adjusting, and balancing for HVAC as specified herein.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the testing, adjusting, and balancing for HVAC Work.

C. Related Sections:

1. Section 10 14 00, Signage.
2. Section 23 09 00, Instrumentation and Control for HVAC.

1.2 REFERENCES

A. Associated Air Balance Council (AABC).

1. AABC National Standards for Total System Balance.

B. American National Standards Institute/American Industrial Hygiene Association (ANSI/AIHA).

1. ANSI/AIHA Z9.5 – Laboratory Ventilation.

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

1. ASHRAE Handbook – Fundamentals.

D. National Environmental Balancing Bureau (NEBB).

1. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

1. SMACNA HVAC Systems – Testing, Adjusting & Balancing Handbook.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Balancer:

- a. Engage an experienced balancer to perform the work of this Section who has specialized in testing, adjusting, and balancing for HVAC systems similar to that required for this Project.
- b. Minimum of five years of experience in testing, adjusting, and balancing substantially similar equipment and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
- c. Submit name and qualifications to Engineer along with the following information on a minimum of five successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for projects.
 - 2) Approximate contract cost of the testing, adjusting, and balancing for HVAC Work.
 - 3) Amount of area tested, adjusted, and balanced.
 - 4) Biographical information on employee proposed to directly supervise the testing, adjusting, and balancing Work.

B. Regulatory Requirements:

1. Associated Air Balance Council (AABC).
2. National Electrical Code (NEC).
3. National Environmental Balancing Bureau (NEBB).
4. National Fire Protection Association (NFPA).
5. Underwriters Laboratories Inc. (UL).
6. Local and State Building Codes and Ordinances.

7. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:

- a. Data sheets with name of devices, manufacturer's name, model number, latest date of calibration, and correction factors for each testing, adjusting, and balancing instruments.
- b. Other technical data related to specified material and equipment as requested by Engineer.

B. Informational Submittals: Submit the following:

1. Certificates:

- a. Certification by National Environmental Balancing Bureau (NEBB), Association Air Balance Council (AABC), or equal.

2. Source Quality Control Submittals:

- a. Specimen copies of report forms for Engineer's review and approval.
 - 1) Forms shall be 8-1/2 by 11-inch paper for loose-leaf binding, with blanks for certification of report and listing all required testing, adjusting, and balancing requirements and ratings.

3. Field Quality Control Submittals:

- a. Written startup and field test reports presenting results of required field testing, adjusting, and balancing.
 - 1) Certified reports shall be in typed format on approved forms imprinted with the company's name.
 - 2) Reports shall include procedure outline used to test, adjust, and balance the systems and the types of instruments used.
 - 3) Minimum three certified copies of testing, adjusting, and balancing reports to the Engineer for review.
 - 4) Reports must be submitted to Engineer and Owner for approval prior to Owner's acceptance for responsibility.

4. Qualifications Statements:

- a. Balancer, when requested by Engineer.
- C. Closeout Submittals: Submit the following:
 - a. Check List:
 - 1) Provide a checklist and post a copy of it, where directed by the Owner.
 - 2) Include each piece of equipment specified or shown.
 - 3) Provide four columns for required quarterly inspections.
 - 4) Provide columns for the following:
 - a) Equipment condition.
 - b) Equipment operation.
 - c) Equipment lubrication.
 - d) Preventive maintenance.
 - 5) Preventive maintenance shall be performed in accordance with the manufacturer's recommendations and accepted practice.
 - 2. Operations and Maintenance Data:
 - a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. Equipment Description:
 - 1. Air Balance Instruments:
 - a. Provide all velometers, anemometers, pitot tubes, differential air pressure gages, manometers, hook gages, static pressure probe units, and all other instruments and accessories as required to perform all air balance tests of HVAC equipment, ducts, registers, grilles, etc.

- b. Flow-measuring hoods (manufactured, not fabricated) shall be acceptable for measurement of ceiling diffuser performance only.
- 2. System Performance Measuring Instruments:
 - a. Provide insertion thermometers, sling psychrometers, tachometers, revolution counters, clamp-on volt-ammeter recorders, and other instruments as required to measure all facets of the complete HVAC system performance.
- B. Performance Criteria:
 - 1. Instrumentation shall be in accordance with NEBB, AABC, or SMACNA requirements and shall be calibrated to the accuracy standards demanded by these organizations.

2.2 ACCESSORIES

- A. Balancing Sheaves and Belts:
 - 1. Balancing sheaves and belts shall be provided for all belt driven equipment.
 - 2. Sheaves and belts shall be provided to match construction and duty provided by the equipment manufacturer.
 - 3. Equipment sheaves and belts replaced or not required to achieve balancing shall be submitted to the Owner as spare parts.

2.3 IDENTIFICATION

- A. All equipment and component identification, including valve tags, shall be provided in accordance with Section 10 14 00, Signage.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Heating, ventilating and air conditioning equipment and components shall be completely installed and in continuous operation, as required, to accomplish the testing, adjusting and balancing Work specified.
- B. Inspect all HVAC equipment and components for proper operation prior to
 - 1. Fan Belt Deflection: Not less than 1/4-inch or more than 1/2-inch.

- C. Pre-Startup Inspection:

1. Verify proper equipment mounting and setting.
2. Verify that control, interlock and power wiring is complete.
3. Verify alignment of motors and drives.
4. Verify proper piping connections and accessories.
5. Verify that lubrication is completed.

D. First Run Observations:

1. Verify direction of rotation.
2. Verify setting of safety controls.
3. Monitor heat build-up in bearings.
4. Check motor loads against nameplate data.

E. Equipment Check:

1. Verify proper overload heater sizes.
2. Verify function of safety and operating controls.
3. Verify proper operation of equipment.
4. Report on inspection, observation and checking procedures.

F. Promptly report defects which may affect the Work to Engineer.

G. Should corrective measures caused by faulty installation require re-testing, adjusting and balancing, such Work shall be at no additional cost to the Owner.

3.2 APPLICATION

A. General:

1. Test, adjust, and balance all systems, ductwork, piping, etc. and their control systems in accordance with the AABC National Standards for Total System Balance, NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems, SMACNA HVAC Systems - Testing, Adjusting & Balancing Handbook, or in compliance with the standard procedure manual published by the testing, adjusting, and balancing organization affiliated with Contractor. Contractor shall submit one copy of the standard procedure manual to the Engineer for their records.

2. Contractor shall provide all necessary instruments, tools, ladders, etc. to complete all testing, adjusting, and balancing Work.
3. Contractor shall assume full responsibility for safe keeping of all instruments, tools, ladders, etc. during the course of the Work.
4. Contractor shall be solely responsible for the protection and safeguarding of the Work and shall provide every protection against accidents, injury, and damage to persons and property.
5. Contractor shall keep dust, dirt, and debris to an absolute minimum and reinstall all removed ceiling components to their original positions at the end of each day's Work.
6. Contractor shall be fully responsible for removal and reinstallation of ceiling system and replacement of any component damaged.
7. Contractor shall install additional access panels at no extra cost to the Owner, as is required to gain access to equipment concealed above ceilings, behind walls, or any other concealed space.
8. Systems shall be tested, adjusted, and balanced with clean filters and strainers.
9. Where equipment is provided with a variable speed controller (VSC) or variable frequency drive (VFD), balance the equipment first with the VSC or VFD and then with balancing dampers (air systems) or valves (hydronic systems). All systems shall be optimized through the VSC or VFD by balancing with the minimum static pressure needed to meet design flow conditions.

B. Air Systems:

1. Preliminary:
 - a. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals.
2. Central Systems:
 - a. Test rpm for all equipment, including adjusting of each fan, air handling unit, and air conditioning unit to design requirements within the limits of mechanical equipment provided.
 - b. Test and record motor voltages and running amperes including motor nameplate data, and starter heater ratings for each unit as listed above.

- c. Make pitot tube traverse of main supply, exhaust and return ducts, determine airflow at all fans and units and adjust fans and units to within five percent of design requirements.
 - d. Test and record system static pressure, suction and discharge.
 - e. Test and adjust system for design outside air, (cfm).
 - f. Test and adjust system for design recirculated air, (cfm).
 - g. Test and record heating apparatus entering air temperatures, (dry bulb).
 - h. Test and record cooling apparatus entering air temperatures, (dry bulb and wet bulb).
 - i. Test and record heating apparatus leaving air temperatures, (dry bulb).
 - j. Test and record cooling apparatus leaving air temperatures, (dry bulb and wet bulb).
 - k. Record all fan and air handling unit speeds.
 - l. Record air quantity delivered by each fan and air-handling unit.
3. Distribution:
- a. Sheave and belt replacement shall be provided as the first means of accomplishing the balancing Work before volume dampers are adjusted from their initial open positions.
 - b. Adjust volume dampers, control dampers, splitter dampers, etc., to proper design airflow in main ducts, branch ducts, and zones.
4. Air Terminals:
- a. Identify each air terminal as to location and determine required flow reading.
 - b. Test and adjust each air terminal to within tolerance of design requirements as listed below.
 - 1) Positive Zones:
 - a) Diffusers and Supply Air Terminals: 0 percent to +10 percent.
 - b) Exhaust and Return Air Terminals: 0 percent to -10 percent.
 - 2) Negative Zones:
 - a) Diffusers and Supply Air Terminals: 0 percent to -10 percent.

- b) Exhaust and Return Air Terminals: 0 percent to +10 percent.
- 3) Neutral Zones:
 - a) All Air Terminals: -10 percent to +10 percent.
 - c. Test procedure on air terminals shall include recording comparison of required airflow and observed airflow, adjustment of terminal, and recording of final airflow.
 - d. Adjust flow patterns from air terminal units to minimize drafts to the extent that the design and equipment permits.
- 5. Verification:
 - a. Prepare summation of readings of observed airflow for each system, compare with required airflow, and verify that duct losses are within specified allowable range.
 - b. Verify design airflow at fans as described above.
 - c. If determined that the air system has not been properly balanced, Contractor shall rebalance and recheck all equipment and components in the presence of the Engineer and as accepted by the Engineer.
- C. Automatic Temperature Control System:
 - 1. In cooperation with Section 23 09 00, Instrumentation and Control for HVAC, and the control manufacturer's representative, set and adjust automatically operated devices to achieve required sequence of operations.
 - 2. Testing organization shall verify all controls for proper calibration and list those controls requiring adjustment by control system installer.

3.3 SCHEDULES

- A. Test, adjust, and balance the air terminal devices, ductwork, and their control systems associated with the following HVAC equipment:
 - 1. Existing Split System Heat Pump HP-1
 - 2. New Exhaust Fans EF- 6 and EF-7

++ END OF SECTION ++

SECTION 23 07 13
DUCT INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install duct insulation complete with accessories.
2. This Work also includes:
 - a. Repairing all existing duct insulation in all areas that is damaged or displaced due to new construction by Contractor with materials and procedures identical to the existing duct insulation.

B. Coordination:

1. Duct insulation shall not be installed until ductwork has been field tested and approved by Engineer.
2. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the duct insulation Work.

C. Related Sections:

1. Section 09 91 00, Painting.
2. Section 10 14 00, Signage.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

2. ASTM C411 – Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

B. National Fire Protection Association (NFPA).

1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
2. NFPA 90B – Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
3. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Underwriters Laboratories Inc. (UL).

1. UL 181 – Factory-Made Air Ducts and Air Connectors.
2. UL 723 – Test for Surface Burning Characteristics of Building Materials.

1.3 DEFINITIONS

- A. Concealed spaces – spaces in which ductwork are installed and are withdrawn or removed from observation or kept from plain sight. Spaces above hung ceiling are examples of concealed spaces.
- B. Exposed spaces – spaces in which ductwork are installed and laid open to view; unconcealed. All outdoor locations shall be considered exposed spaces.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Minimum of five years of experience producing substantially similar material and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
2. Installer:

- a. Engage an experienced installer to perform the work of this Section who has specialized in installing duct insulation similar to that required for this Project and who is acceptable to manufacturer.
- b. Submit name and qualifications to Engineer along with the following information on a minimum of three successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for projects.
 - 2) Approximate contract cost of the duct insulation.
 - 3) Amount of area installed.

B. Regulatory Requirements:

1. National Fire Protection Association (NFPA).
2. Underwriters Laboratories Inc. (UL).
3. Local and State Building Codes and Ordinances.
4. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, and installation details.
2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all material.
 - b. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.

- c. Other technical data related to specified material and equipment as requested by Engineer.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Independent certification reports:
 - 1) UL Label.
 - 2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the material.
 - b. Installation Data.
 - 3. Source Quality Control Submittals:

1.6 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all material in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to material or components. Replace lost material or components and repair damage to new condition, in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Criteria:

1. All insulation systems including covering, mastics, adhesives, sealers and facings shall have the following Fire Hazard Classifications in accordance with ASTM E84 or UL 723:
 - a. Flame Spread Index: 25 maximum.
 - b. Smoke Developed Index: 50 maximum.
2. All insulation systems shall not flame, glow, smolder or smoke when tested in accordance ASTM C411 at service temperature of 250 degrees F.
3. All insulation systems shall meet fire safety standards NFPA 90A, 90B, and 255 where applicable.

2.2 MANUFACTURERS

A. Manufacturer: Provide product of one of the following:

1. CertainTeed.
2. Johns Manville.
3. Owens Corning.
4. Or equal.

2.3 DETAILS OF MATERIALS

A. Flexible Thermal Insulation:

1. Type: Flexible fiberglass blanket with vapor barrier facing.
2. Density: Minimum one pound per cubic foot.
3. Facing: Foil-Scrim-Kraft (FSK).
4. Thermal Conductivity: Maximum 0.27 Btu-in/hr-ft²-degree F at 75 degrees F mean temperature.

5. Water Vapor Transmission: Maximum 0.05 perm.

B. Rigid Thermal Insulation:

1. Type: Rigid fiberglass board with vapor barrier facing.
2. Density: Minimum six pound per cubic foot.
3. Facing: Foil-Scrim-Kraft (FSK).
4. Maximum Thermal Conductivity: 0.22 Btu-in/hr-ft²-degree F at 75 degrees F mean temperature.
5. Water Vapor Transmission: Maximum 0.05 perm.

2.4 IDENTIFICATION

- A. All external duct insulation shall be legibly printed or identified at intervals not greater than 36 inches with the name of the manufacturer, the thermal resistance R-value at the specified thickness and the flame spread and smoke-developed indexes of the composite materials.
- B. All duct insulation identification shall be provided in accordance with Section 10 14 00, Signage.

2.5 SOURCE QUALITY CONTROL

A. Shop Tests:

1. Material shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
 - a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label.
 - b. Factory test material to ensure that the entire package has been properly fabricated and assembled, and that the package meets the specified performance requirements including manufacturer's data report.
 - c. Flame Spread.

- d. Smoke Developed.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. All ductwork leaks shall be repaired prior to installation of duct insulation.
- C. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 INSTALLATION

- A. General:
 - 1. Install the material in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 2. Install in accordance with Laws and Regulations.
 - 3. Do not modify structures to facilitate installation of material, unless approved in writing by Engineer.
 - 4. Installation to conform to requirements of all local and state codes.
- B. Duct insulation shall be continuous through walls and floor openings except where walls or floors are required to be firestopped or required to have a fire resisting rating.

- C. Install insulation so as to make surfaces smooth, even, substantially flush with adjacent insulation and installed in a manner to maintain the integrity of the vapor barrier.

3.3 CLEANING

- A. Thoroughly clean all exterior and interior surfaces of ductwork and accessories prior to installation and prior to putting into service.
- B. Remove all dirt, rust, dust, etc. from material after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 SCHEDULES

- A. Insulation Thicknesses:
 - 1. Insulation for outside air intake ductwork and ductwork located outdoor shall be minimum 2 inches thick with a minimum installed thermal resistance value of R-8.
 - 2. Insulation for all other ductwork shall be minimum 1-1/2 inches thick with a minimum installed thermal resistance value of R-6.
- B. Insulation Types:
 - 1. Flexible thermal insulation shall be used on ductwork in concealed spaces.
 - 2. Rigid thermal insulation shall be used on ductwork in exposed spaces.
- C. Insulation Locations:
 - 1. All supply, return, and exhaust ductwork and plenums including appurtenances (e.g., volume dampers, diffusers, grilles, etc.) associated with air conditioning units (except those located within air-conditioned spaces).
 - 2. All outside air intake ducts and plenums from the outside air intake louver, outside air intake shaft, or roof mounted intake up to the point where the duct or plenum is connected to the unit in heated or air-conditioned spaces.

3. All heated or air-conditioned ductwork located outdoors or in unheated spaces.
4. All exhaust ductwork associated with dehumidification units.
5. Any additional ductwork and plenums including appurtenances where condensation may occur due to contact with surrounding atmosphere.

+ + END OF SECTION + +

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install HVAC piping insulation complete with accessories.
2. This Work also includes:
 - a. Repairing all existing HVAC piping insulation in all areas that is damaged or displaced due to new construction by Contractor with materials and procedures identical to the existing HVAC piping insulation.

B. Coordination:

1. HVAC piping insulation shall not be installed until piping has been field tested and approved by Engineer.
2. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the HVAC piping insulation Work.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM C411 – Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
3. ASTM C449 – Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

B. National Fire Protection Association (NFPA).

1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
2. NFPA 90B – Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
3. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Underwriters Laboratories Inc. (UL).

1. UL 723 – Test for Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Minimum of five years of experience producing substantially similar material and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
2. Installer:
 - a. Engage an experienced installer to perform the work of this Section who has specialized in installing HVAC piping insulation similar to that required for this Project and who is acceptable to manufacturer.
 - b. Submit name and qualifications to Engineer along with the following information on a minimum of three successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for projects.
 - 2) Approximate contract cost of the HVAC piping insulation.
 - 3) Amount of area installed.

B. Regulatory Requirements:

1. National Fire Protection Association (NFPA).

2. Underwriters Laboratories Inc. (UL).
3. Local and State Building Codes and Ordinances.
4. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, and installation details.
2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all material.
 - b. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - c. Other technical data related to specified material and equipment as requested by Engineer.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Independent certification reports:
 - 1) UL Label.
2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the material.
 - b. Installation Data.
3. Qualifications Statements:
 - a. Manufacturer, when requested by Engineer.

- b. Installer, when requested by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

- 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.

B. Storage and Protection:

- 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
- 2. Store all material in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Criteria:

- 1. All insulation systems including covering, mastics, adhesives, sealers and facings shall have the following Fire Hazard Classifications in accordance with ASTM E84 or UL 723:
 - a. Flame Spread Index: 25 maximum.
 - b. Smoke Developed Index: 50 maximum.
- 2. All insulation systems shall not flame, glow, smolder or smoke when tested in accordance ASTM C411 at service temperature of 220 degrees F.
- 3. All insulation systems shall meet fire safety standards NFPA 90A, 90B, and 255 where applicable.

2.2 DETAILS OF MATERIALS

A. Flexible-Elastomeric Thermal Insulation (for refrigerant piping):

1. Product and Manufacturer: Provide one of the following:
 - a. Model Armaflex Tube Insulation, as manufactured by Armacell.
 - b. Model Insul-Tube Insulation, as manufactured by K-Flex USA.
 - c. Or equal.
2. Type: Expanded close cell structure elastomeric thermal insulation.
3. Density: Minimum three pound per cubic foot.
4. Thermal Conductivity: Maximum 0.25 Btu-in/hr-ft²-degree F at 75 degrees F mean temperature.
5. Water Vapor Transmission: Maximum 0.05 perm.
6. Provide manufacturer's approved contact adhesive for sealing seams and butt joints.

2.3 ACCESSORIES

A. Stainless Steel Protective Jacketing:

1. Product and Manufacturer: Provide one of the following:
 - a. Model Strap-On, as manufactured by Pabco-Childers Metals.
 - b. Model Insul-Mate, as manufactured by RPR Products, Inc.
 - c. Or equal.
2. Material: Smooth Type 304 stainless steel, Standard 2B mill finish.
3. Thickness: 0.016-inch.
4. Moisture Retarder: 3-mil thick coextrusion of polyethylene and DuPont's Surlyn.
5. Fastening: Continuous modified Pittsburgh Z-lock longitudinal seam with self-gauging 2-inch built-in overlap.
6. Bands: 1/2-inch stainless steel bands with wing seals.
7. Fittings:
 - a. Type: Pre-fabricated Type 304 stainless steel fittings.
 - b. Thickness: 0.016-inch.

2.4 SOURCE QUALITY CONTROL

A. Shop Tests:

1. Material shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
 - a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label.
 - b. Factory test material to ensure that the entire package has been properly fabricated and assembled, and that the package meets the specified performance requirements including manufacturer's data report.
 - c. Flame Spread.
 - d. Smoke Developed.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. All HVAC piping leaks shall be repaired prior to installation of HVAC piping insulation.
- C. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 INSTALLATION

A. General:

1. Install the material in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written

interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.

2. Install in accordance with Laws and Regulations.
 3. Do not modify structures to facilitate installation of material, unless approved in writing by Engineer.
 4. Installation to conform to requirements of all local and state codes.
- B. HVAC piping insulation shall be continuous through walls and floor openings except where walls or floors are required to be firestopped or required to have a fire resisting rating.
- C. Where hangers are in direct contact with low temperature piping the hanger and supporting rod shall be wrapped with foil-faced blanket insulation and vapor sealed. Hanger rod insulation and vapor barrier shall extend up to the rod a minimum distance equal to the diameter of the pipe.
- D. Install insulation so as to make surfaces smooth, even, substantially flush with adjacent insulation and installed in a manner to maintain the integrity of the vapor barrier.
- E. Provide insulation protection shields for insulated piping supported by pipe hangers.

3.3 CLEANING

- A. Thoroughly clean and dry all exterior surfaces of HVAC piping and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from HVAC piping insulation after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

3.4 PROTECTION OF EXECUTED WORK

- A. All insulation applied in one day shall have the vapor barrier applied the same day and any exposed ends shall be temporarily protected with a moisture barrier and sealed to the piping.

3.5 SCHEDULES

- A. See Schedule below for minimum insulation thickness and locations where required.

<u>Pipe Service</u> (Including Valves, Fittings, and Accessories)	<u>Pipe Size</u>	<u>Minimum Insulation Thickness</u>	<u>Location</u>
Refrigerant	All Sizes	1-inch	All piping

- B. All insulated piping exposed within six feet vertically of floor or other working surface shall be covered with weatherproof stainless steel protective jacketing.
- C. All insulated piping located outdoors shall be covered with weatherproof stainless steel protective jacketing.

+ + END OF SECTION + +

SECTION 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, material, equipment, related services, supervision and incidentals required, including, but not limited to, manufacturing, fabrication, configuration and installation for a complete HVAC Monitoring and Control System (HMCS) including all necessary hardware and all operating and applications software as required for the complete performance of the Work as shown on the Drawings and as specified herein.
2. An overview of the HMCS is summarized below:
 - a. The HMCS system at Cross Town WTP's Post-Treatment Chemical Building shall include controls associated with existing Heat Pump unit, new exhaust fans and their HOA switches, new isolation dampers in the supply and exhaust air ducts with motorized actuators as described in Article 3.4 Sequence of Operations.
 - b. Control devices shall be suitable for the environment they are installed in.
 - c. CONTRACTOR shall be responsible for providing control wiring, conduits, and appurtenances for interconnecting factory controls provided with HVAC equipment including but not limited to remote control devices, thermostats, temperature sensors, controllers, etc.
 - d. Existing controls, conduits, wiring, and appurtenances made obsolete by new control work or, no longer required, shall be removed.
 - e. Existing controls which are specified to remain and be reused shall be tested and calibrated for proper operation. Existing equipment control systems that are remaining and require check out and testing include the following:
 - 1) Heat Pump HP-1
3. The Contract Documents illustrate and describe the overall functional and operational requirements. CONTRACTOR is responsible for tagging, integrating, and verifying the functionality of all system components.
4. At a minimum, provide controls for the following:
 - a. Heat Pump unit.
 - b. Exhaust fans.
5. The Work also includes:
 - a. Motorized dampers including linkage kits and other accessories.
 - b. Mounting accessories, junction boxes, face plates, wall plates, covers, and mounting hardware as required.
 - c. Relays, selector switches, pushbuttons, indicating lights, "HAND/OFF/AUTOMATIC" selector switches.

- d. Transformers.
 - e. Other control devices and appurtenances, as required.
 - f. Power and control wiring and conduit.
 - g. Conduit layouts are not shown on the drawings. CONTRACTOR shall determine the requirements based upon the arrangement of the components being furnished.
- B. Work Furnished Under the Electrical Contract:
- 1. All 460v/3ph, 277v/1ph phase power wiring and conduit.
 - 2. 120 volt, single phase power wiring and conduit for the following:
 - a. Single phase fans
 - b. All wiring and conduit between 120V unit heaters and associated 120V thermostats.
 - 3. Starters.
 - 4. Disconnects, except where specified to be furnished under the HVAC Contract.
 - 5. "HAND/OFF/AUTOMATIC" selector switches, lockout stops, pushbuttons, "START/STOP" switches, and indicating lights.
- C. Coordination:
- 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, Instrumentation and Control for HVAC Work.
- D. Related Sections:
- 1. Section 10 14 00, Signage.
 - 2. Section 26 05 19, Low Voltage Electrical Power Conductors and Cables.
 - 3. Section 26 05 29, Hangers and Supports for Electrical Systems.
 - 4. Section 26 05 33.13, Rigid Conduit.
 - 5. Section 26 05 33.16, Flexible Conduits.
 - 6. Section 26 05 33.33, Pull, Junction and Terminal Boxes.
 - 7. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
- 1. American National Standards Institute, (ANSI).
 - 2. Federal Communications Commission (FCC)
 - 3. Factory Mutual, (FM).
 - 4. Institute of Electrical and Electronic Engineers, (IEEE).
 - 5. The Instrumentation, Systems and Automation Society, (ISA).
 - 6. National Electrical Code, (NEC).
 - a. NFPA 79, Electrical Standard for Industries Machinery.
 - 7. National Electrical Manufacturers Association, (NEMA).
 - 8. National Fire Protection Association, (NFPA).
 - a. NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems

9. Occupational Safety and Health Administration, (OSHA).
10. Underwriters' Laboratories, Inc., (UL).
 - a. UL 873, Standard for Temperature-Indicating and -Regulating Equipment.
 - b. UL 916, Standard for Energy Management Equipment.
 - c. UL 555S, Standard for Smoke Dampers.

1.3 DEFINITIONS

- A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.
- B. Definitions:
 1. Commercial Area: This is an area that has a clean environment. Examples include administration and office areas.
 2. Industrial Non-Process Area: This is an area that generally has a clean environment but could be dusty. Examples include but are not limited to electric rooms, control rooms, and mechanical rooms.
 3. Industrial Process Area: This is an area that could have a wet and or corrosive environment and could be electrically classified. Examples include but are not limited to process equipment spaces, chemical rooms, wet wells, drywells, and pump stations.
 4. Supplier: The Supplier shall be Contractor and manufacturer jointly, that has undivided responsibility for the engineering, design, installation and commissioning of a complete and fully functional HMCS with all required appurtenances. An approved representative of the manufacturer is an acceptable substitute to for the manufacture where independent control Contractors are authorized by the manufacturer to provide their products and services.
- C. Acronyms:
 1. General
 - a. ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers
 - b. AHU: Air Handling Unit
 - c. AU: Air-conditioning Unit
 - d. HP: Heat Pump
 - e. EF: Exhaust Fan
 - f. MD: Motorized Damper
 - g. ASC: Application Specific Controllers
 - h. BACnet: Building Automation Controls Network
 - i. BMS: Building Management System
 - j. DDC: Direct Digital Control
 - k. EIA: Electronic Industries Alliance
 - l. GUI: Graphical User Interface

- m. HVAC: Heating, Ventilation, and Air Conditioning
- n. IEEE: Institute Electrical Electronic Engineers
- o. PID: Proportional, Integral, Derivative

1.4 QUALITY ASSURANCE

A. General:

1. The HMCS shall be furnished by a single Supplier responsible for the adequacy, performance and configuration of all items.
2. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the approved manufacturer's local field office.
3. Provide HMCS components and ancillary equipment, which are UL-916 listed and labeled.
4. All components used in conditioned air streams, spaces or return air plenums shall comply with NFPA 90A Flame/Smoke rating of 25/50.
5. All wiring shall conform to the National Electrical Code.

B. Supplier's Qualifications:

1. Shall have a minimum of 5 years of installation experience with the manufacturer and shall provide documentation in the bid and submittal package verifying longevity of the installing company's relationship with the manufacturer.
2. Shall have an in place support facility within 100 miles of the site with factory certified technicians and engineers, spare parts inventory and all necessary test and diagnostic equipment for the installed system.
3. Shall have the capability to provide on-site service within a 2 hour period.
4. Shall have 24 hours/day, 7 days/week emergency service available.
5. Shall be a financially sound firm having at least five years continuous experience in designing, implementing, supplying and supporting control systems at similar facilities which are comparable to the HMCS in terms of hardware, software, cost and complexity.

C. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of the component manufacturer from a single Supplier.
2. The Supplier shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the Supplier.

1.5 SUBMITTALS

A. Submit the following:

1. All shop drawings shall be prepared in Visio Professional or AutoCAD software. In addition to the drawings, the Contractor shall furnish a CD

containing the identical information. Drawings shall be 11" x 17" size or larger.

2. Shop drawings shall include a riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller.
3. Submittal data shall contain manufacturer's data on all hardware and software products required by the specification. Valve, damper and air flow station schedules shall indicate size, CV where applicable, configuration, capacity and location of all equipment.
4. Wiring diagrams, including the following:
 - 1) Name of panel, console or cabinet.
 - 2) Wiring sizes and types.
 - 3) Terminal strip numbers.
 - 4) Color coding.
 - 5) Functional name and manufacturer's designation for components to which wiring is connected.
5. Electrical control schematics in accordance with NFPA 79 Standards.
6. Conduit Layout Information:
 - a. Conduit layout drawings showing proposed routing of exposed and concealed conduits.
 - b. Drawings shall show locations of pull boxes, junction boxes, and all building penetrations.
 - c. All conduits shall have proper identification as to size and quantity of wire.

B. Closeout Submittals: Submit the following

1. Operations and Maintenance Manuals:
 - a. Operation and Maintenance Manuals shall conform to the requirements of Section 01 78 23, Operation and Maintenance Data and the supplemental requirements below.
 - b. The Operation and Maintenance Manuals shall include the following:
 - 1) Name, address, e-mail address and telephone number of the Supplier's local service representative.
 - 2) Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spares.
 - 3) Copy of all approved submittal information and system Shop Drawings.
2. Record Documentation:
 - a. CONTRACTOR and Supplier shall revise all system drawings, submittals and software documentation to reflect as-built conditions in accordance with the requirements of the Contract Documents.
 - b. Half-size black line prints of wiring diagrams and any program or configuration printouts applicable to each control panel shall be placed inside a clear plastic envelope and stored in a suitable print pocket or container inside each control panel.

C. Maintenance Material Submittals: Furnish the following:

1. Spare Parts:
 - a. Spare parts and testing equipment list with recommended quantities to be provided.

1.6 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. HMCS equipment shall be packaged at the factory prior to shipment to protect each item from damage during shipment and storage. Containers shall be protected against impact, abrasion, corrosion, discoloration and/or other damages.
2. Clearly label contents of each container and provide information on the required storage conditions necessary for the equipment. Keep OWNER and ENGINEER informed of equipment delivery.
3. Deliver materials to the Site to ensure uninterrupted progress of the Work.

B. Storage and Protection:

1. Store materials and equipment to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms or other supports. Protect metal enclosures and parts and other material from corrosion.
2. Supplier shall notify CONTRACTOR, in writing, of the storage requirements and recommendations for the equipment prior to shipment.
3. Protection of materials and equipment shall comply with the requirements of Division 01, General Requirements, and in accordance with manufacturer's instructions and relevant organization standards.
4. Store all material in covered storage and protect from condensation and in accordance with the manufacturer's recommendations.
5. Store computers and electronic devices in a secure environmentally control warehouse.

C. Acceptance At Site:

1. All boxes and crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to the components or equipment. Replace lost equipment or components and repair damage to like new condition in accordance with the manufacturer's requirements.

1.7 WARRANTY

- A. The warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents.

- B. All components, system software, and parts furnished and installed by the Supplier shall be guaranteed against defects in materials and workmanship for 1 year after substantial completion. Labor to repair, reprogram, or replace these components shall be provided. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. The following manufactures are acceptable provided they meet the requirements of the Contract Documents.
 - 1. Schneider Electric.
 - 2. Siemens.
 - 3. Johnson Controls.
 - 4. Or equal.

2.2 GENERAL REQUIREMENTS

- A. Design requirements:
 - 1. All HMCS components necessary to meet functional and operational requirements shall be provided to meet the intent of the Work.
 - 2. Components located in Industrial Process and Industrial Non-Process Areas shall be heavy-duty type, designed for continuous service in industrial environments.
 - 3. Components located in corrosive or wet electrically unclassified areas shall be provided with NEMA 4X enclosures.
 - 4. Components located in or exposed to corrosive atmospheres shall be constructed of materials suitable for use in areas containing wet hydrogen sulfide, sodium hypochlorite, and sodium hydroxide laden atmosphere. Suitable exposed materials shall be Type 316 stainless steel, epoxy or Teflon coated aluminum or other similar materials approved by the ENGINEER. Steel, galvanized steel, and Type 304 stainless steel are not suitable materials for exposure in corrosive areas.
 - 5. Design all logic and control loops to fail safe.
 - 6. Surge protection shall be provided for all instruments and all other control system components, which could be damaged by electrical surges.
 - 7. Relays with interconnections to field devices shall be wired through terminal blocks. Terminals as part of the relay base are not an acceptable alternate.
 - 8. Panel mounted instruments, switches, and other devices shall be selected and grouped for functionality and arranged to present a pleasing coordinated appearance. Similar type front of panel mounted devices shall be of the same manufacturer and model line.

9. Components furnished, including field and panel instruments, shall be tagged with the item number and nomenclature indicated as shown and/or approved Shop Drawings.
10. Ranges and scales shall be coordinated to suit equipment furnished.
11. Components shall be protected from exposure to freezing temperatures.

2.3 DAMPER ACTUATORS

- A. Type: Electric, Direct Coupled (over the shaft):
 1. Proportional and two position as indicated in the Sequence of Operations.
 2. Spring return where specified.
 3. V-bolt and V-shaped cradle shaft attachment.
 4. Electronic overload or digital rotation sensing circuitry to prevent damage to actuator throughout the rotation of actuator.
 5. Spring return actuators shall be capable of either clockwise or counterclockwise spring return operation by changing mounting orientation.
 6. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mADC control input and provide a 2 to 10 VDC or 4 to 20 mADC operating range. Proportional control through a pulse width modulating signal is acceptable. Proportional control through floating (Tri-state) control is not acceptable. Actuators shall be capable of providing 2 to 10 VDC position feedback signals.
 7. 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 watts for DC applications. Actuators operating on 120 VAC power shall not require more than 10 VA.
 8. Modulating actuators shall have an external, built in switch to allow the reversing of direction of rotation.
 9. External manual gear release with manual crank to allow manual positioning of shaft.
 10. Factory-mounted electrical cable and conduit fitting for connection to junction box.
 11. Conforming to UL 873.
 12. Actuators shall be provided with sufficient torque to open and close the device. Provide a minimum torque of 133-in-lb.
 13. 120VAC or 24VDC.
 14. NEMA Type 2 housing.
 15. Accessories:
 - a. Linkage kit.
 - b. Mounting bracket.
 - c. Auxiliary switches.
 - d. NEMA Type 4X enclosure in all corrosive atmospheres.
 - e. NFPA Class 1, Division 1, enclosure where located in Class 1, Division 1 areas.
 16. Manufacturers: Provide products of one of the following:
 - a. Belimo.
 - b. Schneider Electric

- c. Or equal.

2.4 CONTROL RELAYS

- A. Type: General purpose, plug-in type rated for continuous duty.
- B. Coil Voltages: 24 VDC and 120 VAC as required.
- C. Contacts:
 - 1. Silver cadmium oxide rated not less than five amperes resistive at 120 VAC or 28 VDC continuous.
 - 2. For switching low energy circuits (less than 200 mADC) fine silver, gold flashed contacts rated not less than three amperes resistive at 120 VAC or 28 VDC continuous shall be provided.
- D. Relays to have clear plastic dust cover.
- E. Relays to be recognized by UL.
- F. Manufacturers: Provide products of one of the following:
 - 1. IDEC.
 - 2. Potter & Brumfield.
 - 3. Allen-Bradley.
 - 4. Or equal.

2.5 CONDUIT, WIRE AND ACCESSORIES

- A. Provide conduit and conduit supports in accordance with Section 26 05 33.13, Rigid Conduit, and Section 26 05 33.16, Flexible Conduits, and Section 26 05 29, Hangers and Supports for Electrical Systems.
- B. Provide wire in accordance with Section 26 05 19, Low Voltage Electrical Power Conductors and Cables.
- C. Provide conduit, boxes and accessories in accordance with Section 26 05 33.33, Pull, Junction and Terminal Boxes.
- D. Provide identification in accordance with Section 26 05 53, Identification for Electrical Systems.

2.6 LABELING

- A. Labeling of all equipment shall be in conformance with requirements specified herein.

2.7 MISCELLANEOUS

- A. Provide additional controls and appurtenances as required to meet the intent of the Sequence of Operations.
- B. Provide all mounting accessories, as required.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Building openings and penetrations shall be capped to protect the building from outside conditions.

3.3 INSTALLATION

- A. General:
 - 1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from ENGINEER in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 2. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.
 - 3. Install in accordance with Laws and Regulations.
 - 4. Do not modify structures to facilitate installation of equipment, unless approved in writing by ENGINEER.
 - 5. Installation to conform to requirements of all local and state codes.
 - 6. All the Work described in this Section shall be installed, wired, circuit tested and calibrated by manufacturers trained and certified electricians, technicians and mechanics qualified for the Work.
 - 7. CONTRACTOR shall be responsible for the proper operation and installation of all control systems herein specified. CONTRACTOR shall be responsible for coordination of all interfaces with other equipment and contractors to achieve the required control operation.
- B. Sensors:
 - 1. Wall sensors shall be installed five feet above finished floor unless otherwise noted.

2. Where sensors are located on exterior walls provide an insulated mounting subbase.
3. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized. Provide sunshield enclosures.
4. Space humidity or temperature sensors will be mounted away from machinery generating heat, direct light and diffuser air streams.
5. Provide all mounting accessories including but not limited to junction boxes, wall boxes, wall plates and mounting hardware as required for a complete installation.

C. Hardware Installation Practices for Wiring

1. All controllers are to be mounted vertically and per the manufacturer's installation documentation.
2. The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
3. A true earth ground shall be available in the building. Do not use a corroded or galvanized pipe, or structural steel.
4. All wiring shall be enclosed in conduit.
5. Conduit in finished areas will be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction.
6. Exposed conduit will run parallel to or at right angles to the building structure.
7. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.
8. Provide fire caulking at all rated penetrations.

D. Installation Practices for Field Devices

1. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
2. Relay outputs will include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.

E. Identification

1. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
2. All field enclosures shall be identified as specified under Panels and Enclosures.
3. Junction box covers will be marked to indicate that they are a part of the HMCS system.

3.4 SEQUENCES OF OPERATION

- A. Exhaust Fans (EF-6 and EF-7) and Motorized Supply Air Dampers (HP1-MD-1, HP1-MD-2, AND HP1-MD-3), Exhaust Air Dampers (EF7-MD-1 and EF7-MD-2), HOA Switches, and existing Heat Pump HP-1 and Space Thermostat:
 - a. The existing controls for the heat pump HP-1 shall be re-programmed as needed to run its supply fan all the time (24x7x365). The heating and cooling modes shall be energized as needed based on the space thermostat set points. The duct smoke detection, smoke detection alarming, and equipment shutdown shall continue to function as installed currently.
 - b. The motorized dampers in the supply air ducts to the chemical storage areas shall be interlocked with HP-1. When HP-1 is energized, the dampers shall open to their preset balanced airflow position. When HP-1 is de-energized, the dampers shall be closed. The dampers shall fail open.
 - c. The exhaust fans EF-6 and EF-7 shall be indexed by individual HOA switches. In the AUTO position the fan shall be interlocked with heat pump HP-1. When HP-1 is energized, the exhaust fan shall be energized. When HP-1 is de-energized, the exhaust fan shall be de-energized. Normally the HOA switches shall be in the AUTO position.
 - d. When exhaust fan EF-7 is energized, the motorized exhaust air dampers EF7-MD-1 and EF7-MD-2 shall open to their preset balanced airflow position. When EF-7 is de-energized, these dampers shall be closed. The dampers shall fail open.
- B. Exhaust Fans (EF-5 and EF-8) and Motorized Outdoor Air Intake Dampers (EF5-MD-1, EF8-MD-1), HOA Switches, and Space Thermostats.
 - a. The motorized outdoor air intake dampers EF5-MD-1 and EF8-MD-1 shall be interlocked with exhaust fan EF-5 and EF-8 respectively.
 - b. The exhaust fans EF-5 and EF-8 shall be indexed by individual HOA switches. In the AUTO position the fan shall be interlocked with corresponding space thermostat. When the space temperature rises above space thermostat setpoint, the corresponding exhaust fan shall be energized. Normally the HOA switches shall be in the AUTO position.
 - c. When the exhaust fan is energized, the corresponding motorized outdoor air intake damper shall open. When the exhaust fan is de-energized, the outdoor air intake damper shall be closed. The dampers shall fail close.
- C. Electric Unit Heaters (EUH-1 and EUH-2)
 - a. The electric unit heaters shall be controlled by their factory furnished integral thermostats to maintain a set space temperature in the winter.

3.5 SYSTEM CHECKOUT AND START-UP

- A. CONTRACTOR shall perform the following:
 - 1. Check and approve the installation of all controls components and all cable and wiring connections between the system components prior to placing the system into operation.

2. Conduct a complete system checkout and adjustment, including calibration of all instruments, tuning of control loops, checking operation functions, and testing of final control actions. All problems encountered shall be promptly corrected to prevent any delays in start-up of the system.
- B. CONTRACTOR shall be responsible for initial operation of monitoring and control system and shall make all necessary modifications or replacements to ensure that the operation, monitoring and control of the HVAC systems function in the manner intended by these Specifications.
- C. CONTRACTOR shall submit to the ENGINEER certified calibration reports for field instruments and devices and panel mounted devices upon completion of calibration.
- D. CONTRACTOR shall submit to the ENGINEER an installation inspection report certifying that all system components have been installed correctly and are operating in the manner intended. The report shall be signed by authorized representatives of CONTRACTOR.

3.6 ADJUSTING

- A. Adjust for proper settings and to achieve proper control.

3.7 CLEANING

- A. Thoroughly clean all equipment and accessories prior to installation and at substantial completion.
- B. Remove all dirt, rust, dust, etc. from equipment and accessories.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

3.8 PROTECTION OF EXECUTED WORK

- A. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.
- B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.

++ END OF SECTION ++

SECTION 23 23 00

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install refrigerant piping complete and operational with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the refrigerant piping Work.
 - 2. Notify other contractors in advance of the installation of the refrigerant piping to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the refrigerant piping Work.
- C. Related Sections:
 - 1. Section 10 14 00, Signage.
 - 2. Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.

1.2 REFERENCES

- A. American National Standards Institute (ANSI).
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
 - 1. ASHRAE Standard 15 – Safety Standard for Refrigeration Systems.
- C. American Society of Mechanical Engineers (ASME).
 - 1. ASME/ANSI B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASME/ANSI B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 3. ASME B40.100 – Pressure Gauges and Gauge Attachments.
- D. American Society for Testing and Materials (ASTM).
 - 1. ASTM B32 – Standard Specification for Solder Metal.
 - 2. ASTM B280 – Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - 3. ASTM B813 – Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.

4. ASTM B828 – Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
- E. American Welding Society (AWS).
 1. AWS A5.8/A5.8M – Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS A5.31 – Specification for Fluxes and Braze Welding.
 3. AWS B2.2 – Specification for Brazing Procedure and Performance Qualification.
 4. AWS B2.3 – Specification for Soldering Procedure and Performance Qualification.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 1. Manufacturer:
 - a. Minimum of five years of experience producing substantially similar material and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
 2. Installer:
 - a. Engage an experienced installer to perform the work of this Section who has specialized in installing refrigerant piping similar to that required for this Project and who is acceptable to manufacturer.
 - b. Submit name and qualifications to Engineer along with the following information on a minimum of three successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for projects.
 - 2) Approximate contract cost of the refrigerant piping.
 - 3) Amount of area installed.
 3. Brazing and Soldering:
 - a. Qualify processes and operators in accordance with AWS B2.2 and B2.3 as appropriate for material to be brazed or soldered.
 - b. Provide certification that operators employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.
- B. Regulatory Requirements:
 1. National Electrical Code (NEC).
 2. National Fire Protection Association (NFPA).
 3. Underwriters Laboratories Inc. (UL).
 4. Local and State Building Codes and Ordinances.
 5. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:

FCWS Crosstown WTP
Chemical Upgrades

1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, and installation details, including supports, expansion joints, guides and anchors.
 - b. 1/4-inch scale piping layouts, dimensioned to show length of runs, sizes, support spacing and expansion provisions.
 - c. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.
 - c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - f. Other technical data related to specified material and equipment as requested by Engineer.
 3. Testing Plans, Procedures, and Testing Limitations:
 - a. Plan for performing required field testing.
- B. Informational Submittals: Submit the following:
1. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 - c. Instructions for handling, start-up, and troubleshooting.
 2. Field Quality Control Submittals:
 - a. Written report presenting results of required field testing.
 3. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service personnel, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
 4. Qualifications Statements:
 - a. Manufacturer, when requested by Engineer.
 - b. Installer, when requested by Engineer.
 - c. Brazing and Soldering, when requested by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 SITE CONDITIONS

A. Existing Conditions:

1. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
2. The Drawings are intended as an indication of the arrangement of equipment and piping and are as nearly correct as can be determined in advance of the actual construction of the Work. Equipment, piping and appurtenances found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description:

1. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, Contractor, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval.
2. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each case and adequately provide for expansion and circulation and minimize the amount of space required for the same.
3. The Drawings do not show all offsets, fittings, accessories and details, which may be required. Contractor shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the

respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others," to complete the systems to the true extent of the Contract Documents.

2.2 DETAILS OF MATERIALS

A. Tubing:

1. Tubing shall be seamless copper tube of Type ACR, hard or annealed, complying with ASTM B280.
2. Tubing shall be clean, dehydrated, and supplied with a nitrogen charge and pressure tight plugs for each length.

B. Fittings:

1. Fittings shall be in long pattern and shall be wrought copper or copper alloy conforming to the requirements of ASME/ANSI 16.22 or cast copper alloy conforming to the requirements of ASME/ANSI 16.18.
2. Unions shall be wrought or cast copper with a 300 psig working pressure, female pattern, brass to brass seat, and ground joint.
3. Flanges shall be wrought or cast copper with a 300 psig working pressure, tongue-and-groove raised ground face, and bolt holes spot faced.
4. Gaskets shall be of a material suitable for the refrigerant, temperature and pressure for which they will be used.

C. Joints:

1. Joints shall be soldered using alloys containing less than 0.2 percent lead (Pb) as listed in ASTM B32. Soldering flux shall conform to the requirements of ASTM B813. Joint preparation and operations shall be in accordance with the requirements of ASTM B828.

2.3 ACCESSORIES

A. Solenoid Valves:

1. Manufacturer: Provide product of one of the following:
 - a. Sporlan Division.
 - b. Or equal.
2. Hermetic, direct acting, normally closed, with manual lift stem and dual voltage 4-wire coil as required.
3. Pressure drop shall not exceed two psig when full open.
4. Solder or brazed connections.
5. Minimum 500 psig working pressure.

B. Thermostatic Expansion Valves:

1. Manufacturer: Provide product of one of the following:
 - a. Sporlan Division.
 - b. Or equal.
2. Thermostatic modulating type with external equalizer, complete with sensing bulb and distributor.

3. Sized, as required, by specific evaporator requirements.
4. Solder or brazed connections.
5. Minimum 500 psig working pressure.

C. Isolation Valves:

1. Product and Manufacturer: Provide one of the following:
 - a. EBVT Series, as manufactured by Sporlan Division.
 - b. Type 937, as manufactured by Henry Technologies.
 - c. Or equal.
2. Forged brass body with brass or plated steel stem, polished brass full port ball, extended copper fittings, and equalizer port (access fitting).
3. Teflon ball seals.
4. Solder or brazed connections.
5. Minimum 500 psig working pressure.

D. Check Valves:

1. Manufacturer: Provide product of one of the following:
 - a. Henry Technologies.
 - b. Or equal.
2. Spring type.
3. Cast bronze or forged brass body.
4. Teflon seat.
5. Solder or brazed connections.
6. Minimum 425 psig working pressure.

E. Liquid-Moisture Indicators:

1. Product and Manufacturer: Provide one of the following:
 - a. See-All Series, as manufactured by Sporlan Division.
 - b. Or equal.
2. Single port, leak-proof, copper plated steel body with extended copper fittings.
3. Self-cleaning molded sight glass with plastic safety cap.
4. Reversible color moisture indicator.
5. Solder or brazed connections.
6. Minimum 500 psig working pressure.

F. Filter-Driers:

1. Product and Manufacturer: Provide one of the following:
 - a. Catch-All Series, as manufactured by Sporlan Division.
 - b. Or equal.
2. Combination filter-drier type.
3. Heavy-steel body with neoprene gasketed removable flange.
4. Spring loaded core with replaceable non-dusting and non-channeling molded desiccant briquettes and sintered bronze outlet filter.
5. Pressure drop shall not exceed one psig.
6. Angle type solder or brazed connections.
7. Minimum 500 psig working pressure.

G. Strainers:

1. Manufacturer: Provide product of one of the following:
 - a. Sporlan Division.
 - b. Henry Technologies.
 - c. Or equal.
2. Wye pattern with forged brass body, stainless steel or monel wire mesh screen, and cleanout plug.
3. Mesh size shall as recommended by manufacturer for application.

H. Vibration Eliminators:

1. Seamless tin bronze or stainless steel core with high tensile bronze braid covering.
2. Pressure tested and dehydrated.
3. Minimum 7 inches in length.
4. Solder or brazed connections.
5. Minimum 500 psig working pressure.

I. Pressure Gauges:

1. Product and Manufacturer: Provide one of the following:
 - a. Model 750SS, as manufactured by H.O. Trerice Company.
 - b. Or equal.
2. Reference: ASME/ANSI B40.100 for Grade 1A gauges.
3. Range: Pressure range shall be selected such that operating pressure is at the midpoint of range.
4. Type: Direct mounted, dial type, dry pressure gauge.
5. Details of Construction:
 - a. Case: 2-1/2-inch Type 304 stainless steel with satin finish.
 - b. Ring: Bayonet type, Type 304 stainless steel.
 - c. Window: Laminated safety glass.
 - d. Dial: White with black markings and graduations.
 - e. Pointer: Micrometer type with black finish.
 - f. Movement: Stainless steel rotary type.
 - g. Bourdon Tube/Socket: Type 316 stainless steel tube and socket, 1/4-inch NPT.
 - h. Accuracy: ASME/ANSI B 40.100, Grade 1A; 1 percent of scale range.
6. Isolation Valve:
 - a. Type: Needle valve.
 - b. Details of Construction:
 - 1) Body: Brass.
 - 2) Seat: Brass.
 - 3) Stem: Brass.
 - 4) Tee Handle: Brass.
 - 5) Packing: Teflon.
 - c. Maximum Operating Pressure: 2,000 psi.
 - d. Maximum Operating Temperature: 300 degrees F.
 - e. Gauge cock isolation valve is not acceptable.

J. Mechanical Link Seals:

1. Manufacturer: Provide product of one of the following:
 - a. Pipeline Seal and Insulator, Inc.
 - b. Thunderline Corporation.
 - c. Calpico, Inc.
 - d. Or equal.
2. Provide mechanical link seals through walls or floors with adjusting bolts suitable for 20 psig of pressure where shown or specified.
3. Details of Construction:
 - a. Non-Fire Rated Seals:
 - 1) Pressure Plates: Glass reinforced nylon composite.
 - 2) Bolts and Nuts: Type 316 stainless steel.
 - 3) Sealing Element: EPDM.
 - b. Fire Rated Seals:
 - 1) Pressure Plates: Zinc dichromate steel.
 - 2) Bolts and Nuts: Two part zinc dichromate steel with corrosion inhibiting coating.
 - 3) Sealing Element: Silicone.
 - 4) 1-1/2-hour fire rating.

K. Sleeves and Wall Pipes:

1. General:
 - a. Wall pipes and wall sleeves shall be provided in accordance with the following schedule when passing through new or existing concrete or masonry structures, except where noted otherwise:

<u>From</u>	<u>To</u>	<u>Fitting</u>
Dry area	Wet area	Wall Pipe
Dry area	Earth Exterior	Wall Pipe
Dry area	Dry area	Plain Sleeve
Earth	Earth	Plain Sleeve
Exterior	Exterior	Plain Sleeve
 - b. Material of construction shall be Type 316 [304] stainless steel where located in corrosive areas and G90 hot dipped galvanized steel in non-corrosive areas. Refer to the Corrosive and Non-Corrosive Area Designation Table on the Drawings for a list of these areas.
2. Sleeves:
 - a. Wall sleeves shall be Schedule 40.
 - b. Shall be of sufficient size to pass the pipe and the insulation covering the pipe.
 - c. Shall extend 2-inches above the finished floor.
 - d. Shall be provided with split type escutcheon plates at the floor and wall openings.
 - e. Shall terminate flush with walls and ceilings.
 - f. Shall not be required in existing concrete walls where walls are core drilled and the resulting hole has a smooth inside surface.
 - g. Shall be caulked with a fire retardant caulking compound at firewalls and a gas tight caulking compound at gas tight walls.

3. Wall Pipes:
 - a. Wall pipes shall be equipped with a waterstop.
 - b. Shall be of sufficient length to pass through the wall and provide adequate clearance for fastening.
 - c. The end of the wall pipes shall be of a type consistent with the piping to be connected to them and shall conform to their standards and specifications.
 - d. All wall pipes shall have the same interior protection as specified for the connecting piping. Exterior protection shall be as specified for the yard piping.

L. Structural Supports:

1. Contractor shall provide and install all hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances as required to mount all refrigerant piping.
2. All hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances shall conform to Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.

2.4 IDENTIFICATION

- A. All piping and equipment identification shall be provided in accordance with Section 10 14 00, Signage.
- B. Isolation valves shall be identified where their intended purpose is not obvious. Numbers shall not be used to label the valves, unless a key to the numbers is located near the valves.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Protection of Surrounding Areas/Surfaces:
 1. Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.3 INSTALLATION

- A. General:
 - 1. Install the piping and equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 2. Install in accordance with Laws and Regulations.
 - 3. Do not modify structures to facilitate installation of piping, unless specifically approved by Engineer.
 - 4. Installation shall conform to requirements of all local and state codes.
- B. All refrigerant piping installations shall conform to ANSI/ASHRAE Standard 15.
- C. Reduction in pipe sizes shall be made using concentric reducer couplings.
- D. All pipes, whether insulated or not, shall be identified with pipe labels and the direction of flow indicated.
- E. Install oil traps and oil return line tubing in refrigerant piping, as required.
- F. All valves shall be manually opened and closed before installation to check their operation, and the interior of the valves shall be cleaned. Joints shall be made as specified.
- G. Install the valves so that they can be conveniently operated.
- H. Valves shall be supported as integral components of the piping systems.
- I. Isolation valves shall be installed on each side of strainers and filter-driers, in liquid and suction lines at evaporator coils, and where shown on the Drawings.
- J. For systems containing more than 6.6 pounds of a refrigerant in systems using positive-displacement compressors, isolation valves shall be installed:
 - 1. At the inlet of each compressor, compressor unit or condensing unit.
 - 2. At the discharge outlet of each compressor, compressor unit or condensing unit and each liquid receiver.
- K. Liquid-moisture indicators shall be installed upstream of any expansion valves, in the liquid line to the receiver, and where shown on the Drawings.
- L. Liquid line filter-driers shall be installed immediately upstream of any other liquid line controls, such as thermostatic expansion valve, solenoid valve, and liquid-moisture indicator.
- M. Suction line filter-driers shall be installed immediately upstream of the compressor.
- N. Each filter-drier shall have a 3-valve full by-pass connection.

- O. Strainers shall be installed immediately upstream of each expansion and solenoid valve, evaporator pressure regulator, back pressure valve, compressor suction valve, and where shown on the Drawings.
- P. Vibration eliminators shall be used for all inlet and discharge final connections to compressors and other vibration producing equipment.
- Q. Pressure gauges shall be installed on both the suction and discharge of the compressor, and where shown on the Drawings.
- R. Pressure gauge ranges shall be selected for proper sensitivity, so that the dial indicator points to the approximate center of the dial in normal operation.
- S. Before setting wall sleeves, pipes, castings and pipes to be cast-in-place, Contractor shall coordinate with the Drawings and Figures, which may have a direct bearing on the pipe locations. Contractor shall be responsible for coordinating the proper location of the pipes and appurtenances during the construction with all trades.
- T. Field coordinate for exact pipe penetrations and routing of all piping.
- U. Provide mechanical link seals with sleeves or wall pipes at all piping penetrations through wall, roof and floor slabs.
- V. Escutcheon plates shall be provided for all exposed piping penetrations.
- W. Contractor shall coordinate accessories included in packaged and split air conditioning equipment. Any accessories not included shall be provided by Contractor.
- X. Contractor shall furnish and install a complete charge of refrigerant.

3.4 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Remove and plug the connection points of any controls or relief valves that could be damaged by test pressure.
 - 2. Remove all expansion valves and install temporary bypasses.
 - 3. Front seat both the compressor suction and discharge valves.
 - 4. Open the liquid line shutoff valve at the condenser, and any auxiliary valves in the hot gas and liquid lines.
 - 5. Apply control power to open all solenoid valves.
 - 6. Connect a cylinder of oil free dry nitrogen to the front seat port of the compressor discharge valve.
 - 7. Introduce dry nitrogen into the system to a design test pressure listed on the condensing unit, compressor or compressor unit nameplate, as required by ANSI/ASHRAE Standard 15.
 - 8. Test all piping for leaks by observing system pressure drop and applying a bubble test to all joints and connections.

9. After testing is completed, bleed the test pressure and repair any leaks found.
10. After the system is assumed to be free of leaks, charge enough refrigerant through the liquid line charging valve to raise the pressure to 15 psig. Remove the refrigerant connection and charge enough dry nitrogen into the system to raise the system pressure to the listed design test pressure.
11. Test all joints with an electronic leak detection meter. Record all test results.
12. After the results of the pressure tests have been approved, release test pressure and mechanically evacuate the system to a minimum of 22-inches Hg vacuum and maintain for 24 hours with no leaks. Disconnect the vacuum pump prior to vacuum leak test.
13. Record and report the test results.
14. After test results have been approved by Engineer, remove plugs and temporary bypass, and fully charge the system with the specified refrigerant.
15. All leaking joints shall be disassembled and remade using new materials. Retesting shall be conducted on all portions failing the tests.

B. Inspection:

1. Examine areas to receive piping and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances.
 - c. Start the Work only when conditions are satisfactory.
2. The Engineer reserves the right to reject or authorize replacement of piping and accessories found to be defective or deviated from allowable tolerances.

3.5 ADJUSTING

- A. Adjust all controls for proper settings.
- B. While system is operable, balance all equipment to achieve design conditions.

3.6 CLEANING

- A. Remove all dirt, rust, dust, etc. from refrigerant piping after installation.
- B. Remove and dispose of all debris and waste from the Site resulting from installation.

3.7 SCHEDULES

- A. All refrigerant piping shall be sized in accordance with manufacturer's recommendation.

+ + END OF SECTION + +

SECTION 23 31 13

METAL DUCTWORK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install metal ductwork complete and operational with accessories.
 - 2. The Work shall comply with vibration, seismic, and wind control requirements in Section 40 05 96, Vibration, Seismic, and Wind Controls.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the metal ductwork Work.
- C. Related Sections:
 - 1. Section 10 14 00, Signage.
 - 2. Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.
 - 3. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
 - 4. Section 23 09 00, Instrumentation and Control for HVAC.

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc. (AMCA).
 - 1. AMCA Standard 500-D – Laboratory Methods of Testing Dampers for Rating.
 - 2. AMCA Publication 511 – Certified Ratings Program - Product Rating Manual for Air Control Devices.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
 - 1. ASHRAE Standard 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- C. American Society for Testing and Materials (ASTM).
 - 1. ASTM E84 – Standard Test Method for Burning Characteristics of Building Materials.
 - 2. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 3. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

- D. American Welding Society (AWS).
 - 1. AWS B2.1 – Specification for Welding Procedure and Performance Qualification.
- E. National Bureau of Standard's Voluntary Product Standard.
 - 1. NBS PS 15-69 – Standard for Contact-Molded Reinforced Polyester Chemical Resistant Process Equipment.
- F. National Fire Protection Association (NFPA).
 - 1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - 2. NFPA 90B – Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - 3. NFPA 701 – Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
- G. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
 - 1. Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems.
 - 2. HVAC Duct Construction Standards – Metal and Flexible.
 - 3. Round Industrial Duct Construction Standards.
 - 4. Rectangular Industrial Duct Construction Standards.
- H. Underwriters Laboratories Inc. (UL).
 - 1. UL 181 – Factory-Made Air Ducts and Air Connectors.
 - 2. UL 181A – Closure Systems for Use with Rigid Air Ducts.
 - 3. UL 181B – Closure Systems for Use with Flexible Air Ducts and Air Connectors.
 - 4. UL 555 – Fire Dampers.
 - 5. UL 555S – Smoke Dampers.
 - 6. UL 900 – Air Filter Units.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer:
 - a. Minimum of five years of experience producing substantially similar equipment and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
 - 2. Installer:
 - a. Engage an experienced installer to perform the work of this Section who has specialized in installing metal ductwork similar to that required for this Project and who is acceptable to manufacturer.
 - 3. Welding:
 - a. Qualify processes and operators in accordance with AWS B2.1 as appropriate for material to be welded.

- b. Provide certification that operators employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.
- B. Regulatory Requirements:
 - 1. National Electrical Code (NEC).
 - 2. National Fire Protection Association (NFPA).
 - 3. Underwriters Laboratories Inc. (UL).
 - 4. Local and State Building Codes and Ordinances.
 - 5. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, and installation details.
 - b. 1/4-inch scale duct layouts, dimensioned to show length of runs, sizes, support spacing and expansion provisions.
 - c. Detailed installation drawing of each individual component showing:
 - 1) Mounting requirements.
 - 2) Locations.
 - d. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
 - 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, wall thicknesses, design pressures, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.
 - c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - f. Other technical data related to specified material and equipment as requested by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of that Work.
 - 3. Comply with manufacturer's recommendations for rigging of equipment.
- B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 SITE CONDITIONS

A. Existing Conditions:

1. The Contract Documents show the general arrangement and extent of the Work to be done. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work is governed by the general building plans and the actual building conditions.
2. The Drawings are intended as an indication of the arrangement of equipment and ductwork and are as nearly correct as can be determined in advance of the actual construction of the Work. Equipment, ductwork, and appurtenances found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description:

1. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of the systems, Contractor, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval.
2. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each case and adequately provide for expansion and minimize the amount of space required for the same.
3. The Drawings do not show all offsets, fittings, accessories and details, which may be required. Contractor shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required

items to meet such conditions which are not specified as work “by others,” to complete the systems to the true extent of the Contract Documents.

B. Design Criteria:

1. All sheet metal construction shall be in accordance with the construction details and installation details in the latest edition of the SMACNA HVAC Duct Construction Standards. This Standard is hereinafter referred to as HVAC DS.
2. Sheet metal construction shall conform to the following minimum pressure classification (positive and negative pressure), unless otherwise shown or specified:
 - a. Ductwork serving administrative (office) spaces: 2-inch W.G.
 - b. Ductwork serving process spaces: 2-inch W.G.

2.2 DETAILS OF MATERIALS

A. Material Type:

1. Galvanized steel ductwork shall be G90 hot dipped in accordance with ASTM A653/A653M.
 - a. All accessories for galvanized ductwork shall be G90 hot dipped galvanized steel, unless noted otherwise.

B. Duct construction alternatives (duct gauge in relation to reinforcement spacing) selected by Contractor from HVAC DS Tables shall be identified by duct system and shall be submitted in schedule form to the Engineer prior to beginning installation of ductwork. Contractor shall construct ductwork to meet the requirements of the HVAC DS Tables in conjunction with the minimum duct thickness schedules in Part 3 below.

C. Rectangular ductwork longitudinal seams shall be Pittsburgh Lock type with permanently elastomeric sealant applied continuously within the seam.

D. Round ductwork seams shall be spiral lock seam except for laboratory exhaust systems which shall be solid wall welded longitudinal seams.

E. Duct reinforcement shall be made using external stiffener angles. Tie rods shall not be acceptable. Stiffener angles shall be constructed of the same material as the ductwork.

F. Transverse Joints:

1. Manufacturer: Provide product of one of the following:
 - a. Ductmate Industries, Inc.
 - b. Elgen Manufacturing Company, Inc.
 - c. Or equal.
2. Ductwork shall be connected by a mechanical joining system, except where otherwise noted.
3. Manufacturer’s installation instructions will be followed, except where otherwise noted.

4. SMACNA T-24 and other flange type connectors formed from the duct edge will NOT be allowed.
5. All connectors shall meet or exceed the functional criteria outlined in the HVAC DS and shall be constructed of the same material as the ductwork.

G. Turning Vanes:

1. Manufacturer: Provide product of one of the following:
 - a. Ductmate Industries, Inc.
 - b. Elgen Manufacturing Company, Inc.
 - c. C.L. Ward & Family, Inc.
 - d. Or equal.
2. Material: Same material as ductwork.
3. Ducts 24-inches or shorter:
 - a. Vanes: Single thickness.
 - b. Runners: Type 2.
4. Ducts taller than 24-inches:
 - a. Vanes: Double thickness.
 - b. Runners: Type 1.

H. Splitter Dampers:

1. Reference: HVAC DS.
2. Material: Same material as ductwork.

I. Transitions and Offsets:

1. Reference: HVAC DS.
2. Material: Same material as ductwork.

J. Branch Take-Offs:

1. Reference: HVAC DS.
2. Material: Same material as ductwork.
3. 45 degrees, NO straight taps, unless specifically shown.

K. Rectangular Square Throat Elbows:

1. Reference: HVAC DS.
2. Material: Same material as ductwork.
3. Provided with turning vanes.

L. Rectangular Radius Elbows and Round Elbows:

1. Reference: HVAC DS.
2. Material: Same material as ductwork.
3. Centerline Radius: $R=1.5W$, unless specifically shown otherwise.

M. Round Converging Flow Fittings:

1. Converging flow fittings shall be constructed with a radius entrance to all branch taps and with no excess material projecting from the body into the branch tap entrance.
2. Branch entrances shall be by means of factory-fabricated fittings or factory fabricated duct tap assemblies.

N. Seal Class:

1. Class A – Ductwork constructed with a minimum pressure classification (positive and negative pressure) of 4-inch W.G. and up.
2. Class B – Ductwork constructed with a minimum pressure classification (positive and negative pressure) less than 4-inch W.G.

O. Flexible duct or duct constructed of fiberglass duct board shall not be permitted.

2.3 ACCESSORIES

A. Hangers and Supports:

1. Hangers and supports shall be provided in accordance with Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.

B. Motorized Control Dampers and Volume Dampers (for Rectangular Ductwork):

1. Commercial Type Dampers for Galvanized Steel Ductwork:
 - a. Design and Performance Criteria (based on 48-inch damper width):
 - 1) Dampers shall be performance rated and certified in accordance with AMCA Standard 500-D and AMCA Publication 511.
 - 2) Maximum Design Total Static Pressure: 5.2-inch W.G.
 - 3) Damper Leakage: Class 1 Leakage Rated – Not more than 8 cfm per square foot at 4-inch W.G. with blade seals.
 - 4) Certification: Manufacturer shall submit certified test data.
 - b. Product and Manufacturer: Provide one of the following:
 - 1) Model CD60, as manufactured by Ruskin.
 - 2) Or equal.
 - c. Details of Construction:
 - 1) Material: Galvanized steel.
 - 2) Frame: 16 gauge hat channel reinforced with corner braces for structural strength equal to 11 gauge channel frame with mounting flanges.
 - 3) Single Section Sizes:
 - a) Minimum: 8-inch wide by 10-inch high.
 - b) Maximum: 60-inch wide by 72-inch high.
 - 4) Blades:
 - a) 6-inch wide.
 - b) Opposed blades.
 - c) Airfoil shape with 14 gauge equivalent galvanized steel double skin construction.
 - d) EPDM edge seals for motorized control dampers only.
 - 5) Linkage: Concealed in frame outside the air stream.
 - 6) Axles: 1/2-inch plated steel hex.
 - 7) Bearings: Stainless steel sleeve.
 - 8) Jamb Seals: Flexible metal compressible type.
 - 9) Provide galvanized steel outside handle, quadrant with 2-inch standoff and approved position indicator with locking device for all volume dampers.

C. Heavy Duty Flexible Connectors (FC):

1. Design and Performance Criteria:
 - a. Flexible connectors shall be tested in accordance with UL 181.
 - b. Flexible connectors shall be listed and labeled as Class 0 or Class 1 flexible connectors.
 - c. Flexible connectors shall meet NFPA 90A, NFPA 90B, NFPA 701, and local building codes.
 - d. Maximum Design Total Static Pressure: ± 3 psig (± 83.0 -inch W.G.).
 - e. Temperature Range: -65 degrees F to 300 degrees F.
 - f. Maximum Movement Capabilities:
 - 1) Axial Compression: 4 inches.
 - 2) Axial Extension: 1 inch.
 - 3) Lateral Offset: 3 inches.
 - g. Width: Minimum 12 inches, measured from flange to flange.
2. Product and Manufacturer: Provide one of the following:
 - a. Model 945-W, as manufactured by Holz Rubber Company, Inc.
 - b. Model Duct Connectors, as manufactured by Mercer Rubber Company.
 - c. Or equal.
3. Details of Construction:
 - a. Material: Minimum 1/4-inch thick EPDM or Butyl, reinforced with a strong synthetic asbestos-free fabric suitable for corrosive service.
 - b. Flexible connectors shall be fabricated with compound curve molded corners and straight sections with premolded arch. Arch shall continue throughout the corner and straight sections and shall be fully developed when in the neutral installed position. Precompression or tucking of the corner to form the arch shall not be permitted.
 - c. Corners on rectangular flexible connectors shall be completely molded and free of splices.
 - d. Flanged ends shall conform to NBS PS 15-69.
 - e. Provide Type 316 stainless steel retaining back-up bars and hardware.

D. Miscellaneous Duct Fittings:

1. Reference: HVAC DS.
2. Material: Same material as ductwork.

E. Sleeves:

1. Material: Same material as ductwork passing through opening.
2. Thickness: Minimum 24-gauge.
3. Calk airtight with fire resistant sealant between sleeve and ductwork.

F. Duct Gaskets:

1. Product and Manufacturer: Provide one of the following:
 - a. Model 440 Gasket Tape, as manufactured by Ductmate Industries, Inc.
 - b. Model 440 Butyl Gasket, as manufactured by Elgen Manufacturing Company, Inc.
 - c. Or equal.
2. Material: Non-hardening butyl.
3. Service Temperatures: -30 degrees F to 180 degrees F.

4. Service Life: 20 years minimum.
5. Gaskets shall have the following Fire Hazard Classifications in accordance with ASTM E84:
 - a. Flame Spread: 10 maximum.
 - b. Smoke Developed: 10 maximum.

G. Hardware and Fasteners:

1. All hardware and fasteners for aluminum and stainless steel ductwork shall be Type 316 stainless steel, unless noted otherwise.
2. All hardware and fasteners for galvanized ductwork shall be G90 hot dipped galvanized steel, unless noted otherwise.

H. Grilles and Diffusers:

1. General:
 - a. Grilles and diffusers mounted in hung ceilings shall have a baked enamel white finish.
 - b. Aluminum grilles and diffusers not mounted in hung ceilings shall have a clear anodized finish.
 - c. Stainless steel grilles and diffusers shall have a satin polish mill finish except where white polyvinylidene fluoride (PVDF) coating is specified on the Equipment Schedule.
 - d. Air terminal devices mounted in hung ceilings shall have a baked enamel white finish.
 - e. Air terminal devices not mounted in hung ceilings shall have a mill finish.
 - f. Where registers are shown to be provided in lieu of grilles, include an integral opposed blade damper of the same construction as the grille.
2. Supply Grilles (SG):
 - a. Product and Manufacturer: Provide one of the following:
 - 1) Aluminum construction:
 - a) Model X20, as manufactured by Anemostat.
 - b) Model A54, as manufactured by Tuttle & Bailey.
 - c) Model 300FL, as manufactured by Titus.
 - d) Or equal.
 - 2) Stainless steel construction:
 - a) Model SS2, as manufactured by Anemostat.
 - b) Model T54SS, as manufactured by Tuttle & Bailey.
 - c) Model 300RL-SS, as manufactured by Titus.
 - d) Or equal.
 - b. Double deflection with horizontal face bars for horizontal duct and vertical face bars for vertical duct.
 - c. 3/4-inch blade spacing.
 - d. For surface mounting as shown or indicated on Drawings.

2.4 IDENTIFICATION

- A. All equipment and component identification shall be provided in accordance with Section 10 14 00, Signage.

2.5 SOURCE QUALITY CONTROL

- A. Shop Tests:
 - 1. Equipment shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
 - a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label or equal.
 - b. Factory test equipment to ensure that the entire package has been properly fabricated and assembled, that all the controls function as specified herein and that the package meets the specified performance requirements including manufacturer's data report.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Protection of Surrounding Areas/Surfaces:
 - 1. Openings and penetrations shall be capped to protect the building from outside conditions.
 - 2. Properly cap the open ends of all ductwork at the end of each day's work or other stopping point throughout the construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.3 INSTALLATION

- A. General:
 - 1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 2. Install in accordance with Laws and Regulations.
 - 3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
 - 4. Installation to conform to requirements of all local and state codes.

- B. All ductwork shall conform accurately to the dimensions shown, the ducts shall be straight and smooth inside with joints neatly finished. Ductwork shall be installed so as to preclude the possibility of vibration under all operating conditions.
- C. Tape and seal all joints in accordance with HVAC DS. Tape shall not be used as the primary means of sealing. Tape used in sealing metallic ductwork shall be listed and labeled in accordance with UL 181A and shall be marked “181 A-P” for pressure-sensitive tape, “181 A-M” for mastic or “181 A-H” for heat-sensitive tape. Tape used in sealing flexible ductwork and connectors shall be listed and labeled in accordance with UL 181B and shall be marked “181 B-FX” for pressure-sensitive tape or “181 B-M” for mastic.
- D. Install all ductwork and accessories to provide a system free from buckling, warping, bellowing, or vibration.
- E. All ducts at flexible connections with fans shall be supported at free end within 12-inches of flexible connection.
- F. Provisions shall be made for supporting all ductwork, dampers, and other ductwork accessories, where necessary.
- G. Coordinate all air outlets for compatibility with ceiling system.

3.4 ADJUSTING

- A. All duct systems shall be tested, adjusted, and balanced per Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
- B. Test openings shall be installed in the ductwork as directed by the testing, adjusting, and balancing Contractor. Test openings shall be sealed by a screw cap and gasket.

3.5 CLEANING

- A. Thoroughly clean all ductwork and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from ductwork and accessories after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

3.6 SCHEDULES

- A. Minimum Duct Thicknesses:
 - 1. Ductwork serving administrative (office) spaces: As recommended in the HVAC DS for the pressure classification, reinforcement and support spacing.
 - 2. Ductwork serving process spaces: One gauge thicker than recommended in the HVAC DS for the same pressure classification, reinforcement and support spacing.

- B. All supply air ductwork and plenums serving the following equipment shall be G90 Galvanized Steel:
 - 1. HP-1

++ END OF SECTION ++

SECTION 23 31 16

FRP DUCTWORK

PART 1 - GENERAL1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all professional services labor, materials, tools, equipment and incidentals as shown, specified and required to design, field measure, furnish and install all fiberglass reinforced plastic (FRP) ductwork and accessories complete with auxiliary equipment as shown, specified and/or required for proper system operation.
2. The ductwork system shall be specifically designed, constructed, and installed for the equipment being served.
3. Contractor shall secure the services of a single System Supplier to design, engineer and furnish ductwork materials, taking into consideration design criteria specified, use of stiffener ribs, supports, hangers, anchors and seismic restraints for all ductwork and accessories furnished under this Section. Ductwork Manufacturer shall perform sufficient stress analysis calculations, including support interface and distance between supports, thermal expansion and contraction of ductwork and determination of final design details for all expansion joints and flexible connectors.
4. All the supply air ductwork located inside the chemical storage and feed areas and all the ductwork handling exhaust air from these areas shall be of FRP construction in this project.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, the FRP ductwork and accessories Work.

C. Related Sections:

1. Section 05 05 33, Anchor Systems.
2. Section 10 14 00, Signage.
3. Section 23 05 29, Hangers and Supports for HVAC Piping and Equipment.
4. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

1.2 REFERENCES

- A. Comply with reference standards, except as otherwise shown or specified within this Section. Where reference is made to one of the standards, the revision in effect at time of bid opening shall apply. General Requirements of this Contract shall supersede Standards in case of conflict.

- B. Where referenced industry standards are in conflict, the more stringent and conservative engineering rules and fabrication methods shall govern design, manufacturing and quality control. Reference to ASME RTP-1 pertains only to those areas within this Section that specifically reference Articles from this standard.
- C. Air Movement and Control Association International, Inc. (AMCA).
 - 1. AMCA Standard 500-D – Laboratory Methods of Testing Dampers for Rating.
 - 2. AMCA Publication 511 – Certified Ratings Program - Product Rating Manual for Air Control Devices.
- D. American Society of Mechanical Engineers (ASME).
 - 1. ASME RTP-1-2011 Reinforced Thermoset Plastic Corrosion-Resistant Equipment.
- E. American Society for Testing and Materials (ASTM).
 - 1. ASTM E84-10b – Standard Test Method for Burning Characteristics of Building Materials.
 - 2. ASTM C33 – Standard Specification for Concrete Aggregates
 - 3. ASTM C582-09 – Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
 - 4. ASTM D638-10 – Standard Test Method for Tensile Properties of Plastics.
 - 5. ASTM D790-10 – Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics Electrical Insulating Materials.
 - 6. ASTM D2563-08 – Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts.
 - 7. ASTM D2583-07 – Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
 - 8. ASTM D2584-08 – Standard Test Method for Ignition Loss of Cured Reinforced Resins.
 - 11. ASTM D3982-08 – Standard Specification for Contact Molded “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Ducts.

1.3 DEFINITIONS

- A. System Supplier: The System Supplier shall be Contractor and Manufacturer jointly, where contract duties for Contractor and Manufacturer are defined within this specification Section.
- B. Acronyms:
 - 1. Bis-A: Bisphenol-A
 - 2. CB: Corrosion Barrier
 - 3. CoNap: Cobalt Napthinate
 - 4. EVER: Epoxy Vinyl Ester Resin
 - 5. FR: Fire Retardant
 - 6. FRP: Fiberglass Reinforced Plastic
 - 7. MEKP: Methyl Ethyl Keytone Peroxide

- 8. OS: Outer Surface
- 9. SL: Structural Layer
- 10. SS: Stainless Steel

1.4 QUALITY ASSURANCE

A. Qualifications:

- 1. Manufacturer:
 - a. Minimum of ten years of experience producing substantially similar equipment and able to show evidence of at least thirty installations in satisfactory operation for at least five years in the continental United States.
 - b. Ductwork shall be manufactured by a single company at a single location in the United States, with undivided responsibility for performance.
 - c. FRP ductwork and accessories shall be fabricated in a heated and well-ventilated structure protected from weather and temperature extremes (minimum 50 F). Entire fabrication, curing and assembly process of any piece of FRP equipment shall be indoors.
 - d. Manufacturer's service person that will be providing Manufacturer's Services in accordance with this Section shall have a minimum of five (5) years full time experience directly with Manufacturer, including twenty (20) field and five (5) training/inspection assignments during their employ. Service person shall also be OSHA 29 CFR 1926 Construction Safety certified through a minimum ten (10) hour course. Direct or independent sales representatives are not permitted to perform Manufacturer's services. Data for each application shall include project reference, scope, design basis and complete current reference information.
- 2. Contractor:
 - a. Contractor shall have at least five years' experience in the installation of the Work specified. He shall employ only tradesmen with specific skills, training and experience in this type of Work.
 - b. Contractor shall have undivided responsibility as a single firm for performance and other requirements for the installation of the Work specified herein.
 - c. Contractor shall qualify laminators performing secondary bonding to field join sections of ductwork through certified training and inspection provided by the ductwork Manufacturer as a Manufacturer's services requirement of this Section.

B. Component Supply and Compatibility:

- 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single ductwork manufacturer.
- 2. Require the ductwork equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.

3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the ductwork equipment manufacturer.
- C. Comply with applicable provisions of Regulatory Requirements and others having jurisdiction:
 1. Local and State Building Codes and Ordinances.
 2. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.
 - D. Ductwork Certifications:
 1. AMCA labels shall be affixed to all dampers requiring a performance rating by this Section.
 - E. Preinstallation Conference:
 1. The Contractor shall call a meeting with Manufacturer and Engineer:
 - a. At start of Manufacturer's engineering and drawing preparation for purpose of coordinating support locations and interface, shop and field joint locations, amount of field trim, piece numbers, manufacturing priorities, handling, laydown and temporary support during installation.
 - b. Prior to the start of installation for purpose of:
 - 1) Coordinating timing of piece number deliveries, material storage, proper expansion joint fit-up, site conditions, resin formulation, field joint training and inspection as related to Manufacturer's Services.
 - 2) Reviewing management of fiberglass dust and styrene emissions propagated through cutting, grinding and laminating operations.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following per Section 01 33 00 Submittal Procedures:
 1. Contractor shall submit Working, Shop and Assembly Drawings and material specifications as prepared by Contractor and relevant Manufacturer for approval of Engineer in accordance with requirements of Division 1 General Requirements of Specifications. Working, Shop and Assembly Drawings with related details shall include, but not be limited to:
 - a. Drawings showing fabrication methods, assembly, accessories, installation details and wiring diagrams, with plans, elevations, sections, components, piece numbers, outside diameters at support interface points and attachments to other work.
 - b. 1/4-inch scale duct layouts dimensioned to show length of runs, sizes, support spacing and expansion provisions.
 - c. Schedules for:
 - 1) Round and rectangular duct sizes, thicknesses, weights per foot, vacuum and pressure ratings and allowable spans,
 - 2) Ductwork laminate construction details for all compositions.

- 3) Ductwork joint details showing width, thickness, tapering and composition of butt wraps.
- 4) Flange dimensions for inside and outside diameter, flange, hub and neck thickness plus bolt hole and circle diameter.
- 5) Flange data for number and size of bolts plus recommended bolt torque minimum and maximum values.
- d. Construction and attachment details for reinforcing ribs, transitions, reducers, elbows, nozzles, flanges, access doors, turning vanes, louvers, dampers, grilles and valves.
- e. FRP buildups at supports and hangers plus shear collars, support rings and pedestals used individually or in conjunction with supports of another material of construction.
- f. Shop and field joint locations, with numbering system for each field joint keyed to individually prepackaged butt and wrap field joint kit.
- g. Field but wrap joint details.
- h. Field trim allowance at field joint locations.
- i. Sloped top flat surfaces of outdoor rectangular ductwork.
- j. Individual hangers, supports, anchors and seismic restraints with configurations, dimensions, thickness and weights shown.
- k. Mounting requirements.
- l. Penetrations through fire-rated and other partitions.
- m. Setting drawings, templates, and directions for the installation of anchor bolts, and other anchorages.
- n. Standard and custom color selection charts for outer surface.
- o. Dampers and leakage performance ratings.
- p. Expansion joints
- q. Flexible connectors.
- r. Deviations from Contract Documents. Any exceptions to the Contract Documents shall be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
- s. Other technical data related to specified material and equipment as requested by Engineer.
2. Samples:
 - a. Submit manufacturer's standard color Samples of finish coating system. Engineer will select finish color. Engineer's review of Samples is for color only; compliance with all other requirements is Contractor's responsibility.
3. Testing Plans, Procedures, and Testing Limitations:
 - a. Plan for performing required shop testing, to include visual and dimensional inspection, Barcol hardness and acetone sensitivity testing plus related forms from quality control procedures.
 - b. Plan for performing required field testing, to include visual and dimensional inspection, Barcol hardness and acetone sensitivity testing plus related forms from quality control procedures.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Contractor shall submit an affidavit certifying that all FRP equipment shall be fabricated, cured and assembled as described in this Section.
 - b. Contractor shall provide certification that all stainless steel accessories including screws, hangers, supports, etc. are Type 316 stainless steel.
2. Test and Evaluation Reports:
 - b. Damper leakage tests from an AMCA approved testing laboratory.
3. Supplier Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 - c. Instructions for:
 - 1) Field joining of ductwork with butt wrap joints, including quality control procedures that assure all material is properly applied, laminate quality meets specifications and complete resin cure is achieved.
 - 2) Handling hazardous materials, including Material Safety Data Sheets (MSDS) for all hazardous materials used to perform field butt wrap joint work.
 - 3) Managing fiberglass dust and styrene emissions propagated through cutting, grinding and laminating operations.
 - 4) Making FRP flange connections.
 - 5) Ductwork handling, cleaning, inspecting, repairing start-up, and troubleshooting.
4. Source Quality Control Submittals:
 - a. Written report presenting results of required shop inspection and testing.
 - b. Tabulation in check list forms to indicate ductwork laminate compliance with ASTM D 2563 Table I, Level II visual acceptance levels.
 - c. Submit a letter stating that the resins proposed in the fabrication of the FRP ductwork will give satisfactory performance under the specified service conditions or a corrosion resistance chart indicating same.
 - d. Certified literature indicating compliance with proposed pressure and vacuum classification.
 - e. Tolerance checks, including ductwork out of roundness or square and lengths plus flange face flatness, warpage, perpendicularity and cant.
 - f. Any other Factory test reports required by this section.
5. Field Quality Control Submittals:
 - a. Written report presenting results of required field inspection and testing. Report shall include but not be limited to:
 - 1) Received quality conformance of ductwork and installation materials.
 - 2) Butt wrap joint materials suitability for use.
 - 3) Ductwork butt edge gaps at joint fit up.
 - 4) Surface preparation for butt wrap joints.
 - 5) Complete application of all butt wrap material layers.
 - 6) Paste protrusion past ductwork inner surface.
 - 7) Butt wrap laminate visual quality.
 - 8) Proper cure of field applied butt wrap joints.

6. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service personnel, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
7. Special Procedure Submittals:
 - a. Contractor shall provide plan for managing fiberglass dust and styrene emissions propagated through field cutting, grinding and laminating operations.
8. Qualifications Statements:
 - a. Manufacturer and Manufacturer's service person, when requested by Engineer.
 - b. Professional Engineer, when requested by Engineer.
 - c. Contractor, when requested by Engineer.
 - d. Testing Agency, when requested by Engineer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 1. Manufacturer shall properly prepare and protect ductwork from damage under normal circumstances.
 - a. Ductwork is to be shipped complete, with no fiberglass related laminating work or fabrication permitted outside of the manufacturing facility.
 - b. Round ductwork larger than 30 inches in diameter or rectangular ductwork with one dimension larger than 30 inches shipped horizontally shall be mounted on padded cradles of sufficient size to prevent damage and adequately support ductwork. All smaller sizes of ductwork shall be blocked. Suitable skid or dunnage shall be provided for ductwork shipped vertically. Cradles, skids and dunnage shall stay with ductwork for protection prior to installation.
 - c. Sufficiently cross brace openings to maintain roundness or squareness within standard tolerances. Plug or cover all openings to prevent entrance of undesirables such as stones, dirt, water or debris.
 - d. Protect all flange faces with durable flat blinds securely fastened to them, where covering material extends to or beyond flange edges.
 - e. Accessories not reliably attached to ductwork for transportation purposes and cradled or skidded shall be properly packaged and shipped to prevent damage.
 - f. Nesting small diameter ductwork sections inside large diameters is forbidden. No components are allowed to be shipped inside ductwork.
 - g. Load freight with sufficient clearances all around to eliminate potential adjacent interferences. Firmly secure and protect all freight to prevent shifting or other movement during transportation. Nozzles, lugs, brackets or other projections shall not be used for securing freight.
 - h. Nozzles, lugs, brackets or other projections shall not be used for lifting or rotating ductwork. Skids and cradles shall be configured and oriented

- during transport for ease of offloading and handling at site with crane or lift truck.
2. Manufacturer shall properly package butt and wrap field joint materials and supplies.
 - a. Each fiberglass butt and wrap field joint shall be individually packaged in a water proof container and labeled, with all reinforcement precut by the manufacturer and properly sequenced in the package.
 - b. Labeling shall designate size, location keyed to drawings and laminate sequence.
 - c. One (1) extra kit per joint type and size shall be provided.
 - d. Resin and Catalyst (hardener) shall be packaged and properly labeled in Department of Transportation (DOT) approved five (5) gallon or smaller pails. Separate pails shall be provided for Inner Corrosion Barrier, Structural Layer and Outer Surface resin, Finish Coat resin and Paste used to fill allowable gaps at fit up of joints.
 - e. An extra 35% more resin shall be supplied than theoretically required given butt and wrap kit resin to glass ratios.
 - f. Resin shipped for field work shall have a minimum six (6) month shelf life, with non-consumed resin removed from the jobsite upon completion of the installation.
 - g. All cups, brushes, stir sticks and rollers required shall be supplied by the manufacturer and bulk packaged.
 3. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 4. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of that Work.
 5. Comply with manufacturer's recommendations for rigging of equipment.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
3. Store all field butt and wrap joint materials and related supplies furnished by the Manufacturer in an area that is dry, between 35 and 75 degrees F for maximum shelf life, properly protected from humidity and away from any direct sunlight and potential source of ignition or fire.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.7 SITE CONDITIONS

- A. Environmental Requirements:
 - 1. All fiberglass reinforced plastic joint work shall be done at temperatures between 60 and 90 degrees Fahrenheit and humidity less than 80%, without exposure to wind, rain, snow, direct sunlight and any other wet and extreme temperature conditions beyond the ranges permitted. Temporary weather tight temperature and humidity controlled shelters shall be provided by the Contractor where needed during field but wrap joining procedures.
- B. Installation of ductwork:
 - 1. Actual installation temperature shall be verified with design by the Manufacturer for expansion and contraction considerations as it pertains to ductwork lengths and expansion joint operation. Contractor shall support such evaluation with field information as needed.
 - 2. Ductwork shall be stabilized and isolated from any and all movement during FRP butt and wrap field joint work.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Design Criteria:
 - 1. Design calculations supporting ductwork component thicknesses shall include all applicable loads individually or in combination, whereas required by Section References, federal, state and local building codes and best engineering practices.
 - 2. Design Pressure/Vacuum: +/-10-inches water column.
 - 3. Weight of ductwork, accessories and other interconnected equipment or materials.
 - 4. Accumulation of liquid, sludge and solids buildup in ductwork.
 - 5. Locations of hangers, supports, anchors and seismic restraints.
 - 6. Air Temperature: Fabrication, installation, and operating temperatures shall be factored into the design to account for compression, elongation and misalignment resulting from temperature swings within the materials and for sizing expansion joints.
- B. Performance Criteria:
 - 1. The ductwork system shall be free from leakage, deflection, pulsation, vibration, chatter or any other such condition when ductwork system is in or out of operation.
 - 2. Expansion joint and flexible connector deflection shall be within design criteria submitted during all modes of operation and throughout all times of the year.
 - 3. No stress cracks shall be observed in any inside or outside surfaces or radii of FRP system components.

2.2 MANUFACTURERS

- A. Manufacturers: Provide product of one of the following:

1. Ershigs; Bellingham, WA.
2. Kenway; Augusta, ME.
3. RPS Composites; Front Royal, VA
4. Composites USA; North East, MD.
5. Belco, Belton, TX.
6. Perry Fiberglass Products, Inc., Westlake, OH
7. Or approved equal.

2.3 DETAILS OF CONSTRUCTION

A. Ductwork:

1. Ductwork shall be hand lay-up, spray-up and/or filament wound construction in accordance with ASTM D3982 and specific ASME RTP-1 articles as referenced within this Section.
2. Ductwork shall meet Class I fire retardant rating per ASTM E84 with a flame spread of less than or equal to 25.
3. All laminate thicknesses for ductwork shall be calculated such that 10:1 factor of safety for internal and 5:1 for external pressure has been provided, with strain limited to 0.001 for hand lay-up laminates per ASME RTP-1 Subpart 2A. Strain for filament wound laminates shall be limited to 1/10 of strain at failure, where strain at failure must be proven by ductwork Manufacturer per applicable articles of ASME RTP-1 Subpart 2A through testing or Subpart 2B through lamination analysis plus 6-930 Physical Property and Laminate Reinforcing Content Tests. Laminate designs used for proof of allowable strain used in calculations submitted shall be representative of same laminate sequence and resin to glass ratio as used for ductwork shown on drawings submitted..
4. Safety factors for combined loads shall be 10:1 for sustained loads and 5:1 for intermittent loads, where intermittent are combined individual loads or individual combined with sustained loads. As a minimum, loadings to be considered are defined in Article 2.1 above. The greater laminate thicknesses as determined by paragraph 2.3 A.6 and 7 herein shall be used.
5. Minimum longitudinal tensile strength shall be 9,000 psi for all Structural Layer laminate designs.
6. All exterior ductwork shall be designed and fabricated to span minimum spacing as shown or specified. Ductwork wall thickness shall be suitably designed with reinforcing ribs incorporated where necessary to achieve span, within acceptable deflection tolerance.
7. Maximum allowable deflection for any size ductwork or span shall be the lesser of 1/2-in or 1/2-percent of span under worse case operating and weather conditions.
8. Buckling between supports shall be taken into consideration through stress analysis.
9. FRP Pedestal supports and shear collars for vertical support and/or anchor interfaces shall be provided. Design calculations and drawings illustrations shall be included in the shop drawing submittals.

10. Ductwork runs, rises and fittings shall be fabricated to the fullest extent in the manufacturer's shop with shop applied exterior butt and wrap joints. No fitting or component site fabrication is permitted.
11. Reinforcing Ribs:
 - a. Design calculations shall be submitted to substantiate rib and duct wall design given all design criteria and deflection limits defined above, including demonstration for moment of inertia achieved with rib type selected.
 - b. Rib construction shall be detailed on shop drawings.
 - c. Where half round ribs are utilized on ductwork, the minimum moment of inertia shall be determined per ASME RTP-1 Section 3A-330.
 - d. Ribs shall be installed at point of ductwork manufacture and located so as not to interfere with supports, hangers, anchors, seismic restraints and other such interconnected or adjacent equipment, accessories, materials and building structures.
12. Fittings:
 - a. All fittings such as elbows, laterals, tees, and reducers shall be hand lay-up construction and have the same internal dimensions as the adjacent duct.
13. Butt Wrap Joints:
 - a. All ductwork joints shall be butt wrap per ASTM D3982 Article 9.2 Joints. Bell and spigot joints may be used for alignment purposes only, whereas no adhesives are used and step from bell end to inserted spigot shall taper 6:1 with smooth butt wrap transition between joined sections. All outer surfaces of joint overlays are to be coated with a resin finish coat containing paraffin wax.
 - b. All gaps between mating edges of ductwork and fittings shall be less than or equal to 3/8-inches per ASTM C582 Article 9.2.4 and maximum offset of lesser of 1/4-inch or two (2) times edge thickness divided by three (3) prior to application of paste and butt wrap joint material. Paste used to fill gaps shall not protrude more than 1/8-inch past inner surface of ductwork, fitting or transition wall.
 - c. Total width of overlays for butt-wrap joints shall be not less than 6-inches for thicknesses up to 0.30-inches, 8-inches from greater than .030 to 0.49-inches thick and 12-inches from greater than 0.49 to 0.76-inches thick. Overlay widths where bell and spigot joint alignment is utilized shall be increased by 6 times the step dimension from bell end to inserted spigot.
 - d. At least one (1) field butt wrap joint shall be allowed for in each change in direction and elevation, with a minimum of 6-in field trim included and shown on drawings by the Manufacturer at each field joint location. Field joints shall also be located at dimension "H" from duct flange faces per ASTM D3982 Figure 4 Standard Duct Dimensions. Duct flanges mating with dampers, fans, flex connectors and other related equipment shall be properly aligned and reliably bolted together with no undue stresses prior to applying butt wrap joint material.
 - e. No adhesive joints are allowed.
14. Nozzle and Branch Connections:

- a. Nozzle connections shall meet ASME RTP-1 Article 4-430 and be Flush-Type per Figure 4-12, where structural overlay is placed as All Exterior material. Instillation shall follow ASME RTP-1 Figure 4-4. Inside overlay material is not required.
 - b. Nozzles shall project 6-in from outside diameter of ductwork.
 - c. All nozzles 4-in and smaller shall have Plate-Type gussets per ASME RTP-1 Figure 4-13, where complete contact with back of flange is required.
 - d. Branch connections shall be perpendicular or 45 degrees per ASTM D3982 Figure 4.
 - e. Cutout reinforcement shall be provided following ASME RTP-1 and good engineering practices for all nozzle and branch connections.
 - f. FRP Threaded couplings and nipples shall be installed following the same requirements above as specified for nozzles of the same size. Thermoplastic and metallic couplings and nipples are not allowed.
15. Flange Connections:
- a. All connections to expansion joints, flexible connectors, fans, dampers, louvers, registers, hatches, covers, tank vents, vessels, condensate drain piping, instrumentation or other equipment shall be flanged with 6-in projection where flange is not on a straight run of ductwork. Auxiliary equipment directly screwed into fiberglass ductwork is not allowed.
 - b. Flanges shall be hand lay-up flat full face flange on straight section (pipe) or integrally molded construction. Flange face shall be textured by lightly hand sanding with block sander to move surface gloss imparted by mold surface. Flange on straight section (pipe) type flanges shall have no voids or filler material where pipe joins flange lay-up.
 - c. All bolt holes shall be shop drilled by Manufacturer using calibrated template and back spot faced or otherwise formed for flat and parallel seating of SAE or ASME B18.22.1 Type A Narrow washer seat, with all flange exterior and machined surfaces resin finish coated. Randomly match drilling flanges in manufacturer's shop or field drilling of any kind is not allowed.
 - d. Flange construction and dimensions shall meet ASTM D5421 for all tank vent, condensate drain piping and instrumentation connections and D3982 for all other connections.
 - e. Flange flatness, warpage, perpendicularity and cant tolerances specified within Referenced standards and this Section shall be strictly adhered to. Flange faces refaced or machined to meet tolerances shall have the Corrosion Barrier fully included.
 - f. Flanges on smaller end of reducers and transitions shall have a minimum of 6-in straight section to accommodate bolting, as shown for reducers in ASTM D3982 Figure 4 Standard Duct Dimensions.
 - g. Furnish all gaskets required. Gasket material shall be EPDM or chlorobutyl, with a shore A hardness of 60 to 70. Gaskets shall be full face, pre-punched to match flange bolt pattern plus single piece construction up to 36-in diameter and dovetail vulcanized construction for sizes greater than 36-in diameter. Minimum gasket thickness shall be

1/8-in for flanges less than or equal to 6-in, 3/16-in for flanges greater than 6-in and up to 18-in and 1/4-in for flanges equal to or greater than 20-in diameter. For rectangular flange minimum gasket thickness, the applicable minimum for round duct correlates to the longest flange leg on the rectangular duct. Gasket thickness shall be determined by the Manufacturer as a variable in their flange design. Gasket manufacturers shall be by Aero Rubber of Tinley, IL, Corley Gasket of Dallas, TX, Seal and Design of Clarence, NY or equal.

- h. Furnish all fasteners required. Fastener material shall be 316 SS and properly sized to fit gasketed or non-gasketed connections. Washers shall meet SAE or ASME B18.22.1 Type A Narrow washer seat requirements.
- i. Expansion joints, flexible connectors, fans, dampers, louvers, registers, hatches, covers, tank vents, vessels, condensate drain piping, instrumentation or other equipment flanges shall be full faced for proper seating with ductwork flanges.
- j. Custom filler pieces or spacer rings shall not be allowed between mating flanges.
- k. Coordinate FRP flange dimensions with auxiliary equipment of dissimilar material and origin of manufacture.
- l. All flange bolts shall be torqued to values as recommended by Manufacturer.

B. Round Ductwork:

- 1. Reinforcing Ribs:
 - a. Ductwork wall thicknesses shall be suitably designed for all loads and spans with or without reinforcing ribs.
 - b. Ribs utilized shall be Hand Lay-up or filament wound and formed to a suitable shape over core material. Rib core material shall impart a laminate shape suitable for stiffening ductwork consistent with design calculations submitted, not contribute to strength of material in calculations and be non-metallic, such as half round or trapezoidal polyurethane foam. Ductwork stiffening shall rely on strength of rib laminate overlay only.
- 2. Fittings:
 - a. Fitting thickness and laminate composition shall be equal to design of hand lay-up duct cylindrical sections meeting the design basis of this Section. Minimum thickness for reducer and transition fittings shall be the same as the wall thickness of the ductwork connecting to the larger fitting opening.
 - b. Standard Round Elbows up to 48-inch diameter shall have smooth radius with a centerline radius equal to 1-1/2 times the ductwork diameter.
 - c. Short radius round elbows, where the centerline radius is less than 1-1/2 times the ductwork diameter, are not permitted unless otherwise shown on contract drawings to meet dimensional restrictions.

- d. Mitered Elbows are permitted for ductwork 54-inch diameter and greater. Standard dimensions shall be as shown in ASTM D3982 Figure 4, with mitered sections as specified below:
 - 1) 0° to 44° elbows shall contain one (1) mitered joint and two (2) sections.
 - 2) 45° to 80° elbows shall have a minimum of two (2) mitered joints and three (3) sections.
 - 3) Elbows greater than 80° shall have a minimum of four (4) mitered joints and five (5) sections.
 - e. The length of concentric and eccentric reducers shall be five (5) times the difference in diameter and not as shown in ASTM D3982 Figure 4.
 - 3. Butt Wrap Joints:
 - a. Joint thickness and laminate composition shall be equal to design of hand lay-up duct cylindrical sections meeting the design basis of this Section.
 - 4. Flange Connections:
 - a. Minimum flange thicknesses shall be 5/8-in for less than or equal to 8-in diameter and 3/4-in for 10-in to 36-in diameter. Thicknesses for flanges greater than 36-in diameter shall be determined following rules in ASME RTP-1 Non-Mandatory Appendix NM-12 FRP Flange Design, with minimum thickness of 1-1/8-in allowed. Minimum flange thickness shall be measured at bolt hole in washer seating area.
- C. Rectangular Ductwork and Transitions:
- 1. Filament winding is not allowed for rectangular ductwork and transitions.
 - 2. All rectangular ductwork, fittings, transitions and other structures shall have integrally molded corners with radiuses. Corner radii for adjoining walls of less than or equal to 24-inch shall be 1/2-inch, 1-inch for adjoining walls between 24-inch and 48-inch and 1 1/2-inch for greater than 48-inch adjoining wall lengths. In no case shall rectangular or rectangular to round components or systems be fabricated from flat panels, with or without quartered pipe sections in corners, and joined by butt wrap joints. Care shall be exercised to assure corner radii thicknesses are maintained as a minimum, with additional plies added if required.
 - 3. Ductwork wall thicknesses shall be suitably designed for all loads and spans with or without reinforcing ribs.
 - 4. Ribs utilized shall be constructed from hand lay-up angle, channel, tee or tube material and laminated to the ductwork. Adhesives may be used in place of laminating ribs to ductwork where ductwork Manufacturer in-house test data, design calculations and drawing details are submitted that demonstrate reliability. No pultruded, extruded, formed, milled or welded plastic, metallic or wood structural shapes or mechanical fasteners are allowed.
 - 5. Flange Connections:
 - a. Square or rectangular ductwork flange connections shall meet the same design and fabrication requirements as round flanges above as a minimum, where square or rectangular ductwork flange requirements shall correspond to those of round ductwork having the same diameter as

the longest side of the square or rectangular duct when rounded up if not equal.

- b. Bolt hole location and size shall be designed by the Manufacturer, shall straddle major centerlines and not exceed 4 1/2-in space between hole centerlines.

D. Support System:

1. Provisions shall be made for supporting all ductwork, dampers and other ductwork accessories.
2. All ductwork shall be securely hung and anchored to the building structure.
3. The support system, comprised of hangers, supports, anchors and seismic restraints, shall be designed and supplied by Contractor and coordinated by Contractor with Manufacturer's ductwork system design.
4. Support system design criteria and supply shall include the following requirements:
 - a. Conform to all requirements of 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - b. Supports shall be custom fabricated to match as built ductwork outside diameter and account for FRP thickness and steel fabrication tolerances. Support fabricator shall define fabrication and fit up tolerances on individual assembly drawings for Contractor coordination with Ductwork Manufacturer.
 - c. Support system steel shall line up with shop laminated FRP buildups. Round ductwork support bearing area shall be a minimum of 180 degrees of its circumference by a minimum width of the lesser of 1/3 the ductwork diameter or 4". Rectangular ductwork support bearing area shall be a full support across ductwork underside by a minimum width of the lesser of 1/3 the underside dimension or 4". A 1/4-in thick EPDM sheet shall be adhered to each support to provide a fully padded interface with ductwork.
 - d. All ductwork to be hung shall be supported on trapeze hangers with angles or rods. Use of strap hangers and straps is prohibited. Hanger rods shall be minimum 3/8 inch. A pair of rods shall be provided at each duct support point.
 - e. Vertical runs of ductwork shall be supported by a FRP pedestal laminated to the underside of an elbow and/or steel framework with steel ring fully bearing on underside of FRP shear collar on ductwork. Riser or friction clamps are not allowed.
 - f. Where ductwork movement must be restrained, steel framework with 360 degree steel ring shall be used that incorporates and fully bears on FRP shear collars on either side of ring.
 - g. All hangers, rods, supports, anchors, seismic restraints, bolts, nuts, washers, inserts, and appurtenances shall be Type 316 stainless steel.
 - h. Ductwork shall be supported to allow removal of inline devices without adding temporary support.
 - i. Ductwork shall be supported within 12 inches of duct free end where connected to flexible connections, expansion joints or equipment.

- j. Support spacing shall be 8 feet unless otherwise

E. .Ductwork Materials:

1. Laminates for all ductwork shall be Class I fire retardant per ASTM E84.
 - a. Fire retardant resin shall be as manufactured by AOC, Ashland, Reichhold or Interplastic. Resin shall be from a single supplier and of the same brand throughout all ductwork components manufactured. Only resins manufactured within the United States are allowed. A MEKP/CoNap cure system shall be used.
 - b. The Inner Surface shall contain 0.010-inches (10 mil) C-Glass veil saturated with 90% resin by weight.
 - c. The Interior Layer may be laminated utilizing the hand layup or chop spray process meeting laminate composition equal to ASTM C582 Type I construction. The chop reinforcement shall be random strand glass fiber chopped from continuous roving whereas the fiber shall be of the same size and weight as 1-1/2 ounce per square foot random strand mat. This layer shall be applied at a nominal thickness of 0.086-inches (86 mils) with 70 to 75% resin by weight.
 - d. The Inner Corrosion Barrier, consisting of the Inner Surface and Interior Layer, shall have a nominal thickness of 0.096-inches (96 mils) with 75% resin by weight. This Inner Corrosion Barrier shall be regarded as a Corrosion Allowance for all components and shall not be considered as contributing to the components strength when calculating the thickness of the Structural Layer. The Inner Corrosion Barrier shall be Class II fire retardant per ASTM E84 with a flame spread of less than or equal to 75. The Inner Surface and Interior Layer resin shall be clear, with no antimony compounds, pigment, paint or other additives that will interfere with visual inspection. The Corrosion Barrier shall gel before Structural Layer plies are added.
 - e. The Structural Layer for ductwork shall be hand lay-up or chop spray process per ASTM C582, utilizing all mat construction Type I laminates or a combination of alternating mat and 24 ounce per square yard woven roving construction Type II laminates. The Chop reinforcement shall be random strand glass fiber chopped from continuous roving, whereas the fiber shall be of the same size and weight as 1-1/2 ounce per square foot random strand mat.
 - f. The Structural Layer for round straight sections of ductwork may be filament wound as an alternative. Filament winding shall be at an angle determined by the manufacturer, where a nominal 22 mil layer of 1/2 ounce per square foot chopped strand glass or equivalent thickness of chop shall be applied as a bedding layer for first pass filament wound glass strands between the cured Inner Corrosion Barrier and Structural Layer. The Structural Layer for fittings and rectangular ductwork shall not be filament wound.
 - g. The Structural Layer shall have a minimum thickness as calculated by the Manufacturer, where hand lay-up and chop spray shall have a 25 to 41% glass content and the filament wound portion a 50 to 80% glass content.

The Structural Layer shall be Class I fire retardant per ASTM E84 with a flame spread of less than or equal to 25. Antimony compounds may be added to the Structural Layer to achieve Class I rating per resin supplier recommendations.

- h. Uni-axial stitched glass reinforcements are permissible with filament wound laminate designs in order to meet requirements of this Section. Reinforcing such as random strand mat stitched to woven roving shall not be permitted in the Structural Layer.
 - i. The Inner Corrosion Barrier thickness shall be added to Structural Layer calculated thickness.
 - j. The Structural Layer minimum allowable thickness is 0.14-inches.
 - k. The Outer Surface will contain 0.010-inches (10 mil) Glass Veil saturated with 90% resin by weight, cured and then coated with a 3 to 5 mil unreinforced resin rich finish coat containing 0.2 to 0.6% paraffin wax. The Outer Surface shall be Class I fire retardant per ASTM E84 with a flame spread of less than or equal to 25. Antimony compounds may be added to the Outer Surface to achieve Class I rating per resin supplier recommendations. Ultra violet light inhibitor and pigment shall be added to the Outer Surface resin. No paint or other additives are allowed. Manufacturer shall submit standard and custom color selection chart. Color will be selected by the Engineer from the submitted charts.
2. Paste used to fill gaps and create a smooth transition from mating cut edges shall be formulated from the same resin formulation as used to manufacture the ductwork.

2.4 ACCESSORIES

A. Volume and Isolation Dampers:

- 1. General:
 - a. Volume dampers shall be provided where indicated on the Drawings and as required to facilitate accurate volume control.
 - b. The duct of the damper shall be reinforced to prevent vibration.
 - c. Volume dampers specified with registers shall be installed in addition to those shown on the Drawings.
 - d. Dampers larger than 11 inches in any dimension shall be opposed blade type.
 - e. The damper blades shall be operated by a lockable dial regulator and may be set in any position. The dial regulators shall be marked so that the "opened" and "closed" positions are clearly identified. The dial regulators on insulated ductwork shall be mounted on an elevated platform which shall finish flush with the surface of the insulation.
 - f. Dampers shall be located at accessible points and wherever possible some distance from a duct transition or fitting.
 - g. Dampers shall be provided in each branch duct take off and in both ducts downstream of each trunk duct split.
 - h. Dampers shall be FRP construction and be flanged at both ends.
 - i. Splitter type dampers shall not be installed.

- j. FRP damper and flanges shall be constructed of the same materials and conform to the same standards and specifications as specified within this Section for FRP ductwork. Damper flanges shall be the same thickness as the adjoining ductwork.
- 2. Round Fiberglass Reinforced Plastic Dampers:
 - a. Rating Conditions:
 - 1) Velocity Through Damper: 6000 fpm maximum.
 - 2) Pressure Rating: 30 inches water column.
 - 3) Maximum Allowable Leakage: 1.37 cfm per square foot at 10-inch w.g. pressure.
 - b. Materials:
 - 1) Bearings: Teflon.
 - 2) Blade: FRP, reinforced.
 - 3) Frame: FRP channel.
 - 4) Shaft: Type 316 stainless steel rods, full length of damper size as shown on the Drawings.
 - 5) Blade and Shaft Seals: EPDM suitable for use in a hydrogen sulfide atmosphere.
 - 6) Finish: FRP.
 - 7) Handle (manual damper): Type 316 stainless steel.
 - 8) Pins: Type 316 stainless steel.
 - 9) Bushings: Teflon.
 - 10) Hardware: Type 316 stainless steel.
 - 11) Angles: FRP.
 - 12) Ends: Flanged with bolt holes drilled. Flange thickness shall not vary more than 1/16 inch.
 - 13) Blade Stops: FRP angles with full circumference elastomer seals suitable for use in a hydrogen sulfide atmosphere.
 - c. Leakage test and performance data from an AMCA approved testing laboratory shall be submitted.
 - d. Manufacturers: Provide products of one of the following:
 - 1) Swartwout, Phillips Industries, Model 912.
 - 2) Or approved equal.
- B. Motorized Dampers:
 - 1. Furnish and install, where indicated on the Drawings, motorized spring return fiberglass reinforced plastic dampers.
 - 2. Motorized dampers for rectangular and round ductwork shall be as specified above for rectangular and round volume dampers except that a factory installed motorized actuator shall be provided.
 - 3. Motorized actuator shall be factory mounted and tested at the damper manufacturer. Actuator torque shall be verified with the damper manufacturer.
 - 4. Electric motor actuators shall be provided for all electrically operated dampers and shall be furnished complete with accessories as specified.

5. Actuators shall be rated for NEMA 4X as shown on the Drawings. Supply of these conduit fittings shall be the responsibility of the Contractor and will not be provided by the actuator manufacturer.
6. Each electric motor operator shall be capable of providing not less than 1.5 times the required operator torque for opening and closing of the damper. Responsibility for correct actuator sizing shall be that of the damper manufacturer.
7. Motor operation cycle time from full open to full close shall be set for 15 seconds.
8. The operator shall be furnished with a hand wheel for manual operation.
9. The operator gear reducer shall be provided with four limit switches and two torque switches. Two limit switches shall indicate full open and two shall indicate full closed positions. Limit switches shall be field adjustable. Switches shall be equipped with SPDT contacts. Limit switches and torque switches shall be supplied in the enclosure furnished and mounted on the operators.
10. The electric motor shall be designed for actuator service, Class B insulation, squirrel cage construction, with thermal overloads, and suitable for operation on 120 volt, 1 phase, 60 Hz power.
11. Circuitry and devices shall be furnished with the operator to provide damper position and indication for remote control and monitoring. Terminal strips shall accept #12 gauge wire size. Provide additional terminal strips for remote signals.
12. Provide limit switches and position indicators for interlocking and monitoring.
 - a. Provide position indicating signals as follows:
 - 1) Damper completely opened.
 - 2) Damper completely closed.
 - 3) Damper stopped at any intermediate position.
13. The actuator gearing shall be heat treated alloy steel and designed to withstand the stall torque developed by the actuator.
14. All external fasteners shall be type 316 stainless steel.
15. The actuator shall be lubricated at the time of manufacture and not require any field lubrication.
16. Manufacturer: Provide products of one of the following:
 - a. Raymond Control Systems (RCS).
 - b. Rotork.
 - c. Belimo
 - d. Or approved equal.

C. Flexible Connectors and Expansion Joints:

1. Design and Performance Criteria:
 - a. Flexible connectors and expansion joints shall be tested in accordance with UL 181.
 - b. Flexible connectors and expansion joints shall be listed and labeled as Class 0 or Class 1 flexible connectors.
 - c. Flexible connectors and expansion joints shall meet NFPA 90A, NFPA 90B, NFPA 701, and local building codes.

- d. Maximum Design Total Static Pressure: ± 3 psig (± 83.0 -inch W.G.).
- e. Temperature Range: -65 degrees F to 300 degrees F.
- f. Maximum Movement Capabilities:
 - 1) Axial Compression: 4 inches.
 - 2) Axial Extension: 1 inch.
 - 3) Lateral Offset: 3 inches.
- g. Width: Minimum 12 inches, measured from flange to flange.
- 2. Product and Manufacturer: Provide one of the following:
 - a. Model 945-W, as manufactured by Holz Rubber Company, Inc.
 - b. Model Duct Connectors, as manufactured by Mercer Rubber Company.
 - c. Or equal.
- 3. Details of Construction:
 - a. Material: Minimum 1/4-inch thick EPDM or Butyl, reinforced with a strong synthetic asbestos-free fabric suitable for corrosive service.
 - b. Flexible connectors and expansion joints shall be fabricated with compound curve molded corners and straight sections with premolded arch. Arch shall continue throughout the corner and straight sections and shall be fully developed when in the neutral installed position. Precompression or tucking of the corner to form the arch shall not be permitted.
 - c. Corners on rectangular flexible connectors and expansion joints shall be completely molded and free of splices.
 - d. Provide Type 316 stainless steel flanged ends. Flanges and bolt spacing shall be coordinated with ductwork and equipment connections.
- 4. Provide flexible connectors wherever ductwork crosses a building expansion joint.

D. Grilles and Registers:

- 1. General:
 - a. Stainless steel grilles and registers shall have a mil finish.
 - b. Where registers are shown to be provided in lieu of grilles, include an integral opposed blade damper of the same construction as the grille.
 - c. Dampers shown on the drawings do not represent integral dampers provided with registers. Where registers are indicated on the Drawings, dampers shown shall be provided in addition to register integral dampers specified.
- 2. Supply Grilles (SG) and Supply Registers (SR):
 - a. Construction: Stainless steel.
 - b. Product and Manufacturer: Provide one of the following:
 - 1) Model SS2, as manufactured by Anemostat.
 - 2) Model T54SS, as manufactured by Tuttle & Bailey.
 - 3) Model 300RL-SS, as manufactured by Titus.
 - 4) Or equal.
 - c. Double deflection with horizontal face bars for horizontal duct and vertical face bars for vertical duct.
 - d. 3/4-inch blade spacing.
 - e. For surface mounting as shown or indicated on Drawings.

3. Exhaust Grilles (EG) and Exhaust Registers (ER):
 - a. Construction: Stainless steel.
 - 1) Model SS3, as manufactured by Anemostat.
 - 2) Model T70SS, as manufactured by Tuttle & Bailey.
 - 3) Model RL-SS, as manufactured by Titus.
 - 4) Or equal.
 - b. Single 0 degree deflection with horizontal face bars for horizontal duct and vertical face bars for vertical duct.
 - c. 3/4-inch blade spacing.
 - d. For surface mounting as shown or indicated on Drawings.

E. Mechanical Link Seals:

1. Manufacturer: Provide product of one of the following:
 - a. Pipeline Seal and Insulator, Inc.
 - b. Thunderline Corporation.
 - c. Calpico, Inc.
 - d. Or equal.
2. Provide mechanical link seals through masonry construction with adjusting bolts suitable for 20 psig of pressure.
3. Details of Construction:
 - a. Non-Fire Rated Seals:
 - 1) Pressure Plates: Glass reinforced nylon composite.
 - 2) Bolts and Nuts: Type 316 stainless steel.
 - 3) Sealing Element: EPDM.
 - b. Fire Rated Seals:
 - 1) Pressure Plates: Zinc dichromate steel.
 - 2) Bolts and Nuts: Two part zinc dichromate steel with corrosion inhibiting coating.
 - 3) Sealing Element: Silicone.
 - 4) 1-1/2-hour fire rating.

F. Hardware and Fasteners:

1. All hardware and fasteners shall be Type 316 stainless steel, unless noted otherwise.

G. Penetrations:

1. Where ductwork passes through masonry construction, saw cut rectangular openings and core drill round openings. Rough cut edges shall be grouted smooth.
2. Round opening shall be provided with mechanical seals except where otherwise noted.
3. Rectangular openings shall be calked water tight.

H. Flanged condensation drain nozzles shall be shop installed on ductwork by Manufacturer where shown on contract drawings and be a minimum of 2-in diameter.

2.5 FINISHING

- A. Ductwork Edge Preparation and Surface Finish:
 - 1. All cut edges shall be de-burred, chamfered and prepared with a 3 to 5 mil unreinforced resin rich finish coat at the point of manufacturing and fully cured to a Barcol hardness recommended by the resin manufacturer with no acetone sensitive or otherwise tacky spots prior to pasting or shipping.
 - 2. The Finish Coat work for all surfaces shall be free of defects such as but not limited to sharp projections, pinholes, excessive or inadequate film build, dry spots, drips, runs, sagging, and foreign inclusions. Any such defects shall be removed from the coat and the coat reapplied. The Finish Coat shall appear uniform and be of excellent workmanship.
- B. Where existing walls, floors or roofs must be penetrated, Contractor shall neatly cut the required openings and patch the existing work to provide a neat and finished appearance.

2.6 IDENTIFICATION

- A. Each fabricated ductwork section and field joint material packages shall be temporarily labeled with a piece number corresponding with and keyed to layout drawings for ease of storage and field assembly. Labels shall be able to withstand weather and durable enough to remain legible and stay affixed to ductwork until such time installation is complete and shown on drawing submittals.
- B. Label containing Manufacturer's name, job number and date of manufacture shall be permanently laminated to each ductwork run prior to shipment. Label shall be located for ease of reference after installation and shown on drawing submittals.
- C. Resin and Catalyst (hardener) shall be properly labeled with hazardous material warnings per Occupational Safety and Health (OSHA) and Department of Transportation (DOT) requirements.
- D. Field trim locations shall be boldly marked on each plain end of ductwork intending to be field joined.
- E. All equipment and component identification shall be provided in accordance with Section 10 14 00, Signage.

2.7 SOURCE QUALITY CONTROL

- A. Fabrication Tolerances:
 - 1. ASTM D3982 Section 8, identified within this Article for convenience:
 - a. Overall lengths are limited to plus or minus 1/4-in.
 - b. Cut ends of round ductwork shall be square within plus or minus 1/8-in for less than 24-in diameter, 3/16-in for between 24-in and 48-in and 1/4-in for greater than 48-in diameter.
 - c. Flanges:
 - 1) Face flatness plus or minus 1/32-in for less than or equal to 18-in diameter and plus or minus 1/16-in for greater than 18-in diameter.

- 2) Warpage shall be plus or minus 3 degrees.
- 3) Face perpendicularity to axis of duct shall be plus or minus 1/2 degree.
- 4) Flange angularity plus or minus 1 degree for less than or equal to 24-in diameter, 3/4 degree for greater than 24-in to less than or equal to 48-in and 1/2 degree for greater than 48-in diameter.
- 5) Offset shall be plus or minus 1/8-in.
- 6) Cant shall be plus or minus 1/2 degree.
- d. Out of roundness is limit to the greater of plus or minus 1/8-in or 1% of ductwork inside diameter, not to exceed 3/4-in.
- e. Angles of all fittings shall be plus or minus 1 degree, up to and including 24-inch diameter, plus or minus 3/4 degree for greater than 24-inch to less than or equal to 48-inch and plus or minus 1/2 degree for greater than 48-inch diameter.
- f. Gap for fit-up at shop and field joint is limited to the thickness of the adjoining material, not to exceed 3/8-in.
- 2. Other tolerance requirements:
 - a. Flange thickness shall be minus 0.00-inches plus 20% of thicknesses within this Section or as designed and shown on shop drawings.
 - b. Out of flatness is limited to the lesser of plus or minus 1/2-in or 1/2% of span.
 - c. Out of square for rectangular ductwork is limited to 1/16-in per foot of each individual straight leg length, not to exceed 3/4-in.
- 3. Square or rectangular ductwork tolerance requirements shall correspond to those of round ductwork having the same diameter as the longest side of the square or rectangular duct when rounded up if not equal, unless otherwise specified within this Section.
- 4. Tolerance measurements shall take fabrication ambient temperature into consideration.
- B. Shop Tests and Inspections:
 - 1. Ductwork Test and Inspections:
 - a. All component and fabricated assemblies shall meet the dimensions and tolerances specified within this Section.
 - b. All laminate quality shall be inspected and meet ASTM D2563 Table 1 Allowable Defects Visual Acceptance Level II, whereas defects referred to as Air Bubbles shall be limited to four (4) per square inch in the corrosion barrier and ten (10) per square inch of 1/16-inch maximum diameter or four (4) per square inch up to 1/8-inch diameter in the structural layer. The maximum percent repairs allowed shall be limited to 3% for the Corrosion Barrier and 10% for the Structural Layer of the components total surface area.
 - c. Resin cure for all FRP ductwork shall be checked by Barcol hardness and acetone sensitivity tests. Hardness shall be within 90 percent of resin manufacturer's specification. Barcol test shall be required for inside and outside surfaces of all fiberglass fabrications and secondary overlays joining sections in accordance with ASTM D2583.

- d. Paste protrusion past ductwork inner surface shall not exceed 1/8-inch.
- C. Engineer's Inspection and Tests:
 - 1. The Engineer reserves the right to inspect and reject any and all ductwork being manufactured that does not fully and completely meet the requirements of this Section. Fabrication and inspection records shall be made available upon request. The Owner, Owner's Engineer and Owner's or Engineer's designated Agent will have adequate, open and safe access to the Manufacturer's facility at all times during regular business hours for the purpose of inspecting equipment being manufactured for them.
 - 2. The Manufacturer shall make any and all inspection tools readily available to parties that may participate in inspection. Such tools shall be in a good state of repair and properly calibrated for accurate measurement.
 - 3. Final acceptance by Engineer is not in lieu of nor does it intended to compromise Contractor's or Manufacturer's duty and warranty in any way as required by this Section.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.
- C. A thorough inspection of each piece of ductwork and installation materials for damage incurred in transit and material conformance to this Section shall be conducted by Contractor upon delivery to construction site. Any damage and non-conformance shall be immediately repaired and/or corrected by respective ductwork Manufacturer's personnel and not sales representatives.
- D. Contractor shall perform continuous inspection during installation for:
 - 1. Butt wrap joint reinforcement materials and resin, to assure no moisture or other such contamination and proper workability.
 - 2. Gaps at joint fit up, surface preparation for butt wrap joints, application of all butt wrap material layers and laminate visual quality.
 - 3. Proper cure of field applied butt wrap joints utilizing acetone sensitivity and Barcol hardness test methods.
- E. All Contractor continuous inspection during installation shall follow requirements of this Section, be document and be submitted with any corrective action reports necessitated for Engineer review and approval.

3.2 PREPARATION

- A. Protection of Surrounding Areas/Surfaces:
 - 1. Openings and penetrations shall be capped to protect the building from outside conditions.
 - 2. Properly plug or cap the open ends of all ductwork at the end of each day's Work or other stopping point throughout the construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.3 INSTALLATION

- A. General:
 - 1. Section 01 70 00 – Execution and Closeout: Requirements for installation.
 - 2. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 3. Install in accordance with Laws and Regulations.
 - 4. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
 - 5. Installation to conform to requirements of all local and state codes.
- B. Ductwork:
 - 1. All ductwork and accessories shall be installed in accordance with Manufacturer's recommendations and provide an air tight system free from leakage, deflection, pulsation, vibration, chatter or any other such condition when ductwork system is in or out of operation.
 - 2. Install ductwork as shown and dimensioned on contract drawings, such that it runs vertically, horizontally, parallel and perpendicular to building lines and where horizontal runs pitch towards drops or drains.
 - 3. No piping, conduit or structural work shall be installed in or through any ductwork. Ductwork shall not be decreased at any point to avoid obstructions.
 - 4. Any and all modifications that may be necessary to suit field conditions and clear any obstruction or conflicts with other equipment shall be approved by Engineer in writing.
 - 5. All ductwork shall be run as close as possible to structural members, walls, ceilings, overhead construction, columns or other structural and permanent enclosure elements of building, leaving sufficient access for performing field butt wrap joint and quality control work.
 - 6. Ductwork shall be straight and smooth on inside, with neatly finished butt wrap joints
 - 7. Install ductwork with fewest possible field joints, utilizing hangers, supports, anchors and seismic restraints as required by Contractor and Manufacturer design. All ductwork shall be securely supported and anchored to the building structure or free standing support.
 - 8. All gaps between mating edges of ductwork and fittings shall be less than or equal to 3/8-inches per ASTM D3982 Article 9.2.4 and maximum offset of lesser of 1/4-inch or two (2) times edge thickness divided by three (3) prior to application of paste and butt wrap joint material.

9. Bracing and ties screwed to ductwork for positioning and/or to restrain movement during field butt wrap procedures shall not damage ductwork and shall be removed prior to completion of butt wrap joints.
10. FRP work performed during installation shall meet all requirements of this Section and be of Manufacturer shop quality as specified herein.
11. Fiberglass dust and styrene emissions propagated through cutting, grinding and laminating operations shall be managed per Manufacturer's instructions provided and pre-installation conference plans.
12. Test openings shall be field installed in the ductwork as directed by the testing, adjusting and balancing contractor. The openings shall be sealed by a screw cap and gasket, with cut edges of openings sealed with resin finish coat material.

3.4 FIELD QUALITY CONTROL

- A. Contractor shall inspect ductwork upon receipt, verifying Manufacturer supplied laminate quality, flange thicknesses, major dimensions and tolerances meet the requirements per this Section. Any such non-conformities identified shall be immediately reported to Manufacturer and Engineer for corrective action.
- B. Manufacturer's Services:
 1. Provide a qualified, factory-trained service person to perform the following:
 - a. Instruct Contractor in installing equipment.
 - b. At start of installation ductwork Manufacturer service person shall:
 - 1) Train how to apply and assist Contractor to the extent allowed by labor agreements with field butt wrap joints.
 - 2) Inspect Contractor butt warp joint work for conformance with this Section.
 - c. During installation Manufacturer service person shall inspect Contractor butt warp joint work for conformance with this Section and provide retraining if necessary.
 - d. After installation, inspect and adjust equipment, verify proper operation, and assist with field testing.
 - e. Instruct operations and maintenance personnel in operation and maintenance of the equipment.
 - f. The Manufacturer shall provide a final inspection.
 2. Ductwork Manufacturer's service person shall make visits to the Site as follows:
 - a. First visit shall be for instructing Contractor in proper equipment installation, and assisting in installing equipment. Minimum number of hours on-Site: eight (8) hours. Contractor shall have ductwork in position, ready for first cut and surface preparation with materials staged for field butt wrap joint application prior to service person's arrival. Weather protection shall also be in place where required.
 - b. Second visit shall be for checking completed installation. Minimum number of hours on-Site: four (4) hours.

- c. Technician shall revisit the Site as often as necessary until installation is acceptable.
- 3. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.5 TESTING, ADJUSTING AND BALANCING

- A. Adjust all controls for proper settings.
- B. Open all volume control devices in preparation for final testing and balancing.
- C. Install fusible links in fire dampers and verify that dampers are in open position.
- D. Start fan system and check for excessive leaks and vibration and correct.
- E. Systems shall be completely tested, adjusted and balanced by a qualified and certified testing, adjusting and balancing Contractor. A complete balancing procedure shall be submitted for approval. All equipment and connections required to balance the systems shall be provided.
- F. All duct systems shall be balanced in accordance with Section 23 05 93 - Testing, Adjusting and Balancing. Test and balance air volume within 5 percent of specified capacity.
- G. While system is operable, balance all equipment to achieve design conditions.

3.6 CLEANING

- A. Thoroughly clean all equipment and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from equipment and accessories after installation. Prior to final inspection, all surfaces shall be made clean by brushing, wiping, or with a compressed-air blast to remove all loose foreign materials.
- C. Fully remove all temporary piece labels used to aid installation plus loose materials and obstructions from interior of ductwork without damaging FRP.
- D. Remove and properly dispose of all unused butt and wrap joint materials and related supplies plus other debris and waste from the Site resulting from installation.

3.7 SCHEDULES AND SUPPLEMENTS

- A. All exhaust air ductwork and plenums serving the following equipment shall be of FRP construction:
 - 1. EF-6 and EF-7
- B. The supplements listed below, following the "END OF SECTION" designation, are a part of this Section:

Schedules:

Fire Retardant Ductwork Laminates per FRPI LS600

++ END OF SECTION ++

SCHEDULE 1 FIRE RETARDANT DUCTWORK LAMINATES PER FRPI LS600	
LAMINATE FEATURES	REQUIREMENT
Inner Corrosion Barrier (CB):	
Laminate Type	I
Resin Content	70 to 75%
Resin	Brominated Bis-A EVER
Synergist for Fire Retardancy	None
Fire Retardant per ASTM E84	Class II
Cure	MEKP/CoNap
Contact Molding Process	Hand Lay-up or Chop Spray
Inner Surface (Veil)	(1) C-Glass 10 mils (0.010")
Interior Layer (Chop Mat)	86 mils (0.086") 1.5 oz/sf
Inner Corrosion Barrier Thickness	96 mils (0.096")
CB is a Corrosion Allowance	Yes
Visual Quality Standard	ASTM D2563 Level II
Bubble Defect Density Limits	4/sq in
Maximum Percent Repair	3%
Structural Layer (SL):	
Laminate Type	Hand Lay-up, Chop Spray or Filament Wound
Reinforcement Content	25 to 80%
Resin	Brominated Bis-A EVER
Synergist for Fire Retardancy	Antimony As Required
Fire Retardant per ASTM E84	Class I
Cure	MEKP/CoNap
Filament Winding Wind Angle(s)	As Required
Filament Winding CB Bedding Layer	22 mils (0.022") 1.5 oz/sf
Pigment	No
Minimum Thickness	Per Spec & Design
Outer Surface (OS):	
Resin	Brominated Bis-A EVER
Synergist for Fire Retardancy	Antimony As Required
Fire Retardant per ASTM E84	Class I
Cure	MEKP/CoNap
Contact Molding Process	Hand Lay-up or Spray
Resin Rich Wax Coating	Yes
UV Light Protection	Yes
10 mil Glass Veil	Yes
Pigment	Yes

SCHEDULE 1 FIRE RETARDANT DUCTWORK LAMINATES PER FRPI LS600	
LAMINATE FEATURES	REQUIREMENT
Minimum Thickness	15 mils (0.015")
Visual Quality SL and OS:	
Standard	ASTM D2563 Level II
Bubble Defect Density Limits	10/sq in 1/16" or 4/sq in up to 1/8"
Maximum Percent Repair	10.0%

SECTION 23 34 06

NON-METALLIC HVAC FANS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install non-metallic HVAC fans complete and operational with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the non-metallic HVAC fans Work.
- C. Related Sections:
 - 1. Section 10 14 00, Signage.
 - 2. Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.
 - 3. Section 23 09 00, Instrumentation and Control for HVAC.
 - 4. Section 26 05 05, General Provisions for Electrical Systems.
 - 5. Section 26 05 53, Identification For Electrical Systems.
 - 6. Section 26 28 16.33, Disconnect Switches.
 - 7. Section 40 05 93, Common Motor Requirements for Process Equipment.

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc. (AMCA).
 - 1. AMCA Standard 204 – Balance Quality and Vibration Levels for Fans.
 - 2. AMCA Standard 210 – Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
 - 3. AMCA Standard 300 – Reverberant Room Method for Sound Testing of Fans.
 - 4. AMCA Standard 301 – Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- B. American Bearing Manufacturers Association (ABMA).
 - 1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 – Load Ratings and Fatigue Life for Roller Bearings.
- C. American Society for Testing and Materials (ASTM).
 - 1. ASTM E84 – Standard Test Method for Burning Characteristics of Building Materials.
 - 2. ASTM D4167 – Standard Specification for Fiber-Reinforced Plastic Fans and Blowers.

- D. National Electrical Code (NEC).
- E. National Fire Protection Association (NFPA).
 - 1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - 2. NFPA 91 – Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids.
- F. Underwriters Laboratories Inc. (UL).

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer:
 - a. Minimum of five years of experience producing substantially similar equipment and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single non-metallic HVAC fan manufacturer.
 - 2. Require the non-metallic HVAC fan manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the non-metallic HVAC fan manufacturer.
- C. Certifications:
 - 1. Non-metallic HVAC fans shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the National Electric Code.
 - 2. Non-metallic HVAC fans shall be AMCA certified.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, installation details, and wiring diagrams.
 - b. Setting drawings, templates, and directions for the installation of roof/equipment curbs, anchor bolts, and other anchorages.
 - 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.

- c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Fan performance curves with operating points.
 - f. Expected sound power levels in each octave band and A-weighted for unit's inlet and outlet. Submit proposed measures to reduce sound power if expected levels are above (--1--) dBA.
 - g. Standard and custom color selection charts for finishing system.
 - h. Lubricant Specification: Furnish lubricant specification for type and grade required for equipment furnished.
 - i. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - j. Other technical data related to specified material and equipment as requested by Engineer.
3. Testing Plans, Procedures, and Testing Limitations:
- a. Plan for performing required shop testing.
 - b. Plan for performing required field testing.
- B. Informational Submittals: Submit the following:
- 1. Certificates:
 - a. Certification of painting systems, in accordance with "Finishing" Article in this Section.
 - b. Independent certification reports:
 - 1) UL Label or equal.
 - 2) AMCA certification.
 - 2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 - c. Instructions for handling, start-up, and troubleshooting.
 - 3. Source Quality Control Submittals:
 - a. Written report presenting results of required shop testing.
 - b. Factory test reports.
 - 4. Field Quality Control Submittals:
 - a. Written report presenting results of required field testing.
 - 5. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service personnel, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
 - 6. Qualifications Statements:
 - a. Manufacturer, when requested by Engineer.
- C. Closeout Submittals: Submit the following:
- 1. Operations and Maintenance Data:

- a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.
- 2. Warranty Documentation:
 - a. General warranty.
 - b. Special warranties on materials and equipment.
- D. Maintenance Material Submittals: Furnish the following:
 - 1. Spare Parts:
 - a. Spare parts list and recommended quantities.
 - b. One set of bearings for each belt drive fan.
 - c. One drive shaft for each belt drive fan.
 - d. One set of belts for each belt drive fan.
 - 2. Extra Stock Materials:
 - a. Touch up paint for each unit.
 - 3. Tools:
 - a. Two sets of special tools, if any, required for normal operation and maintenance.
 - 4. Spare parts, extra stock materials, and tools shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the Owner at the conclusion of the Project.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of that Work.
 - 3. Comply with manufacturer's recommendations for rigging of equipment.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 WARRANTY

- A. General Warranty: The special warranties specified in this Article shall not deprive Owner of other rights or remedies Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents. The obligations of Contractor under the Contract Documents shall not be limited in any way by the provisions of the specified special warranties.
- B. Special warranties on Materials and Equipment:
 - 1. Provide manufacturer's written warranty, running to the benefit of Owner, agreeing to correct, or at option of Owner, remove or replace materials or equipment specified in this Section found to be defective during a period of 1 year after the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. Design Criteria:
 - 1. Design conditions shall be as indicated on the Equipment Schedule.
 - 2. Fan bearings shall be rated for a minimum L-10 life of 100,000 hours at the fan's maximum operating speed in accordance with ABMA 9 or 11.
 - 3. Fans shall be balanced in accordance with AMCA Standard 204.
 - 4. Fiberglass reinforced plastic fan construction shall conform to ASTM D4167.
- B. Performance Criteria:
 - 1. Minimum performance data for each unit shall be as indicated on the Equipment Schedule. Provided equipment shall not exceed scheduled total power.
 - 2. Fans shall be performance rated in accordance with AMCA Standards 210, 300, and 301.

2.2 DETAILS OF EQUIPMENT

- A. FRP Duct Axial Fan
 - 1. Product and Manufacturer: Provide one of the following:
 - a. Series 35, as manufactured by Hartzell Fan Inc.
 - b. Or equal.
 - 2. Housing:
 - a. All fiberglass reinforced plastic surfaces shall be constructed of Ashland Derakane 510-B vinyl ester resin or equivalent with Class I flame spread rate below 25 and glass fiber with integral inlet and outlet flanges.
 - b. All structural parts in the air stream shall be fiberglass and resin or epoxy coated Type 316 stainless steel.

- c. All internal hardware (air stream) shall be encapsulated Type 316 stainless steel. Provide monel hardware where specified on the Equipment Schedule.
 - d. All external hardware (out of airstream) shall be Type 316 stainless steel.
 - e. All air stream surfaces shall be provided with a synthetic veil and electrostatically conductive surface coating.
- 3. Propeller:
 - a. Six airfoil blades.
 - b. Manufactured as a single piece, removed from the pattern whole using solid fiberglass die formed and coated with a corrosion resistant vinyl ester resin, Ashland Derakane 510-A or equivalent with Class I flame spread rate below 25.
 - c. Totally encapsulated aluminum core insert for secure attachment to the shaft.
 - d. Provided with a synthetic veil and electrostatically conductive surface coating.
- 4. Shaft (Belt Drive Only):
 - a. Type 316 stainless steel, turned, ground, and polished. Provide monel shaft where specified on the Equipment Schedule.
 - b. Machined and keyed at both ends with a fiberglass sleeve in the air stream.
 - c. Propeller shall be held tightly against the shaft shoulder by a Type 304 316 stainless steel bolt in the end of the shaft.
 - d. Type 316 stainless steel set screws shall be used to hold the key in place.
- 5. Shaft Seal (Belt Drive Only):
 - a. Fiberglass and neoprene shaft seal shall be located where the shaft leaves the bearing cover.
 - b. Neoprene shaft slinger shall be provided between the seal and propeller for belt drive fans.
- 6. Bearings (Belt Drive Only):
 - a. Heavy duty, self-aligning type with extended lube tubes for continuous service.
- 7. Motor Base (Belt Drive Only):
 - a. Motor mounting plates shall be steel encapsulated with resin, mat, and cloth and mounted onto the housing exterior.
 - b. Fully adjustable platform style.
- B. Fan Motors:
 - 1. Motors shall be premium efficiency, totally enclosed fan cooled (TEFC) type. Where TEFC motors are not available from the manufacturer, provide open drip proof (ODP) type with a letter from the manufacturer stating TEFC is not available.
 - 2. Motors shall be provided in accordance with Section 40 05 93, Common Motor Requirements for Process Equipment.
 - 3. Motors shall have a service factor of 1.15.
 - 4. Motors shall be normal starting torque, normal slip, squirrel cage induction type. VFD driven motors shall be compatible for variable frequency drive

operation and suitable to be applied in speed varying service without overheating.

5. Motors shall be of sufficient size so that there will be no overload on the motor above rated nameplate horsepower under any condition of operation imposed by the driven equipment.
6. Motors shall have Class F insulation with Class B temperature rise and be capable of carrying nameplate full load current plus service factor continuously without an injurious temperature rise in an ambient temperature of 40 degrees C.
7. Motor thrust bearings shall be adequate to carry continuous thrust loads under all conditions of operation imposed by the driven equipment.
8. Motors shall be in accordance with all current applicable standards of NEMA, IEEE, ABMA, NEC, and ANSI.
9. Locked rotor currents shall be as specified in NEMA Standards.
10. Provide lubrication of non-hygroscopic grease or oil type.
11. Provide automatic breather and drain for TEFC motor enclosures.
12. Two speed motors shall be provided with two windings per phase.
13. Provide integral overload protection on all single phase motors.
14. Provide mil and chemical duty type motors rated for chemical atmospheres where specified on the Equipment Schedule.

C. Belts and Drives:

1. Fans shall be belt drive with adjustable sheaves or direct drive as shown on the Equipment Schedule.
2. Belts shall be oil and heat resistant, non-static type.
3. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized with a minimum 1.5 service factor of the installed motor horsepower.

2.3 ACCESSORIES

A. Disconnects:

1. Provide lockable, horsepower rated, unfused disconnects for all single phase motors conforming to Section 26 28 16.33, Disconnect Switches.
2. Disconnects shall be constructed and rated for the location in which they are installed. Refer to Section 26 05 05, General Provisions for Electrical Systems, and the Electrical Drawings for area classifications and ratings.

B. Combination Motor Cover and Belt Guard:

1. For all fans with out-of-the-airstream mounted motors.
2. Epoxy coated steel construction with vents and tachometer hole.

C. Companion Flanges:

1. For all inline fans.
2. Fiberglass construction, predrilled to fit the flanges of the fan.

D. Mounting Hardware:

1. Provide Type 316 stainless steel hardware for all fan installation.

E. Structural Supports:

1. Contractor shall provide and install all hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances as required to mount equipment where shown. All hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances shall conform to Section 23 05 29, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.

2.4 FINISHING

- A. All fiberglass surfaces shall be protected with a minimum 10 mil dry film thickness of chemical, flame, and ultraviolet resistant resin.
- B. All gears, bearing surfaces, machined surfaces, and other surfaces that are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. Maintain coating during shipping and storage until equipment is placed into operation.

2.5 CONTROLS

- A. Refer to Section 23 09 00, Instrumentation and Control for HVAC, for sequence of operations.

2.6 IDENTIFICATION

- A. All equipment and component identification shall be provided in accordance with Section 10 14 00, Signage.
- B. All electrical wiring identification shall be provided in accordance with Section 26 05 53, Identification for Electrical Systems.
- C. All electrical wiring shall be color-coded and labeled for simplified identification. Power wiring shall be coded per Owner standards.

2.7 SOURCE QUALITY CONTROL

A. Shop Tests:

1. Fan Tests:

- a. Except as described below or otherwise approved by Engineer, test one fan of each size in accordance with AMCA Standard 210. Tests are not required for standard fans for which data on previously tested units of equal design is available. Curves and other test data from units previously tested shall be submitted with shop test results prior to shipping equipment.
- b. Test each fan for a minimum of three hours runtime, at the manufacturer's plant with the job or test motor. Vibration and temperature measurements shall be taken to determine its mechanical integrity. Vibration level shall be limited to a maximum of 1.25 mils. Temperature of bearing housing near the end of run time shall not exceed 215 degrees F under artificially created ambient temperature of 104 degrees F.

2. Equipment shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
 - a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label or equal.
 - b. Factory test equipment to ensure that the entire package has been properly fabricated and assembled, that all the controls function as specified herein and that the package meets the specified performance requirements including manufacturer's data report.
 - c. Fan wheels and shafts shall be statically and dynamically balanced.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Protection of Surrounding Areas/Surfaces:
 1. Openings and penetrations shall be capped to protect the building from outside conditions.
 2. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.3 INSTALLATION

- A. General:
 1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 2. Install in accordance with Laws and Regulations.
 3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
 4. Installation to conform to requirements of all local and state codes.

3.4 FIELD QUALITY CONTROL

- A. Field Tests:
 1. After equipment installation is complete, Contractor and a qualified field service representative of unit manufacturer shall perform an operating test and

a sound test of each unit and associated controls, in presence of Engineer. Equipment will pass the test when each unit and its controls are demonstrated to function correctly, and sound levels do not exceed maximum limits.

2. Running Tests:

- a. Field-test each equipment together with its controls and appurtenances. Tests shall demonstrate to Engineer that each part and all parts together function in accordance with the Contract Documents. Provide all necessary testing equipment, labor, and appurtenances.
- b. Verify that equipment operates at design point as intended, that vibration limits are not excessive and beyond manufacturer's recommendations, and that equipment operates smoothly without excessive noise, temperature rise, or other defects, across entire range of operating curve. Verify that all controls work as intended in both manual and automatic mode. Successfully test-operate each equipment for at least 4 hours.
- c. If equipment does not comply with the Contract Documents and does not pass the tests, Contractor shall adjust, modify, and retest the equipment as often as necessary until tests are successfully passed.

B. Manufacturer's Services:

1. Provide a qualified, factory-trained service person to perform the following:
 - a. Instruct Contractor in installing equipment.
 - b. After installation, inspect and adjust equipment, verify proper operation, and assist with field testing.
 - c. Instruct operations and maintenance personnel in operation and maintenance of the equipment.
2. Manufacturer's service person shall make visits to the Site as follows:
 - a. Visit shall be for instructing Contractor in proper equipment installation, and assisting in installing equipment. Minimum number of hours on-Site: 4 hours.
3. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.5 ADJUSTING

- A. Adjust all controls for proper settings.
- B. While system is operable, balance all equipment to achieve design conditions.

3.6 CLEANING

- A. Thoroughly clean all equipment and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from equipment and accessories after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

++ END OF SECTION ++

SECTION 23 82 39.43

ELECTRIC UNIT HEATERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install electric unit heaters complete and operational with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the electric unit heaters Work.
- C. Related Sections:
 - 1. Section 10 14 00, Signage.

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc. (AMCA).
 - 1. AMCA Standard 210 – Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
- B. Factory Mutual (FM).
- C. National Electrical Code (NEC).
- D. National Electrical Manufacturers Association (NEMA).
- E. Underwriters Laboratories Inc. (UL).
 - 1. UL 873 – Temperature-Indicating and -Regulating Equipment.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer:
 - a. Minimum of five years of experience producing substantially similar equipment and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
 - b. Manufacturer's facility, where equipment will be manufactured and tested, shall be ISO 9001:2000 certified. Manufacturer shall include a copy of the ISO 9001:2000 certificate with the submittals.

- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single electric unit heater manufacturer.
 - 2. Require the electric unit heater manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the electric unit heater manufacturer.
- C. Regulatory Requirements:
 - 1. Factory Mutual (FM).
 - 2. National Electrical Code (NEC).
 - 3. National Fire Protection Association (NFPA).
 - 4. Underwriters Laboratories Inc. (UL).
 - 5. Local and State Building Codes and Ordinances.
 - 6. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.
- D. Certifications:
 - 1. Electric unit heaters shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the National Electric Code.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, installation details, and wiring diagrams.
 - 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.
 - c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - f. Other technical data related to specified material and equipment as requested by Engineer.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Independent certification reports:
 - 1) UL Label or equal.

- b. Copy of manufacturer's ISO 9001:2000 certificate.
- 2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 - c. Instructions for handling, start-up, and troubleshooting.
- C. Maintenance Material Submittals: Furnish the following:
 - 1. Spare Parts:
 - a. Spare parts list and recommended quantities.
 - 2. Tools:
 - a. Two sets of special tools, if any, required for normal operation and maintenance.
 - 3. Spare parts and tools shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the Owner at the conclusion of the Project.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of that Work.
 - 3. Comply with manufacturer's recommendations for rigging of equipment.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. Design Criteria:
 - 1. Design conditions shall be as indicated on the Equipment Schedule.
 - 2. All electric unit heaters shall be UL Listed.

B. Performance Criteria:

1. Minimum performance data for each unit shall be as indicated on the Equipment Schedule. Provided equipment shall not exceed scheduled total power.

2.2 DETAILS OF EQUIPMENT

A. Horizontal Unit Heaters (Corrosive Environment)

1. Product and Manufacturer: Provide one of the following:
 - a. Model HD3D, as manufactured by Chromalox.
 - b. Model TRIAD, as manufactured by INDEECO.
 - c. Or equal.
2. Casing:
 - a. Minimum 20-gauge Type 304 stainless steel construction.
 - b. Provided with Type 304 stainless steel universal wall swivel bracket and mounting hardware.
3. Heating Elements:
 - a. Type 316 stainless steel fin tubular element.
4. Fans:
 - a. Epoxy coated aluminum broad blade, axial-flow type design.
 - b. Attached with rubber vibration isolators.
5. Fan Motors:
 - a. Totally-enclosed-fan-cooled epoxy coated enclosure.
 - b. Permanently lubricated bearings.
 - c. Integral thermal cutout.
6. Louvers:
 - a. Same material of construction as casing.
 - b. Individually adjustable for downward, upward or straight air flow.
7. Controls:
 - a. NEMA 4X control enclosure.
 - b. Sub-divided circuits with individual fuse protection for all heaters with a total current draw of 48 A or greater.
 - c. Heavy duty magnetic contactors.
 - d. Thermal cutout with automatic reset.
 - e. Integral control transformer.
 - f. Integral fan delay relay to dissipate residual heat build-up after shutdown.
 - g. Green power indication light.
 - h. Thermostats:
 - 1) Refer to Equipment Schedule for type.
 - 2) Integral Type (factory installed):
 - a) Thermostat Setpoint Range: 40 degrees F – 90 degrees F.
 - b) Adjustable knob.
 - 3) Remote Type (shipped loose):
 - a) Refer to Article 2.3.

2.3 ACCESSORIES

- A. Space Thermostats
 - 1. Product and Manufacturer: Provide one of the following:
 - a. Model WCRT-100, as manufactured by Chromalox.
 - b. Model TW255A, as manufactured by TPI Corporation.
 - c. Or equal.
 - 2. Sealed Noryl case.
 - 3. Shielded nickel-plated sensing bulb attached directly to thermostat enclosure.
 - 4. Thermostat Setpoint Range: 40 degrees F to 100 degrees F, with 2.5-degree F differential.
 - 5. Adjustable setpoints through dial on face.
 - 6. 120 VAC, 125 VA rating.
 - 7. Contacts shall have proper ampere rating for intended use.
 - 8. NEMA 4X rated.

2.4 IDENTIFICATION

- A. All equipment and component identification shall be provided in accordance with Section 10 14 00, Signage.

2.5 SOURCE QUALITY CONTROL

- A. Shop Tests:
 - 1. Equipment shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
 - a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label or equal.
 - b. Factory test equipment to ensure that the entire package has been properly fabricated and assembled, that all the controls function as specified herein and that the package meets the specified performance requirements including manufacturer's data report.
 - c. Fan wheels and shafts shall be statically and dynamically balanced.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 INSTALLATION

A. General:

1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
2. Install in accordance with Laws and Regulations.
3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
4. Installation to conform to requirements of all local and state codes.

3.3 FIELD QUALITY CONTROL

A. Field Tests:

1. After equipment installation is complete, Contractor and a qualified field service representative of unit manufacturer shall perform an operating test of each unit and associated controls, in presence of Engineer. Equipment will pass the test when each unit and its controls are demonstrated to function correctly.
2. Running Tests:
 - a. Field-test each equipment together with its controls and appurtenances. Tests shall demonstrate to Engineer that each part and all parts together function in accordance with the Contract Documents. Provide all necessary testing equipment, labor, and appurtenances.
 - b. Verify that equipment operates at design point as intended, that vibration limits are not excessive and beyond manufacturer's recommendations, and that equipment operates smoothly without excessive noise, temperature rise, or other defects, across entire range of operating curve. Verify that all controls work as intended. Successfully test-operate each equipment for at least 4 hours.
 - c. If equipment does not comply with the Contract Documents and does not pass the tests, Contractor shall adjust, modify, and retest the equipment as often as necessary until tests are successfully passed.

3.4 ADJUSTING

- A. Adjust all controls for proper settings.
- B. Position unit as shown on the Drawings and adjust outlet louvers and diffusers for maximum throw.

3.5 CLEANING

- A. Thoroughly clean all equipment and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from equipment and accessories after installation.

- C. Remove and dispose of all debris and waste from the Site resulting from installation.

++ END OF SECTION ++

SECTION 26 05 05

GENERAL PROVISIONS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to complete the electrical Work.
2. Utility Companies:
 - a. Electric Utility Company: Perform the Work in connection with the electric service and utility metering in accordance with requirements of Coweta-Fayette EMC.

B. Coordination:

1. Review installation procedures and schedules under other Specification Sections and coordinate with other trades the installation of electrical items that will be installed with or within formwork, walls, partitions, ceilings, and panels.
2. Coordination and Intent of Electrical Drawings:
 - a. Dimensions on Drawings related to equipment are based on equipment of certain manufacturers. Verify the dimensions of equipment furnished to space available at the Site and allocated to the equipment.
 - b. Drawings show the principal elements of the electrical Work and are not intended as detailed working drawings for the electrical Work. Drawings supplement and complement the Specifications and other Contract Documents relative to principal features of electrical systems.
 - c. Equipment and devices provided under this Contract shall be properly connected and interconnected with other equipment and devices for successful operation of complete systems, whether or not all connections and interconnections are specifically mentioned or shown in the Contract Documents.
 - d. Drawings are provided for CONTRACTOR's guidance in fulfilling the intent of the Contract Documents. CONTRACTOR shall comply with Laws and Regulations, including safety and electrical codes, and provide materials, equipment, appurtenances, and specialty items necessary for complete and operable systems.

C. Related Sections:

1. Section 03 00 05, Concrete.
2. Section 05 05 33, Anchor Systems.
3. Section 31 20 00, Earth Moving.
4. Section 40 60 05, Instrumentation and Control for Process Systems.

D. Area Classifications:

1. Materials, equipment, and incidentals shall be suitable for the area classification(s) shown, specified, and required.
2. Wet Locations: Comply with NEC and NEMA requirements for wet locations. Enclosures in wet locations shall comply with NEMA 4 unless specified otherwise.
3. Corrosive Locations: Comply with NEC and NEMA requirements for corrosive locations. Enclosures in corrosive locations shall conform to NEMA 4X requirements unless specified otherwise.
4. Dusty Locations: Indoor areas not designated as hazardous, corrosive, or wet are dusty locations. Comply with NFPA 70 NEC and NEMA 12 requirements unless specified otherwise.

1.2 QUALITY ASSURANCE

A. Qualifications:

1. Electrical Subcontractor:
 - a. Electrical Subcontractor shall have not less than five years experience installing electrical systems of the types required for the Project.
 - b. Electrical Subcontractor shall possess a valid electricians' and contractors' license in the jurisdiction where the Site is located.
 - c. Submit the following information for not less than three successful, completed projects: project name and location; year completed; name and contact information for: prime contractor for whom electrical Subcontractor worked, project owner, and project engineer or architect, including addresses and telephone numbers.

B. Component Supply and Compatibility:

1. Materials and equipment similar to each other shall be from the same manufacturer for uniformity.

C. Regulatory Requirements:

1. Permits: Refer to the General Conditions, Supplementary Conditions, and other parts of the Contract Documents for responsibilities relative to obtaining and paying for permits, licenses, and inspection fees.
2. Codes: Refer to Section 01 42 00, References, for indication of applicable codes.

1.3 SUBMITTALS

A. General:

1. To the extent practical, submit Shop Drawings and other CONTRACTOR submittals for each Specification Section into the smallest number of submittals possible. Do not furnish partial submittals.
2. Review of equipment submittals does not relieve CONTRACTOR of responsibility for providing complete and successfully operating systems.

B. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Internal wiring diagram and drawings indicating all connections to components and numbered terminals for external connections.
 - b. Dimensioned plan, section, elevations, and panel layouts showing means for mounting, conduit connection, and grounding.
 - c. List of components including manufacturer's name and catalog number (or part number) for each.
2. Product Data:
 - a. Manufacturer's name and product designation or catalog number.
 - b. Electrical ratings.
 - c. Manufacturer's technical data and specifications.
 - d. Manufacturer's indication of compliance with applicable reference standards.
 - e. Painting and coating systems proposed.
3. Test Procedures: Proposed testing procedures and testing limitations for source quality control testing and field quality control testing.

- C. Informational Submittals: Submit the following:
 - 1. Manufacturer's Instructions:
 - a. Installation data and instructions.
 - b. Instructions for handling, starting up, and troubleshooting.
 - 2. Source Quality Control Submittals: Results for required shop testing.
 - 3. Field Quality Control Submittals: Results for required field testing.
 - 4. Qualifications:
 - a. Electrical Subcontractor.
- D. Closeout Submittals: Submit the following:
 - 1. Record Documentation:
 - a. System Record Drawings: Include the following:
 - 1) One-line wiring diagram of the electrical distribution system.
 - 2) Actual, in-place conduit and cable layouts with schedule of conduit sizes and number, and size of conductors.
 - 3) Layouts of the power and lighting arrangements and the grounding system.
 - 4) Control schematic diagrams, with terminal numbers and control devices identified, for all equipment.
 - b. Record documents shall indicate final equipment and field installation information.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Contractor shall comply with requirements specific to all electrical systems work mentioned in Section 01 65 00, Product Delivery Requirements, and Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

- A. Performance Criteria:
 - 1. Electrical equipment shall be capable of operating successfully at full-rated load, without failure, with ambient outside air temperature of 30 degrees F to 100 degrees F and an elevation of 600 feet above mean sea level.
 - 2. Unless specified otherwise, electrical equipment shall have ratings based on 75 degrees C terminations.

- B. Testing Laboratory Labels: Electrical material and equipment shall bear the label of Underwriters' Laboratories, Inc., or other nationally recognized, independent testing laboratory, where standards have been established, and label service applies.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which Work will be performed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. General:
 - 1. Install materials and equipment in accordance with the Contract Documents, Laws, and Regulations, approved (and accepted, as applicable) Shop Drawings and other CONTRACTOR submittals, and manufacturer's recommendations.
 - 2. Provide tools and equipment required to trace circuits necessary for proper execution of the Work.
 - 3. Define and identify all wiring, circuit terminations, and equipment to be modified to ensure proper interface of components. The Contract Price includes all costs associated with field services specified for a complete and functional system.

3.3 FIELD QUALITY CONTROL

- A. Field Quality Control – General:
 - 1. Perform field quality control for electrical Work in accordance with the Contract Documents and appropriate codes and regulations.
- B. Site Tests:
 - 1. Prior to requesting certificate of Substantial Completion, demonstrate to ENGINEER those electrical systems and electrically operated equipment installed or modified under the Contract operates in accordance with the Contract Documents and operates as required.
 - 2. Perform the following operational tests on electrical systems:
 - a. Operate power circuits to verify proper operation and connection to electrical systems materials and equipment, including mechanical key-interlocks for circuit breakers.
 - b. Operate control circuits, including pushbuttons, indicating lights, and similar devices, to verify proper connection and

function. Operate all devices, such as pressure switches, flow switches, and similar devices, to verify that shutdowns and control sequences operate as required.

- c. Operate lighting systems and receptacle devices to verify proper operation and connections.
 - 3. Prepare and submit report on the equipment demonstration and operating field quality control tests. Report shall include complete information on the tests performed, date completed, and results.
- C. Manufacturer's Services:
- 1. Furnish at the Site qualified, factory-trained representative(s) of equipment manufacturers for the services indicated in the Contract Documents.

+ + END OF SECTION + +

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install low-voltage conductors and cabling.
2. Types of cabling required include:
 - a. Insulated cable for installation in raceways.

B. Related Sections:

1. Section 26 05 53, Identification for Electrical Systems.
2. Section 31 20 00, Earth Moving.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI/NETA ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems.
2. ASTM B3, Specification for Soft or Annealed Copper Wire.
3. ASTM B8, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
4. UL 44, Thermoset-Insulated Wires and Cables.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:

1. NEC Article 300, Wiring Methods.
2. NEC Article 310, Conductors for General Wiring.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:
 - a. Manufacturer's literature, specifications, and engineering data for low volt insulated cable proposed for use.

B. Informational Submittals: Submit the following:

1. Field Quality Control Submittals:
 - a. Written results of field insulation resistance tests.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Insulated Cable in Raceways:

1. Application: Use for circuits located indoors and outdoors.
2. Manufacturers: Provide products of one of the following:
 - a. Southwire.
 - b. The Okonite Company.
 - c. American Insulated Wire
 - d. General Cable
 - e. Or approved equal.
3. Material: Single conductor copper cable complying with ASTM B3 and ASTM B8 with flame-retardant, moisture- and heat-resistant insulation rated for 90 degrees C in dry or wet locations, listed by UL as Type XHHW-2 or RHW-2 complying with UL 44.
4. Wire Sizes: Not smaller than No. 12 AWG for power and lighting and No. 14 AWG for 120-volt control circuits.
5. Stranding: 600-volt cable shall be stranded, except that solid cable, No. 10 and smaller may be used for lighting circuits.

B. Cable Connectors, Solderless Type:

1. Products and Manufacturers: Provide products of one of the following:
 - a. T&B Sta-Kon.
 - b. Burndy Hylug.
 - c. Or approved equal.
2. For wire sizes No. 4 AWG and above, use either compression type or bolted type with silver-plated contact faces.
3. For wire sizes up to and including No. 6 AWG, use compression type. Alarm and control wire shall be terminated using forked type connectors at terminal boards.

Low-Voltage Electrical Power Conductors and Cables

4. For wire sizes No. 250 KCMIL and larger, use connectors with at least two cable clamping elements or compression indents and provision for at least two bolts for joining to apparatus terminal.
5. Properly size connectors to fit fastening device and wire size. Connectors shall be rated for 90 degree C, 600 volts.

C. Cable Splices:

1. Products and Manufacturers:
 - a. Compression-Type Splices: Provide one of the following:
 - 1) Burndy Hylink.
 - 2) T&B Color-Keyed Compression Connectors.
 - 3) Or approved equal.
 - b. Spring Connectors: Provide one of the following:
 - 1) Buchanan B-Cap.
 - 2) T&B Wire Connector.
 - 3) Or approved equal.
2. For wire sizes No. 8 AWG and larger, splices shall be made up with compression type copper splice fittings. Splices shall be taped and covered with materials recommended by cable manufacturer to provide insulation equal to that on conductors.
3. For wire sizes No. 10 AWG and smaller, splices may be made up with pre-insulated spring connectors.
4. For wet locations, splices shall be waterproof. Compression type splices shall be waterproofed by sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring thermosetting resin into mold that surrounds the joined conductor. Spring connector splices shall be waterproofed with sealant filler.
5. Splices shall be suitably sized for cable, rated 90 degrees C, and 600 volts.

D. Wire and Cable Markers:

1. Provide wire and cable markers in accordance with Section 26 05 53, Identification for Electrical Systems.

2.2 SOURCE QUALITY CONTROL

A. Factory Tests:

1. Factory-test wire and cable in accordance with UL standards

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install cables complete with proper terminations at both ends. Check and correct for proper phase sequence and proper motor rotation.
- B. Pulling:
 1. Use insulating types of pulling compounds containing no mineral oil.
 2. Pulling tension shall be within limits recommended by wire and cable manufacturer.
 3. Use dynamometer where mechanical means are used.
 4. Cut off section subject to mechanical means.
- C. Bending Radius: Limit to minimum of six times cable overall diameter.
- D. Slack: Provide maximum slack at all terminal points.
- E. Splices:
 1. Where possible, install cable continuous, without splice, from termination to termination.
 2. Where required, splice as shown and where required for cable installation. Splices below grade, in manholes, handholes, and wet locations shall be waterproof.
 3. Splices are not allowed in conduits.
- F. Identification:
 1. Identify conductors in accordance with Section 26 05 53, Identification for Electrical Systems.
 2. Identify power conductors by circuit number and phase at each terminal or splice location.
 3. Identify control and status wiring using numeral tagging system.
- G. Color-code power cables as follows:
 1. No. 8 AWG and Smaller: Provide colored conductors.
 2. No. 6 AWG and Larger: Apply general-purpose, flame-retardant tape at each end, wrapped in overlapping turns to cover an area of at least two inches.
 3. Colors: Match color scheme in use at the Site. If the Site does not have an existing color scheme, use the following colors:

Low-Voltage Electrical Power Conductors and Cables

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts Three-Phase, Four-Wire Delta, Center Tap Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts Three-Phase, Four-Wire	rounded Neutral Phase A Phase B Phase C	Gray Brown Orange Yellow

3.2 FIELD QUALITY CONTROL

A. Site Tests:

1. Test each electrical circuit after permanent cables are in place, to demonstrate that circuit and equipment are connected properly and will perform satisfactorily, free from improper grounds and short circuits.
2. Individually test 600-volt cable mechanical connections after installation and before they are put in service, with calibrated torque wrench. Values shall be in accordance with manufacturer's recommendations.
3. Individually test 600-volt cables for insulation resistance between phases and from each phase to ground. Test after cables are installed and before they are put in service, with Megger for one minute at voltage rating recommended by cable manufacturer or in accordance with ANSI/NETA ATS recommendations.
4. Insulation resistance for each conductor shall not be less than value recommended by cable manufacturer. Cables not meeting recommended value or that fail when tested under full load conditions shall be replaced with a new cable for full length.

+ + END OF SECTION + +

SECTION 26 05 23

INSTRUMENTATION AND COMMUNICATION CABLES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install instrumentation and communication cables.
2. Types of cables include the following:
 - a. Shielded instrumentation cables.
 - b. Data communication cables.

B. Related Sections:

1. Section 26 05 33.13, Rigid Conduits.
2. Section 26 05 53, Identification for Electrical Systems.

1.2 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:

1. “CPE” means chlorinated polyethylene.
2. “FEP” means fluorinated ethylene-propylene.
3. “XLPE” means cross-linked polyethylene.

1.3 REFERENCES

A. Standards referenced in this Section are:

1. ASTM A510, Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
2. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
3. ANSI/TIA/EIA-568, Commercial Building Telecommunications Cabling (requirements and restrictions of Technical Service Bulletins (TSBs) apply.)
4. UL 13, Power-Limited Circuit Cables.
5. UL 1581, Electrical Wires, Cables, and Flexible Cords.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. NEC 725, Class 1, Class 2, and Class 3 Remote-Control, Signaling and Power-Limited Circuits.
2. NEC 727, Instrumentation Tray Cable.
3. NEC 800, Communications Circuits.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data: Manufacturer's technical information for instrumentation cables and communications cables proposed.

B. Informational Submittals: Submit the following:

1. Field Quality Control Submittals: Written report of results of field quality control testing specified in this Section.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General:

1. Cables shall bear the UL label.

B. Single Shielded Pair Instrument Cables:

1. Manufacturers: Provide products of one of the following:
 - a. Belden Company.
 - b. Okonite Company.
 - c. Dekoron Wire and Cable Company.
 - d. Or approved equal.
2. Tinned Copper, XLPE-insulated, stranded conductors, not less than no. 16 AWG, twisted pair, with overall shield, stranded tinned no. 18 AWG copper drain wire and overall PVC or CPE jacket. Rated for not less than 600 volts and complying with UL 1581 or UL 13.

C. Multi-Paired Shielded Instrument Cables:

1. Manufacturers: Provide products of one of the following:
 - a. Belden Company.
 - b. Okonite Company.
 - c. Dekoron Wire and Cable Company.

- d. Or approved equal.
 - 2. Tinned Copper, XLPE- insulated stranded conductors, not less than no 16 AWG, stranded tinned no. 18 AWG copper drain wire, with overall 100% foil shield and overall PVC or CPE outer jacket. Rated for not less than 600 volts.
- D. Multi-Conductor Shielded Instrument Cables:
- 1. Manufacturers: Provide products of one of the following:
 - a. Belden Company.
 - b. Okonite Company.
 - c. Dekoron Wire and Cable Company.
 - d. Or approved equal.
 - 2. Tinned copper, XLPE-insulated stranded conductors, not less than no. 16 AWG, stranded tinned no. 18 AWG copper drain wire, with overall 100 percent foil shield and overall PVC or CPE jacket. Rated for not less than 600 volts.
- E. Cable Terminals:
- 1. Manufacturers: Provide products of one of the following:
 - a. T&B Sta-Kon.
 - b. Burndy Insulug.
 - c. Or approved equal.
 - 2. Fork type copper compression terminals with nylon insulation for termination of cable at terminal blocks.
- F. Horizontal Unshielded Twisted Pair (UTP) Cables:
- 1. Horizontal cabling is cabling between and including the telecommunications outlet/connector and patch panel or termination block.
 - 2. Manufacturers: Provide products of one of the following:
 - a. Bertek.
 - b. Belden.
 - c. Mohawk
 - d. Or approved equal.
 - 3. Cables shall consist of no. 24 AWG, thermoplastic-insulated, solid conductors formed into four individually twisted pairs and enclosed by thermoplastic jacket.
 - 4. Comply with ANSI/TIA/EIA-568, Part 10.2.

5. Riser-rated where installed in conduit. Other installations shall be plenum-rated.
6. Rated for Category 6 use.

G. Patch Cords:

1. Patch cords are used for connecting patch panel to hub, or wall jack to equipment.
2. Manufacturer: Provide products of one of the following:
 - a. Berteck.
 - b. Belden.
 - c. Mohawk
 - d. Or approved equal.
3. Cables shall consist of no. 24 AWG, thermoplastic-insulated, stranded conductors formed into four individually-twisted pairs and enclosed by thermoplastic jacket.
4. Cables shall be riser-rated.
5. Rated for Category 6 use.
6. Cables shall incorporate integral strain relief into the connector at each end. Connectors shall be RJ45 plugs.
7. Provide the following patch cords:
 - a. One 10-foot cable per wall jack installed.
 - b. One 3-foot cable per every two wall jacks installed.
 - c. One 5 foot cable per every two wall jacks installed.

H. Connecting Hardware for Unshielded Twisted Pair (UTP) Cables:

1. Hardware used to terminate UTP cable shall comply with ANSI/TIA/EIA-568, Part 10.4.
2. Connecting hardware shall be compatible with wiring specified in the Contract Documents.
3. Rated for Category 6 use.
4. Connecting hardware shall utilize 110-type terminal blocks to coordinate with patch panels and termination blocks specified the Contract Documents.
5. Telecommunications Outlets/Connectors:
 - a. Manufacturers: Provide products of one of the following:
 - 1) Hubbell.
 - 2) Or approved equal.
 - b. Outlets and connectors shall utilize RJ45 (eight-pin modular) plug/receptacle configuration.

- c. Outlets and connectors shall utilize T568B pin/pair assignments and must be coordinated with wire type (solid or stranded conductor).
- d. Outlets shall be flush-mount type or surface-mount type, as indicated on the Drawings.

I. Patch Panels:

- 1. Manufacturers: Provide products of one of the following:
 - a. Black Box.
 - b. Or approved equal.
- 2. Patch panels shall utilize RJ45 (eight-pin modular) plug/receptacle configuration and utilize T568B pin/pair assignments for receptacles.
- 3. Coordinate patch panel terminations with wire type (solid or stranded conductor).
- 4. Patch panels shall be wall-mount type or rack-mount type, as indicated on the Drawings.
- 5. Listed as Category 6.
- 6. Provide quantity of ports not less than the quantity of wall jacks installed in the building/area served, plus 50 percent additional as spares.

J. Cable Support Hardware:

- 1. Conduit:
 - a. Where conduit is shown or indicated on the Drawings, comply with Section 26 05 33.13, Rigid Conduits.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. General:
 - 1. Install cables complete with proper terminations at both ends.

Instrumentation and Communication Cables

2. Install in conduit separate from power cables, unless shown or indicated otherwise.
3. Ground shield on shielded cables at one end only and as recommended by instrument manufacturer.
4. Identify conductors in accordance with Section 26 05 53, Identification for Electrical Systems.
5. Install and terminate Supplier-furnished cable in accordance with equipment manufacturer requirements and cable manufacturer's recommendations.
6. Install in accordance with Laws and Regulations, including NEC.

3.3 FIELD QUALITY CONTROL

A. Site Tests:

1. Test the shielded instrumentation cable shields with ohmmeter for continuity along full length of cables, and for shield continuity to ground.
2. Connect shielded instrumentation cables to calibrated 4 to 20 mA dc signal transmitter and receiver. Test at 4 and 20 mA transmitter settings.
3. Replace with new cables the full length of cables that fail test.
4. Test equipment shall be provided by the CONTRACTOR.
5. For testing of communications cables, test equipment used shall comply with the following:
 - a. Equipment shall consist of a "master" and a "remote" unit.
 - b. Test of all aspects of cables shall be automatic and initiated with a single command. Test over entire frequency range. Test unit shall be capable of accepting cable identification tag for reporting. Test unit shall return "pass/fail" status for cables and, if "fail," shall indicate reason for failure.
 - c. Test unit shall be capable of storing all test results internally and printing the results later.
 - d. For unshielded twisted pair cables, test unit shall be specifically designed and manufactured to certify cabling relative to Category 6 compliant.

++ END OF SECTION ++

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install complete grounding for electrical systems, structures, and equipment.

A. Related Sections:

1. 32 31 00, Fences

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM B8, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
2. UL 467, Grounding and Bonding Equipment.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements

1. National Electrical Code, (NEC).
 - a. NEC Article 250, Grounding and Bonding.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Listing of grounding connector types identifying where each will be used.
 - b. Layouts of each structure's ground grid.
 - c. Test point construction details.
2. Product Data:
 - a. Manufacturer's technical information for grounding materials proposed for use.
3. Testing Plans:
 - a. Ground resistance test procedure.

B. Informational Submittals: Submit the following:

1. Field Quality Control Submittals
 - a. Results of ground resistance tests at each test point.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Bare Ground Cable:

1. Manufacturers: Provide products of one of the following:
 - a. Cablec Corporation.
 - b. General Cable Corporation.
 - c. Southwire Cable Company.
 - d. Or approved equal.
2. Material: Soft-drawn, bare copper stranded cable complying with ASTM B8. No. 4/0 AWG minimum size unless otherwise shown or indicated on the Drawings.

B. Ground Rods:

1. Manufacturers: Provide products of one of the following:
 - a. Copperweld, Bimetallics Division.
 - b. ITT Blackburn Company.
 - c. Or approved equal.
2. Material: Copper-clad rigid steel rods, 3/4-inch diameter, ten feet long.
3. All required ancillary items: As shown in Contract Drawings.

C. Grounding Connectors:

1. Products and Manufacturers: Provide one of the following:
 - a. Pressure Connectors:
 - 1) O.Z./Gedney, Division of General Signal Corporation.
 - 2) Burndy Corporation.
 - 3) Or approved equal.
 - b. Welded Connections:
 - 1) Cadweld by Erico Products, Incorporated.
 - 2) Therm-O-Weld by Burndy Corporation.
 - 3) Or approved equal.

Grounding and Bonding for Electrical Systems

2. Material: Pressure connectors shall be copper alloy castings, designed and fabricated specifically for items to be connected and assembled with Durium or silicone bronze bolts, nuts, and washers. Welded connections shall be by exothermic process utilizing molds, cartridges, and hardware designed specifically for connection to be made.
- D. Ground Test Well:
 1. As shown in Contract Drawings.
- E. Ground Bonding Jumpers:
 1. Braided copper tape, one inch wide, woven of No.30-gauge bare copper wire, terminated with copper ferrules.
- F. Ground system components shall comply with UL 467.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions for the Work and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions are corrected.

3.2 STRUCTURE GROUND SYSTEM

- A. Provide ground grids as shown and indicated on the Drawings.
- B. Provide No. 4/0 bare copper cable around exterior perimeter of structures at not less than 2.5 feet below grade, unless otherwise shown or indicated on the Contract Documents.
- C. For structures with steel columns, provide No. 4/0 ground cable from grid to each column around perimeter of structure. Connect cable to steel with exothermic welds.
- D. Connect grids to continuous underground water pipe system, when practical.
- E. For new structures with concrete foundation or footings, connect structure's reinforcing steel or other concrete-encased electrode to grounding grid.
- F. Provide accessible test points for measuring the ground resistance of each grid.
- G. Weld all buried connections except for test points.

3.3 EQUIPMENT GROUNDING

- A. Ground electrical equipment in compliance with Laws and Regulations and the Contract Documents.

Grounding and Bonding for Electrical Systems

- B. Equipment grounding conductors shall be bare stranded copper cable of adequate size installed in metal conduit where required for mechanical protection. Ground conductors, pulled into conduits with non-grounded conductors, shall be insulated. Insulation shall be green.
- C. Control panels grounding conductors shall be bare stranded copper cable of adequate size to ground grid from AC ground bus, and an insulated stranded copper cable of adequate size to ground grid from DC ground bus.
- D. Connect ground conductors to conduit with copper clamps, straps, or with grounding bushings.
- E. Connect to piping by welding or brazing. Use copper bonding jumpers on gasketed joints.
- F. Connect to equipment by means of lug compressed on cable end. Bolt lug to equipment frame using holes or terminals provided on equipment specifically for grounding. Do not use hold-down bolts. Where grounding provisions are not included, drill suitable holes in locations recommended by equipment manufacturer or designated by ENGINEER.
- G. Connect to motors by bolting directly to motor frames, not to soleplates or supporting structures.
- H. Connect to service water piping by means of copper clamps. Use copper bonding jumpers on gasketed joints.
- I. Scrape bolted surfaces clean and coat with conductive oxide-resistant compound.

3.4 FIELD QUALITY CONTROL

- A. Site Tests:
 - 1. Test completed grounding systems for resistance to ground using an electrical three-terminal ground resistance tester. Test all grounded cables and metal parts for continuity of connection. ENGINEER and OWNER will witness the testing.
 - 2. Grounding system maximum resistance shall not exceed five ohms under normally dry conditions when measured by resistance tester. Resistance values above five ohms shall be brought to ENGINEER's attention. Provide additional ground rods as required to attain a resistance to ground of less than five ohms for each ground grid. Add grounding additive installing additional ground rods to increase their effectiveness.

+ + END OF SECTION + +

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install hangers and supports for electrical systems.
2. Area Classifications: Materials shall be suitable for the area classification(s) shown or indicated on the Drawings, and specified in Section 26 05 05, General Provisions for Electrical Systems.

B. Related Sections:

1. Section 05 05 33, Anchor Systems.
2. Section 26 05 05, General Provisions for Electrical Systems.
3. Section 26 05 33.13, Rigid Conduits.

1.2 REFERENCES

A. Standards referenced in this section are:

1. ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Detailed installation drawings showing dimensions and compatibility with the proposed layout.
2. Product Data:
 - a. Manufacturer's name, product designation, and catalog number of each material item proposed for use.
 - b. Manufacturer's specifications including material, dimensional and weight data, and load capacity for each supporting system component proposed for use.
 - c. Pictorial views and corresponding identifying text of each component proposed for installation.

- d. Documentation that confirms product compatibility with Laws and Regulations.
- B. Informational Submittals: Submit the following:
 - 1. Certifications:
 - a. Submit certifications required under this Section.
 - 2. Manufacturer's Instructions:
 - a. Manufacturer's installation instructions, including recommended tightening torque values for all nuts and bolts.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide products of one of the following:
 - 1. B-Line.
 - 2. Kindorf.
 - 3. Unistrut
 - 4. Or approved equal.

2.2 MATERIALS

- A. Strut, Fittings, and Accessories:
 - 1. General
 - a. Unless otherwise shown or indicated, strut shall be 1-5/8 inches by 1-5/8 inches. Double struts shall be two pieces of the same strut, welded back-to-back at the factory.
 - b. Attachment holes, when required, shall be factory-punched on hole centers approximately equal to the cross-sectional width and shall be 9/16-inch diameter.
 - c. Fittings, braces, brackets, hardware, and accessories shall be Type 316 stainless steel.
 - d. Strut nuts shall be spring captured Type 316 stainless steel.
 - e. Square and round washers shall be Type 316 stainless steel.
 - 2. Strut materials shall be suitable for area classifications indicated in Section 26 05 05, General Provisions for Electrical Systems, and shown or indicated on the Drawings.
 - a. Wet Locations:
 - 1) Strut shall be 12-gage Type 316 stainless steel.

- B. Hanger Rods:
 - 1. Material:
 - a. Dry Locations: All-thread, zinc-coated
 - b. Wet, Corrosive, or Hazardous Areas: Stainless steel.
 - 2. Size: Not less than 3/8-inch diameter, unless otherwise shown on the Drawings or specified.
- C. Beam Clamps for Attaching Threaded Rods or Bolts to Beam Flanges for Hanging Struts or Conduit Hangers:
 - 1. Beam clamps shall be stainless steel equipped with stainless steel square head set screw and shall include threaded hole sized for attaching the all-thread rod or threaded bolt.
- D. Miscellaneous Hardware:
 - 1. Bolts, screws, and washers shall be stainless steel.
 - 2. Hex Nuts: Shall be stainless steel and include nylon inserts.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Provide hangers and supports for electrical systems with necessary channels, fittings, brackets, and related hardware for mounting and supporting materials and equipment. Provide anchor systems, concrete inserts, and associated hardware for proper support of electrical systems.
- B. Install equipment and devices on hangers and supports as shown on the Drawings, as specified, and as required.
- C. Install hangers and supports level, true, free of rack, and parallel and perpendicular to building walls and floors, so that the hangers and supports are installed in a neat, professional, skillful manner.
- D. Holes in suspended ceilings for rods for hangers and supports and other equipment shall be provided adjacent to bars, where possible, to facilitate removal of ceiling panels.
- E. Coordinate installation of hangers and supports with equipment, cabinets, consoles, panels, enclosures, boxes, conduit, cable tray, wireway, busway, cablebus, piping, ductwork, lighting fixtures, and other systems and

equipment. Locate hangers and supports clear of interferences and access ways.

- F. Anchor Bolts, Expansion Anchors, and Concrete Inserts: Shall be in accordance with Section 05 05 33, Anchor Systems, and requirements of this Section.
- G. Mounting of Conduit:
 - 1. Provide space of not less than 1/4-inch between conduit surfaces and abutting or near surfaces except struts, cable trays, steel beams, and columns.
 - 2. Fasten conduit to struts, cable trays, steel beams, and columns using specified clamps and straps as shown, specified, and required.
 - 3. Devices shall be compatible with size of conduit and type of support. Following installation, size identification shall be visible and legible.
 - 4. Install conduit supports and fasteners in accordance with Section, 26 05 33.13, Rigid Conduits.
- H. Supports for Cabinets, Consoles, Panels, Enclosures, and Boxes:
 - 1. Freestanding: Unless otherwise specified or shown on the Drawings, provide supports for floor-mounted equipment, cabinets, consoles, panels, enclosures, and boxes. Such supports shall be 3.5-inch-high concrete equipment base with a 45-degree chamfered edge. Base shall extend two inches beyond outside dimensions of equipment on all sides.
 - 2. Wall-Mounted:
 - a. Provide space not less than 1/4-inch between cabinets, consoles, panels, enclosures, and boxes and the surface on which each is mounted. Provide non-metallic or stainless-steel spacers as required.
 - b. Do not mount equipment, enclosures, panels, and boxes directly to beams or columns. Mount struts to beams or columns using beam clamps, and mount equipment, enclosures, panels, and boxes to the struts.
 - 3. Floor Stand Rack:
 - a. Where equipment, cabinets, consoles, panels, enclosures, and boxes cannot be wall-mounted, provide an independent floor stand rack.
 - b. Floor stand rack shall consist of struts, plates, brackets, connection fittings, braces, accessories, and hardware

assembled in a rigid framework suitable for mounting of intended materials and equipment.

- c. Equip floor stand racks with brackets and bases for rigidly mounting the framework to the ceiling or floor, as applicable; or equip floor stand racks with beam clamps, angle plates, washers, and bolts for fastening to beam flanges, as applicable.
- d. When equipment, cabinets, consoles, panels, enclosures, and boxes weigh more than 100 pounds:
 - 1) Main vertical supports of floor stand rack assemblies shall be back-to-back struts.
 - 2) Bracing, clamping, and anchoring of each floor stand rack shall be sufficient to ensure rigidity of the floor stand rack with the intended equipment, enclosures, conduit, cable tray, busway, cable bus, and wireway installed. Floor stand racks shall not be deflected more than 1/8-inch by a 100-pound force applied at any point on the floor stand rack in any direction.
- I. Drilling into beams or columns is not allowed unless authorized by ENGINEER.
- J. Tighten nuts and bolts to the manufacturer's recommended torque values.
- K. Field Cutting:
 - 1. Cut edges of strut and hanger rod shall have rounded corners, edges beveled, and burrs removed. If field cutting the strut is required, use clean, sharp, dedicated tools. Remove oil, shavings, and other residue of cuttings prior to installation.
 - 2. Coatings: To prevent corrosion:
 - a. Coat cut edges with epoxy-base touchup paint.
 - b. Coat cut edges with zinc-rich paint.

++ END OF SECTION ++

SECTION 26 05 33.13

RIGID CONDUITS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install conduit and fittings to form complete, coordinated, and grounded raceway systems.
2. When specific, detailed conduit routings for various systems within buildings and other areas are not be shown on the Drawings, CONTRACTOR shall establish routings based on single-line, riser, and interconnection diagrams and other information on the Drawings. CONTRACTOR shall provide for the proper installation of conduits in each system.
3. Conduit types and the installation methods shall comply with the following, unless otherwise shown or indicated in the Contract Documents:
 - a. Use steel conduit (rigid steel or intermediate metallic) for exposed indoor conduit runs in non-corrosive areas.
 - b. Use PVC-coated rigid steel or aluminum conduit for exposed interior or exterior conduit runs in hazardous, wet, and corrosive locations.
 - c. Use PVC-coated rigid steel conduit for individual conduits direct-buried in the ground.
 - d. Use Schedule 40 PVC or steel conduit for concrete-encased duct bank runs.
 - e. Use steel conduit for plant monitoring and control (PMCS) systems, system control and data acquisition (SCADA) systems, and communication systems, regardless of the installation.

B. Coordination:

1. Conduit runs shown are diagrammatic. Coordinate conduit installation with piping, ductwork, light fixtures, and other systems and equipment and locate to avoid interferences.
2. For conduits to be embedded in concrete slabs, confirm adequate slab thickness and coordinate location of conduits with placement

of reinforcing steel, waterstops, expansion joints, and other features of the concrete slab.

C. Related Sections:

1. Section 05 05 33, Anchor Systems.
2. Section 26 05 29, Hangers and Supports for Electrical Systems.
3. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI C80.1, Standard for Rigid Electrical Steel Conduit (ERSC).
2. ANSI/NEMA FB1, Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable.
3. NEMA TC2, Electrical Polyvinyl Chloride (PVC) Conduit.
4. NEMA TC3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
5. UL 6, Electrical Rigid Metal Conduit – Steel.
6. UL 514B, Conduit, Tubing, and Cable Fittings.
7. UL 651, Safety Schedule 40 and 80 Rigid PVC Conduit and Fittings.
8. UL 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
9. UL 1242, Electrical Intermediate Metal Conduit – Steel.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:

1. NEC Article 342, Intermediate Metal Conduit
2. NEC Article 344, Rigid Metal Conduit.
3. NEC Article 352, Rigid Nonmetallic Conduit.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Assembly details of conduit racks and other conduit support systems.
 - b. Layout drawings showing proposed routing of exposed conduits, conduits embedded in structural concrete, and conduits directly buried in the ground. Shop Drawings shall

show locations of pull and junction boxes and penetrations in walls and floors. Shop Drawings of embedded conduits shall include cross-sections showing thickness of concrete slabs and locations of conduits relative to reinforcing steel, waterstops, and other features of the slab.

2. Product Data:
 - a. Manufacturer's catalog cuts and product data for conduit, fittings, and appurtenances.
- B. Informational Submittals: Submit the following:
 1. Manufacturer's Instructions:
 - a. When requested by ENGINEER, provide copies of manufacturer's recommendations for handling and installing products.
 2. Site Quality Control Submittals:
 - a. When requested by ENGINEER, provide copies of results of specified Site quality control testing.
- C. Closeout Submittals: Submit the following:
 1. Record Drawings:
 - a. Show actual routing of exposed and concealed conduit runs in record documents in accordance with Section 01 78 39, Project Record Documents.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Rigid Steel Conduit, Elbows, and Couplings:
 1. Manufacturers: Provide products of one of the following:
 - a. Allied Tube and Conduit.
 - b. Wheatland Tube Company.
 - c. Western Tube and Conduit Corporation.
 - d. Or approved equal.
 2. Material: Rigid, heavy-wall, mild steel, hot-dip galvanized, smooth interior, tapered threads, and carefully reamed ends; 3/4-inch NPS minimum size.
- B. PVC-coated Rigid Steel Conduit, Elbows, and Couplings:
 1. Manufacturers: Provide products of one of the following:
 - a. Robroy Industries.

- b. Perma-Cote Industries.
 - c. OCAL, Inc.
 - d. Or approved equal.
 - 2. Material: Rigid, heavy-wall, mild steel, hot-dip galvanized, smooth urethane interior coating, tapered threads, carefully reamed ends, 3/4-inch NPS minimum size with factory exterior coating of 40-mil thick PVC.
 - 3. Color: Color of coating shall be the same on all conduit and fittings.
- C. Metallic Conduit Fittings, and Outlet Bodies:
- 1. Manufacturers: Provide products of one of the following:
 - a. Crouse-Hinds Company.
 - b. Appleton Electric Company.
 - c. Or approved equal.
 - 2. Material and Construction: Cast gray iron alloy, cast malleable iron or aluminum bodies, and covers consistent with conduit material. Units shall be threaded type with five full threads. Materials shall comply with ANSI/NEMA FB1 and be listed by UL. Do not use "LB" fittings. Use type "LBD" fittings where use of fittings is unavoidable.
 - 3. Use: Conduits shall be gasketed and watertight in hazardous, wet, and corrosive locations.
- D. PVC-coated Conduit Fittings, and Outlet Bodies:
- 1. Manufacturers: Provide products of one of the following:
 - a. Robroy Industries.
 - b. Perma-Cote Industries.
 - c. OCAL, Inc.
 - d. Or approved equal.
 - 2. Material and Construction: Cast gray iron alloy, cast malleable iron bodies, and covers with factory coating of 40-mil thick PVC and smooth urethane interior coating. Units shall be threaded type with five full threads. Material shall comply with ANSI/NEMA FB1 and be listed by UL. Do not use "LB" fittings. Use type "LBD" fittings where use of fittings is unavoidable.
 - 3. Use: Provide PVC-coated or aluminum conduit fittings and outlet bodies in hazardous, wet, and corrosive locations. Fitting material shall be consistent with conduit material.

E. Non-metallic Conduit and Fittings:

1. PVC Plastic Conduit:

- a. Manufacturers: Provide products of one of the following:
 - 1) Amoco Chemicals Corp.
 - 2) Carlon Electrical Products.
 - 3) Or approved equal.
- b. Material: Schedule 40 PVC, rated for 90 degrees C, complying with NEMA TC3 and UL 514B and 651.
- c. Fittings: Form elbows, bodies, terminations, expansions, and fasteners of same material and manufacturer as base conduit. Provide cement by same manufacturer as base conduit.

F. Conduit Hubs:

- 1. Manufacturers: Provide products one of the following.
 - a. Myers Electrical Products Company.
 - b. Or approved equal.
- 2. Material: Threaded conduit hub, vibration-proof, weatherproof, with captive O-ring seal, zinc metal with insulated throat and bonding screw.
- 3. Use: Provide for all conduit terminations to boxes, cabinets, and other enclosures in areas designated as wet locations.

G. PVC-coated Conduit Hubs:

- 1. Manufacturers: Provide products one of the following:
 - a. Robroy Industries.
 - b. Perma-Cote Industries.
 - c. OCAL, Inc.
 - d. Or approved equal.
- 2. Material: Threaded conduit hub, vibration-proof, weatherproof, with captive O-ring seal, zinc metal with insulated throat and bonding screw, and factory coating of 40-mil thick PVC and smooth urethane interior coating.
- 3. Use: Provide for PVC-coated steel or aluminum conduit terminations to boxes, cabinets, and other enclosures in areas designated as corrosive location.

H. Conduit Bushings and Locknuts:

- 1. Manufacturers: Provide products one of the following:

- a. O-Z/Gedney.
- b. Appleton Electric Company.
- c. Or approved equal.
- 2. Insulated Bushings: Malleable iron body with plastic liner. Threaded type with steel clamping screw. Provide with bronze grounding lug, as required.
- 3. Locknuts: Steel for sizes 3/4-inch through two-inch diameter and malleable iron for sizes 2.5-inch through four-inch diameter.
- 4. Use: Provide for all conduit terminations to boxes, cabinets, and other enclosures except threaded type in areas designated as dusty locations.

I. Thruwall Seals

- 1. For new construction through exterior subsurface walls and exterior concrete walls.
 - a. Manufacturer: Provide one of the following:
 - 1) Type WSK and WSCS by O-Z/Gedney.
 - 2) Or approved equal.
- 2. For new construction passing through concrete floors and floor slabs.
 - a. Manufacturer: Provide one of the following:
 - 1) Type FSK and FSCS floor seals by O-Z/Gedney.
 - 2) Or approved equal.
- 3. For conduits passing through new exterior masonry block walls or through core-drilled holes in existing exterior subsurface walls, exterior concrete walls, floor slabs, and roof slabs, and for conduits passing through existing interior concrete walls or floors and interior masonry block walls.
 - a. Manufacturer: Provide one of the following:
 - 1) Type CSMI sealing bushing at the inside of the structure and Type CSMC sealing bushing at the outside of the structure by O-Z/Gedney.
 - 2) Or approved equal.

2.2 ACCESSORIES

- A. Fasteners: To the extent possible, fastener material shall be consistent with conduit material. For PVC-coated rigid steel conduit runs, fasteners shall have factory applied PVC coating or be stainless steel. Fasten raceway systems to supporting structures using the following:

1. To Wood: Wood screws.
 2. To Hollow Masonry Units: Toggle bolts, in accordance with Section 05 05 33, Anchor Systems.
 3. To Brick Masonry: Expansion bolts by Price, or equal.
 4. To Concrete: Anchors in accordance with Section 05 05 33, Anchor Systems.
 5. To Steel: Beam clamps in accordance with Section 26 05 29, Hangers and Supports for Electrical Systems.
- B. Duct Sealing Compound
1. Soft, fibrous, slightly tacky, non-hardening sealing compound.
 2. Remains workable at all temperatures.
 3. Manufacturer:
 - a. Type DUX by O-Z/Gedney.
 - b. Or approved equal.

2.3 IDENTIFICATION

- A. Conduit Labels:
1. Provide conduit labels in accordance with Section 26 05 53, Identification for Electrical Systems.
- B. Warning Tape:
1. Provide warning tape in accordance with Section 26 05 53, Identification for Electrical Systems.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install in accordance with Laws and Regulations.
- B. Supports:
1. Rigidly support conduits by clamps, hangers, or Unistrut-type channels. Conduit supports and accessories shall be in accordance with Section 26 05 29, Hangers and Supports for Electrical Systems.

2. Support single conduits by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the support surface. Support multiple runs of conduits on trapeze type hangers.
- C. Fastenings: Fasten raceway systems rigidly and neatly to supporting structures using specified materials.
- D. Exposed Conduit:
 1. Install parallel or perpendicular to structural members or walls.
 2. Where possible, run-in groups. Provide conduit racks of suitable width, length, and height, arranged to suit field conditions. Provide support every ten feet, minimum.
 3. Install on structural members in protected locations.
 4. Locate clear of interferences.
 5. Provide six inches of clearance from hot fluid lines and ¼-inch from walls.
 6. Install vertical runs plumb. Unsecured drop length shall not exceed 12 feet.
- E. Underground Conduits:
 1. Install individual, underground conduits minimum of 20 inches below grade, unless otherwise shown or indicated.
 2. Perform excavation, bedding, backfilling, and surface restoration, including pavement replacement where required, in accordance with Section 31 20 00, Earth Moving, and Section 32 12 00, Flexible Paving.
 3. Install warning tape 12 inches below finished grade over buried conduits.
- F. Empty Conduits:
 1. Install nylon pull wire in each empty conduit and cap conduits not terminating in boxes with permanent fittings designed for the purpose.
- G. Field Bends: No indentations. Diameter of conduit shall not vary more than 15 percent at bends.
- H. Joints:
 1. Apply conductive compound to joints before assembly.
 2. Make up joints tight and ground thoroughly.
 3. Use standard tapered pipe threads for conduit and fittings.

4. Cut conduit ends square and ream to prevent damaging wire and cable.
5. Use full threaded couplings. Split couplings are not allowed.
6. Use strap wrenches and vises to install conduit. Replace conduit with wrench marks.
7. Apply zinc-rich paint to exposed threads and other areas of galvanized conduit system where base metal is exposed.

I. Terminations:

1. Install insulated bushings on conduits entering boxes or cabinets, except when threaded hubs are used.
2. Provide locknuts on both inside and outside of enclosure, except when threaded hubs are used.
3. Use of bushings in lieu of locknuts is not allowed.
4. Install conduit hubs on conduits entering boxes or cabinets in wet and corrosive areas.

J. Moisture Protection:

1. Plug or cap conduit ends at time of installation to prevent entrance of moisture and foreign materials.
2. Underground and embedded conduit connections shall be watertight.
3. Thruwall Seals and Conduit Sealing Bushings: Install for conduits passing through concrete slabs, floors, walls, or concrete block walls.
4. Drainage: Conduit runs shall be fully drainable. Where possible, install conduit runs to drain to one end and away from building. Avoid pockets or depressions in conduit runs.
5. Seal conduit openings within control and instrumentation panels and distribution equipment with duct sealing compound to provide watertight seal.

K. Corrosion Protection:

1. Conduit Curb:
 - a. For conduits routed in concrete slabs or floors and stub-ups through floor, provide (1-)-inch high concrete curb, extending two inches from outer surface of conduit penetrating floor, to prevent corrosion. For floor-mounted equipment, concrete equipment base shall be in lieu of concrete curb.

- b. Conduit stub-ups shall be 90-degree, PVC-coated, rigid, galvanized steel conduit elbow. PVC-coated elbow shall extend a minimum of ½-inch above top of concrete curb or equipment base. Should elbow not reach specified height, provide PVC-coated conduit extension to accommodate specified requirements. Provide coupling or fitting for transition from rigid galvanized steel conduit or PVC conduit in slab to PVC-coated elbow.
 - c. For conduits stubbing up and terminating at equipment enclosure mounted on concrete base, provide insulated grounding bushing on PVC-coated rigid steel elbow.
 - d. For conduits stubbing up and extending to boxes, cabinets, and other enclosures above the concrete curb in wet and dusty areas, provide conduit coupling/fittings between the PVC-coated rigid steel elbow and rigid steel conduit for transition between the two conduit types.
 - e. For conduits stubbing up and extending to boxes, cabinets, and other enclosures above the concrete curb or equipment base in corrosive areas, continue conduit system with PVC-coated rigid steel conduit.
- 2. Dissimilar Metals:
 - a. Prevent occurrence of electrolytic action between dissimilar metals.
 - b. Do not use copper products in connection with aluminum, and do not use aluminum in locations subject to drainage of copper compounds on bare aluminum.
 - c. Back paint aluminum in contact with masonry or concrete with two coats of aluminum-pigmented bituminous paint.
- L. Non-metallic Conduit:
 - 1. Install in accordance with manufacturer's recommendations.
 - 2. Provide manufacturer's recommended adhesives or sealants for watertight connections.
 - 3. Provide expansion fittings for expansion and contraction to compensate for temperature variations. Fittings shall be watertight and suitable for direct burial.
 - 4. Transition to PVC-coated rigid steel conduit before making turn up to enclosures.
- M. PVC-coated Rigid Steel Conduit:
 - 1. Install in accordance with manufacturer's recommendations.

2. Install with manufacturer's installation tools to avoid damage to PVC coating.
 3. Repair damaged PVC coating with manufacturer's recommended touch-up compound.
- N. Identify conduits, including spares, in accordance with Section 26 05 53, Identification for Electrical Systems.

3.3 FIELD QUALITY CONTROL

A. Site Tests:

1. Test conduits by pulling through each conduit a cylindrical mandrel with length not less than two pipe inside diameters, having an outside diameter equal to 90 percent of conduit's inside diameter.
2. Maintain a record, by number, of all conduits successfully tested.
3. Repair or replace conduits that do not successfully pass testing, and re-test.

++ END OF SECTION ++

SECTION 26 05 33.16

FLEXIBLE CONDUITS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install flexible metallic conduit and fittings.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. UL 360, Liquid-Tight Flexible Steel Conduit.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:

1. NEC Article 350, Liquid-Tight Flexible Metal Conduit.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:
 - a. Manufacturer's literature and technical information for flexible conduit and fittings proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Flexible Conduit (Non-hazardous Areas and Class 1, Division 2, Hazardous Areas):

1. Material: Flexible galvanized steel core with smooth, abrasion--resistant, liquid-tight, polyvinyl chloride cover. Continuous copper ground built in for sizes 3/4-inch through 1.25-inch. Material shall be UL-listed.
2. Products and Manufacturers: Provide one of the following:
 - a. Anaconda Sealtite Type UA by Anamet Electrical, Inc.
 - b. Liqueflex Type L.A. by Electric-Flex Company.
 - c. Or approved equal.

B. Flexible Conduit Fittings:

1. Material and Construction: Malleable iron with cadmium finish. Fittings shall adapt the conduit to standard threaded connections, shall have an inside diameter not less than that of the corresponding standard conduit size and shall be UL listed.
2. Manufacturers: Provide products of one of the following:
 - a. Crouse-Hinds Company.
 - b. Appleton Electric Company.
 - c. Or approved equal.
3. Use: Provide on flexible conduit in non-hazardous and Class 1, Division 2 hazardous areas.

C. PVC-Coated Conduit Fittings:

1. Material and Construction: Malleable iron with standard finish and 40-mil PVC exterior coating. Fittings shall adapt the conduit to standard threaded connections and shall have an inside diameter not less than that of the corresponding standard conduit size.
2. Manufacturers: Provide products of one of the following:
 - a. Robroy Industries.
 - b. Permacote Industries.
 - c. OCAL, Inc.
 - d. Or approved equal.
3. Use: Provide flexible conduit in areas designated as corrosive locations.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install at motors, transformers, field instruments, and equipment subject to vibration or require movement for maintenance purposes. Provide necessary

Flexible Conduits

reducer where equipment furnished cannot accept 3/4-inch diameter flexible conduit. Limit flexible conduit length to three feet maximum.

- B. Install in conformance with the Laws and Regulations.

++ END OF SECTION ++

SECTION 26 05 33.26

EXPANSION/DEFLECTION FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. The CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install conduit expansion and deflection fittings.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. UL 514B, Conduit, Tubing, and Cable Fittings.
2. UL 467, Grounding and Bonding Equipment.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:

1. NEC Article 300, Wiring Methods.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Listing of locations where fittings are required.
2. Product Data:
 - a. Manufacturer's literature and technical information for expansion and deflection fittings proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Products and Manufacturers: Provide one of the following:

1. Type DX for expansion/deflection or AX for expansion only, by O-Z Gedney Company.
2. Type XD for expansion/deflection or XJ for expansion only, by Crouse Hinds Company.
3. Type DF for expansion/deflection or XJ for expansion only, by Appleton Electric Company.
4. Or approved equal.

- B. Cast gray iron alloy or bronze end couplings, malleable iron, or hot-dipped galvanized body, stainless steel clamps and tinned copper braid bonding jumper. Fitting shall be watertight, corrosion-resistant, UL-listed, and compatible with the conduit system.
- C. Features:
 - 1. Expansion/Deflection Fittings:
 - a. Axial expansion or contraction up to 3/4-inch.
 - b. Angular misalignment up to 30 degrees.
 - c. Parallel misalignment up to 3/4-inch.
 - 2. Expansion Fittings:
 - a. Expansion/Contraction: Eight-inch total movement.
- D. Expansion/Deflection fittings shall comply with UL 514B and UL 467.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install fittings in accordance with Laws and Regulations.
- B. Provide expansion fittings on exposed conduit runs crossing structural expansion joints and where necessary to compensate for thermal expansion and contraction. Provide expansion fittings on exposed conduit runs exceeding 200 feet.
- C. Provide expansion/deflection fittings on embedded conduit runs crossing structural expansion joints. Provide fittings above waterstops.
- D. Unless specifically shown or indicated otherwise, when crossing structural expansion joints larger than one inch, provide expansion fitting together with expansion/deflection fitting. Install fittings on each conduit run in accordance with manufacturer's recommendations to accommodate additional movement necessary.
- E. Provide expansion/deflection fittings for underground conduit runs at penetrations of buildings, manholes, handholes, and outdoor concrete equipment pads.
- F. Where required in non-metallic conduit and duct systems, provide rigid metal conduit nipples and metal rigid-to-PVC adapters for connection to fittings. Ensure that joints exposed to water or other liquid are made watertight.

+ + END OF SECTION + +

SECTION 26 05 33.33

PULL, JUNCTION, AND TERMINAL BOXES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install pull, junction, and terminal boxes.

B. Related Sections:

1. Section 26 05 05, General Provisions for Electrical Systems.
2. Section 26 05 29, Hangers and Supports for Electrical Systems.
3. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are.

1. AASHTO, Standard Specifications for Highway Bridges.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. NEC Article 314, Outlet, Device, Pull and Junction Boxes; Conduit Bodies; Fittings; and Handhole Enclosures.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:
 - a. Manufacturer's technical information for pull, junction, and terminal boxes proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Pull, Junction, and Terminal Boxes:

1. General – Applicable to All Boxes:
 - a. Description and Performance Criteria:
 - 1) Provide pull, junction, and terminal boxes rated at not less than NEMA 12. Boxes shall be appropriate for each location in accordance with NEMA requirements and as required for area classifications

Pull, Junction, and Terminal Boxes

specified in Section 26 05 05, General Provisions for Electrical Systems.

- 2) For flush-mounted pull boxes in slabs or pavement potentially subject to vehicular traffic, boxes and covers shall be constructed for H-20 loading in accordance with AASHTO Standard Specifications for Highway Bridges.
 - b. Manufacturers: Provide products of one of the following:
 - 1) Appleton Electric Company.
 - 2) Crouse-Hinds Company.
 - 3) Hoffman Engineering Company.
 - 4) Or approved equal.
 - c. Materials: Pull boxes embedded in concrete slabs shall be cast iron.
 - e. Terminal strips and terminal blocks in terminal boxes shall be mounted on terminal box sub-panels.
 - e. Identification: Boxes shall be identified in accordance with Section 26 05 53, Identification for Electrical Systems.
2. Materials and Construction – Dusty Locations:
 - a. Material: Welded and galvanized sheet steel of USS gage.
 - b. Gasket: Oil-resistant gasket.
 - c. Access: Lift-off hinges and quick-release latches.
 - d. Material Thickness:
 - 1) Boxes with dimension two feet and smaller shall be 14-gage.
 - 2) Boxes with dimension between two and three feet shall be 12 gauge.
 - 3) Boxes with dimension of three feet or more in any direction shall be 10-gage.
3. Materials and Construction - Wet, Corrosive, or Hazardous Locations:
 - a. Rating:
 - 1) Pull boxes in wet, corrosive, or outdoor areas shall be NEMA 4X.
 - 2) Boxes for areas classified as hazardous locations, where required by NEC, shall be explosion-proof and comply with UL 886.
 - b. Material:

Pull, Junction, and Terminal Boxes

- 1) Cast gray iron alloy with hot-dip galvanized finish, or cast malleable iron bodies and covers.
 - 2) Large boxes not generally available in cast iron construction shall be copper-free aluminum alloy or Type 316 stainless steel, as required by location.
 - 3) In corrosive locations, where the conduit system is PVC-coated, boxes shall be cast metal with factory-applied 40-mil PVC coating, Type 316 stainless steel, or non-metallic thermoplastic or fiberglass reinforced plastic material.
- c. Gasket:
- 1) Provide neoprene gaskets for wet and corrosive locations.
 - 2) Gaskets shall be an approved type designed for the purpose. Improvised gaskets are not acceptable.
- d. Access: Stainless steel cover bolts.
- e. Features:
- 1) External mounting lugs.
 - 2) Drilled and tapped conduit holes.
 - 3) Boxes where conduits enter building or structure below grade shall have 1/4-inch drain hole at bottom of the box.
 - 4) Provide threaded connections for explosion proof boxes.

B. Terminal Blocks:

1. Products and Manufacturers: Provide one of the following:
 - a. Allen-Bradley Company, Bulletin, Model 1492.
 - b. General Electric Company, Model CR151K.
 - c. Or approved equal.
2. Material and Construction:
 - a. NEMA-rated nylon modular terminal blocks.
 - b. 600-volt rated.
 - c. Control and alarm circuit terminals shall be screwed type with permanently affixed numeric identifiers beside each connection.
 - d. Power terminals shall be copper and rated for the circuit ampacity.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Mount boxes so that sufficient access and working space is provided and maintain clearance of not less than 1/4-inch from walls.
- B. Securely fasten boxes to walls or other structural surfaces on which boxes are mounted. Provide independent supports that comply with Section 26 05 29, Hangers and Supports for Electrical Systems, where boxes will not be mounted on walls or another structural surface.
- C. Install pull boxes where shown or indicated, and provide pull boxes where one or more of the following conditions exist:
 - 1. Conduit runs containing more than three 90-degree bends.
 - 2. Conduit runs exceeding 200 feet in length.
- D. Provide removable, flame-retardant, insulating cable supports in boxes with any dimension exceeding three feet.
- E. Field-apply PVC touch-up to scratched PVC boxes damaged during installation. Touch-up work shall be in accordance with manufacturer's recommendations and instructions.
- F. Size junction, pull, and terminal boxes in accordance with NEC Article 314 and other Laws and Regulations.
- G. Provide terminal blocks in boxes where shown and where cable terminations or splices are required.

++ END OF SECTION ++

SECTION 26 05 33.36

OUTLET BOXES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install outlet boxes for mounting wiring devices and lighting fixtures.

B. Related Sections:

1. Section 26 05 05, General Provisions for Electrical Systems.
2. Section 26 05 29, Hangers, and Supports for Electrical Systems.
3. Section 26 05 53, Identification for Electrical Systems.
4. Section 26 27 26.13, Low-Voltage Receptacles.
5. Section 26 27 26.23, Snap Switches.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:

1. NEC Article 314, Outlet, Device, Pull and Junction Boxes; Fittings; and Handhole Enclosures.
2. UL 514A, Metallic Outlet Boxes.
3. UL 514B, Fittings for Conduit and Outlet Boxes.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data:
 - a. Manufacturer's technical information for outlet boxes proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Device Boxes:

1. Manufacturers: Provide products of one of the following:
 - a. Crouse-Hinds Company.
 - b. Appleton Electric Company.
 - c. Or approved equal.

2. Material:
 - a. In Wet Locations: Cast gray iron alloy or cast malleable iron with zinc electroplate finish, or aluminum bodies consistent with conduit material.
 - b. Where conduit is installed concealed, boxes shall include suitable extension rings and covers, as required.
 - c. Where used with PVC-coated conduit system, boxes shall include factory applied 40-mil-thick PVC coating.
 - d. Cast boxes shall be hub-type and include external mounting lugs.
 - e. Metallic outlet boxes shall comply with UL 514A.
 - f. Fittings for outlet boxes shall comply with UL 514B.
3. NEMA rating of box shall be as required for area classifications specified in Section 26 05 05, General Provisions for Electrical Systems.
4. Cover Plates:
 - a. Type 302 stainless steel alloy for indoor finished areas.
 - b. Plates in corrosive locations shall include factory-applied 40-mil PVC coating.
 - c. Stainless steel screws and hardware.
 - d. For receptacle and switch cover plates, comply with Section 26 27 26.13, Low-Voltage Receptacles, and Section 26 27 26.23, Snap Switches.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Fasten boxes rigidly and neatly to supporting structures.
- B. Securely fasten equipment to walls or other surfaces on which materials or equipment is mounted. Provide independent supports complying with Section 26 05 29, Hangers and Supports for Electrical Systems, where boxes are not mounted on walls or other surface capable of supporting the materials or equipment.
- C. For units mounted on masonry or concrete walls, provide suitable 1/2-inch spacers to prevent mounting back of box directly against wall.
- D. Leave no open conduit holes in boxes. Close unused openings with capped bushings.

- E. Label each circuit in boxes and identify each circuit in accordance with Section 26 05 53, Identification for Electrical Systems.
- F. Install outlet boxes in accordance with NEC Article 314.

+ + END OF SECTION + +

SECTION 26 05 43.13

UNDERGROUND DUCTBANKS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. The CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install underground ductbanks.

B. Coordination:

1. Ductbank routing on the Drawings is diagrammatic. Coordinate installation with piping and other Underground Facilities and locate ductbanks clear of interferences.
2. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before underground ductbank Work.

C. Related Sections:

1. Div 31 , Earthwork.
2. Section 03 00 05, Concrete.
3. Section 26 05 26, Grounding and Bonding for Electrical Systems.
4. Section 26 05 53, Identification for Electrical Systems.
5. Section 26 05 33.13, Rigid Conduits.
6. Section 26 05 33.26, Expansion/Deflection Fittings.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Layouts showing proposed routing of ductbanks and locations of manholes, handholes, and areas of reinforcement.
 - b. Profiles of ductbanks showing crossings with piping and other Underground Facilities.
 - c. Typical cross sections for each ductbank.

B. Informational Submittals: Submit the following:

1. Special Procedure Submittals:
 - a. Installation procedures.
2. Field Quality Control Submittals:
 - a. Field test report.

C. Closeout Submittals: Submit the following:

1. Record Drawings:
 - a. Include actual routing of underground ductbank runs on record documents in accordance with Section 01 78 39, Project Record Documents.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Duct: Provide conduit and fittings in accordance with Section 26 05 33.13, Rigid Conduits. Conduit types shall be as follows:
 1. Schedule 40 PVC conduits for power circuits.
 2. Galvanized rigid steel conduits for the following types of circuits: low voltage status, analog, and communication.
- B. Backfill: Provide backfill, including select backfill, in accordance with Div 31 specifications.
- C. Reinforcing: Provide Ductbank reinforcing in accordance with Section 03 00 05, Concrete.
- D. Concrete: Provide ductbank concrete in accordance with Section 03 00 05, Concrete.
- E. Grounding: Provide ground cable in accordance with Section 26 05 26, Grounding and Bonding for Electrical Systems.
- F. Conduit Spacers: Conduit spacers shall be nonmetallic, interlocking type to maintain spacing between conduits. Provide spacers suitable for all conduit types used in multiple sizes.
- G. Duct Sealing Compound:
 1. Products and Manufacturers: Provide one of the following:
 - a. 0-Z/Gedney, Type DUX.
 - b. Or approved equal.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Excavation and Backfilling:
 - 1. Provide excavation and backfilling for ductbank installation in accordance with Div 31 specifications.
 - 2. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials that can damage or contribute to corrosion of ducts or cables or prevent adequate compaction of backfill.
- B. Ductbank Layout:
 - 1. Top of ductbank concrete shall be a minimum of 2.5 feet below grade, unless shown or indicated otherwise on the Drawings.
 - 2. Slope ductbank runs for drainage toward manholes and away from buildings with slope of approximately three inches vertical per 100 feet of run.
- C. Ductbank Assembly:
 - 1. Assemble ductbanks using non-magnetic saddles, spacers, and separators. Position separators to provide minimum three-inch concrete separation between outer surfaces of each conduit. Provide side forms for each ductbank.
 - 2. Make bends with sweeps of not less than four-foot radius or five-degree angle couplings.
- D. Concrete Placing:
 - 1. Provide minimum four-inch concrete covering on each side, top, and bottom of concrete envelopes around conduits. Concrete covering shall be as shown or indicated on the Drawings.
 - 2. Provide red dye in concrete for easy identification during subsequent excavation; all concrete in entire ductbank, including top and bottom, shall be dyed.
 - 3. Firmly fix conduits in place during concrete placing. Carefully place and vibrate concrete to fill spaces between conduits.
- E. Conduit Transitions:
 - 1. Conduit installations shall be watertight throughout entire length of ductbank.
 - 2. Transition from non-metallic to galvanized rigid steel conduit where ductbanks enter structure walls and slabs.
 - 3. Terminate conduits in insulated grounding bushings.
 - 4. Continue conduits inside buildings in accordance with Section 26 05 33.13, Rigid Conduits, and as shown or indicated in the Contract Documents.
 - 5. If ducts are not concrete-encased, provide expansion and deflection fittings in accordance with Section 26 05 33.26, Expansion/Deflection Fittings.
 - 6. Plug and seal empty spare conduits entering structures. Conduits in use entering structures shall be sealed watertight with duct sealing compound.

- F. Ductbank Reinforcing:
 - 1. Provide reinforcing for all ductbanks:
 - 2. Install ductbank reinforcement as shown or indicated on the Drawings.
 - 3. Provide maximum clearance of 1.5 inches from bars to edge of concrete encasement.
- G. Connections to Structures:
 - 1. Firmly anchor ductbanks to structure walls or slabs. Epoxy-grout ductbank rebar into structure concrete to eliminate shear forces between ductbank and structure wall concrete.
 - 2. Ductbank penetrations through structure walls shall be watertight.
- H. Grounding:
 - 1. Provide bare stranded copper ductbank ground cable in each ductbank envelope. Make ground electrically continuous throughout entire ductbank system.
 - 2. Connect ground cable to building and station ground grid or to equipment ground buses. Also, connect ground cable to steel conduit extensions of underground ductbank system.
 - 3. Provide ground clamp and bonding of each steel conduit extension to maintain continuity of ground system.
 - 4. Terminate ground cable at last manhole or handhole for outlying structures.
- I. Detectable Underground Warning Tape:
 - 1. Provide detectable underground warning tapes complying with Section 26 05 53, Identification for Electrical Systems, over the full length of each underground ductbank.
 - 2. Install warning tapes approximately 12 inches below grade.
 - 3. Provide multiple tapes across the width of each ductbank. Locate center of a warning tape above each edge of ductbank, and at intervals across top width of ductbank so that clear space between tapes does not exceed six inches.
- J. Reused Existing Ducts:
 - 1. Pull rag swab through duct to remove water and to clean conduits prior to installing new cable.
 - 2. Repeat swabbing until all foreign material is removed.
 - 3. Pull mandrel through duct, if necessary, to remove obstructions.

+ + END OF SECTION + +

SECTION 26 05 43.23

MANHOLES AND HANDHOLES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install handholes for electrical systems Work.

B. Coordination:

1. Coordinate handhole installation with piping, sheeting other excavation supports, and other Underground Facilities, and locate clear of interferences.
2. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before handhole for electrical systems Work.

C. Related Sections:

1. Section 03 00 05, Concrete.
2. Div 31, Earthwork.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AASHTO, Specifications for Highway Bridges.
2. ANSI/SCTE 77, Specification for Underground Enclosure Integrity.
3. ASTM A48/A48M, Specification for Gray Iron Castings.
4. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
5. ASTM D4101, Specification for Polypropylene Injection and Extrusion Materials.

1.3 QUALITY ASSURANCE

A. Component Supply and Compatibility:

1. Obtain all handholes furnished under this Section from a single Supplier, unless otherwise acceptable to ENGINEER.
2. Handhole Supplier shall review and approve the Shop Drawing submittals for the handholes furnished.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

- a. Handholes: Submit schedule of handholes to be furnished and dimensions and pertinent data for each.
- b. Castings:
 - 1) Schedule of casting types and models to be furnished, with dimensional data and other pertinent data for each.
 - 2) Fabrication and erection of all frame and cover assemblies. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Provide setting drawings for location and installation of castings and anchorage devices.
 - 3) Where Site-specific castings are specified with unique lettering on handhole cover, provide Shop Drawing for castings indicating appropriate detail to indicate conformance to the Contract Documents.

2. Product Data:

- a. Manufacturer's technical information, specifications, and literature for handholes, castings, and accessories proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Material and Construction:

1. Material shall be in accordance with Section 03 30 05, Concrete.
2. Duct entrances shall be sized and located to suit the ductbanks.

B. Accessories:

1. Frames and Covers:

- a. Manufacturers: Provide products of one of the following:
 - 1) Neenah Foundry Company.
 - 2) Campbell Foundry Company.
 - 3) Or approved equal.
- b. Material: Cast iron complying with ASTM A48/A48M, Class 30A, rated for AASHTO H-20 loading.

Manholes and Handholes for Electrical Systems

- c. Covers: Watertight, sealed type marked “ELECTRICAL” in raised two-inch letters. Identify covers as shown or indicated on the Drawings.
 - d. Grout the frame to the handhole.
- 2. Insulators:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Catalog No. J5122 by MacLean Power Systems.
 - 2) Catalog No. C203-1120 by A.B. Chance Company.
 - 3) Or approved equal.
 - b. Material: Porcelain.

2.2 SMALL HANDHOLES

- A. Material and Construction:
 - 1. Manufacturer: Provide products of one of the following:
 - a. Strongwell Quazite
 - b. Or approved equal
 - 2. Material: Precast polymer concrete.
 - 3. Duct entrances sized and located to suit ductbanks.
 - 4. Enclosures and covers shall be UL-listed.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Excavation and Backfill:
 - 1. Provide handholes for electrical systems where shown or indicated and verify at the Site the required locations.
 - 2. Perform excavation and filling required for installing handholes for electrical systems, in accordance with Section 31 20 00, Earthmoving.
 - 3. Provide handholes on granular subbase course as shown or indicated. If not shown, provide layer of compacted select fill not less than six inches deep on which handhole for electrical systems will be installed.

Manholes and Handholes for Electrical Systems

4. Carefully set, level, and align at proper grade handhole bases and handholes.
- B. Handhole structures shall be watertight. Provide foam sealant to seal all penetrations into handholes for electrical systems.
- C. Grading at Handholes:
 1. Unpaved Areas:
 - a. Install handholes in unpaved areas as shown or directed by ENGINEER to rim elevation higher than finished grade.
 - b. Grade the ground surface to drain away from handholes.
 - c. Provide fill around handholes to level of upper rim of handhole frame and evenly grade the surface to a one (vertical)-to-five (horizontal) slope to surrounding grade, unless otherwise shown or directed by ENGINEER.
 2. Paved or Travelled Areas:
 - a. Install handholes in paved or travelled areas to meet final grade of paved or concrete surface.
 - b. In paved areas in state or county highways or municipal streets or roads, and handholes shall be 1/2-inch below elevation of final surface course (also known as top course or wearing course) of pavement.
 - c. Handholes shall not project above finished roadway pavement.
 3. CONTRACTOR shall be solely responsible for proper height of handholes necessary to reach final grade. ENGINEER's review of Shop Drawings and other submittals for handholes is general in nature. Provide random-length precast handhole riser sections (if required) to adjust handholes to accommodate field conditions for final grading and final elevations.

3.2 FIELD QUALITY CONTROL

- A. Watertightness:
 1. Handholes for electrical systems shall be free of visible leakage. Inspect each handhole accompanied by ENGINEER, and repair leaks.

+ + END OF SECTION + +

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install identification for electrical apparatus and electrical Work.

B. Related Sections:

1. Section 26 05 19, Low Voltage Electrical Power Conductors and Cables.
2. Section 40 60 05, Process Control Systems General Provisions.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:

1. NEC Article 110, Requirements for Electrical Installation.
2. NEC Article 210, Branch Circuits.
3. NEC Article 215, Feeders.
4. NEC Article 504, Intrinsically Safe Systems.
5. NEC Article 700, Emergency Systems.
6. NEC Article 701, Legally Required Standby Systems.
7. NEC Article 702, Optional Standby Systems.
8. 40 CFR 1910.145 (OSHA) – Specification for Accident Prevention Signs and Tags.
9. NFPA 70E, Electrical Safety in the Workplace.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings: Submit the following:
 - a. Complete description and listing of proposed electrical identification and electrical identification devices for associated equipment or systems.
 - b. Conduit and wire identification numbering system and equipment signage.

2. Product Data:
 - a. Manufacturer's literature, cut sheets, specifications, dimensions, and technical data for all products proposed under this Section.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

- A. Engraved Identification Devices (Nameplates and Legend Plates):
 1. Nameplates:
 - a. Laminated thermoset plastic, 1/16-inch thick, engraved condensed block black lettering on white background, square corners, and beveled front edges, or match existing.
 - b. Size: As required.
 - c. Letter Size: Minimum 3/16-inch.
 - d. Nameplates one inch or less in height shall have one mounting hole at each end. Nameplates greater than one inch in height shall have mounting holes in the four corners.
 2. Legend Plates:
 - a. Legend plates for pushbuttons, pilot lights, selector switches, and other panel-mounted devices shall be large size with dimensions of approximately 2-7/16 inches wide by 2-13/32 inches tall (Allen Bradley large automotive size), plastic, custom engraved with black letters on white background.
 - 1) Provide standard-size legend plates where devices are mounted on motor control centers and spacing of devices precludes using automotive-size legend plates.
 - b. Lettering size and line weight shall be the same for all legend plates on the same panel or enclosure. Maximum size shall be 1/4-inch and minimum size shall be 1/8-inch.
- B. Safety Signs and Voltage Markers:
 1. Low-Voltage Safety Signs:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) B-302-86060 by Brady.
 - 2) Or approved equal.

Identification for Electrical Systems

- b. Low voltage safety signs shall be pressure-sensitive vinyl complying with 40 CFR 1910.145, five inches by 3.5 inches in size, and shall read, "DANGER – 480 VOLTS".
- 2. Low-Voltage Markers:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) CV442xx by Brady.
 - 2) Or approved equal.
 - b. Low voltage markers shall be either pressure-sensitive vinyl or vinyl cloth with black lettering on orange background and shall read, "120 VOLTS", "208 VOLTS", "120/208 VOLTS", or "240 VOLTS" as required.
- C. Arc-flash Safety Signs:
 - 1. Products and Manufacturers: Provide one of the following:
 - a. Brady.
 - b. Or approved equal.
 - 2. Warning signs shall be adhesive-backed polyester.
 - 3. Refer to Specification 26 05 73- Arc Flash Short Circuit Study and Protective Device Coordination.
- D. Voltage System Identification Directories:
 - 1. General:
 - a. Directories shall be laminated thermoset plastic, 1/16-inch thick, engraved block black letters on white background, square corners, and beveled front edges.
 - b. Directories shall identify all voltage systems within building or structure.
 - c. Directories shall list the colors that identify ungrounded and grounded conductors of each system.
 - d. Colors shall be in accordance with Section 26 05 19, Low Voltage Electrical Power Conductors and Cables.
 - e. Example Directory Text:

Voltage System Identification		
System	A, B, C	Neutral
277/480	Brown, Orange, Yellow	Gray
120/208	Black, Blue, Red	White

- 2. Large directories for rooms shall have text height not less than 1/2-inch.

3. Small directories for equipment shall have text height of not less than 1/4-inch.
- E. Conduit Labels:
1. Products and Manufacturers: Provide one of the following:
 - a. B-915-xxxxx by Brady.
 - b. Or approved equal.
 2. Shall be pre-tensioned acrylic/vinyl construction coiled to completely encircle conduit for conduit up through five-inch diameter, or pre-molded to conform to circumference of conduit six-inch diameter and larger.
 3. Attach strap-on style for six-inch diameter conduit with stainless steel springs.
 4. Shall be blank for use with custom printed labels.
 5. Custom Labels:
 - a. Shall have black lettering on a yellow background.
 - b. Shall not contain abbreviations in legend.
 - c. Shall be custom printed on continuous tape with permanent adhesive using thermal printer specified below.
- F. Wire Identification:
1. Heat Shrinkable Wire and Cable Labeling System:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) B-341 PS-xxx-2W by Brady.
 - 2) Or approved equal.
 - b. White heat-shrinkable irradiated polyolefin shrink-on sleeves. Labels shall be thermal printed. Labels shall be not less than two inches wide.
 2. Wrap-Around Wire and Cable Labeling System:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) THT-XX-427 by Brady.
 - 2) Or approved equal.
 - b. Self-laminating white/transparent self-extinguishing vinyl strips. Length shall be sufficient to provide at least 2.5 wraps. Labels shall be thermally printed and not less than two inches wide.

G. Detectable Underground Warning Tape:

1. Products and Manufacturers:
 - a. Provide one of the following:
 - 1) Indentoline by Brady.
 - 2) Or approved equal.
2. Material: Polyethylene or polyester with detectable metal core and polyester underlamine.
3. Width: Two inches.
4. Color and Labeling: Yellow or red with permanently imprinted black letters: "CAUTION – Buried Electric Line", repeated continuously over full length of tape.

H. Thermal Printing System:

1. Utilize thermal transfer process to provide non-smearing labels and markers.
2. Wire and Cable Markers:
 - a. Portable, Products and Manufacturers: Provide one of the following:
 - 1) TLS2200 by Brady.
 - 2) Or approved equal.
 - b. Desktop, Products and Manufacturers: Provide one of the following:
 - 1) 200M by Brady.
 - 2) Or approved equal.
3. Cable Markers:
 - a. Portable, Products and Manufacturers: Provide one of the following:
 - 1) Handimark by Brady.
 - 2) Or approved equal.
 - b. Desktop, Products and Manufacturers: Provide one of the following:
 - 1) Labelizer PLUS by Brady.
 - 2) Or approved equal.

2.2 FABRICATION

- A. Engraved Identification Devices (Nameplates and Legend Plates):
 - 1. Nameplate and legend plate text is preliminary and subject to change pending final review and approval of nomenclature by ENGINEER after start-up and testing.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Provide electrical identification in accordance with manufacturer recommendations and as required for proper identification of equipment and materials.
- B. Engraved Identification Devices (Nameplates and Legend Plates):
 - 1. Unless otherwise indicated in the Contract Documents, attach permanent nameplates with permanent adhesive and with 3/16-inch diameter, round head, stainless steel machine screws into drilled and tapped holes.
 - 2. Provide nameplate with 1.5-inch-high letters to identify each console, cabinet, panel, or enclosure as shown or indicated.
 - 3. Provide nameplates for field-mounted motor starters, disconnect switches, manual starter switches, pushbutton stations, and similar equipment operating components, which shall describe motor or equipment function and circuit number.
 - 4. Provide nameplates with 1/2-inch-high letters to identify each junction and terminal box shown or indicated.
 - 5. On switchgear, provide nameplates for each main and feeder circuit including control fuses, and for each indicating light and instrument.
 - a. Provide nameplate with 1.5-inch-high letters giving switchgear designation, voltage rating, ampere rating, short circuit rating, manufacturer's name, general order number, and item number.
 - b. Identify individual door for each compartment with nameplate giving item designation and circuit number.
 - 6. Motor Control Centers:
 - a. Provide nameplate with 1.5-inch letters with motor control center designation.
 - b. Identify individual door for each unit compartment with nameplate identifying controlled equipment.

Identification for Electrical Systems

7. Except conduit, all electrical appurtenances including lighting panels, convenience outlets, fixtures, and lighting switches, shall be provided with nameplates indicating appropriate circuit breaker number(s).
8. Push Buttons:
 - a. Provide legend plates for identification of functions.
 - b. Provide nameplates for identification of controlled equipment.
 - c. Provide red buttons for stop function.
 - d. Provide black buttons for other functions.
9. Pilot Lights:
 - a. Provide legend plates for identification of functions.
 - b. Provide nameplates for identification of controlled equipment.
 - c. Shall have lens colors as shown or indicated. Where no color is indicated, provide the following lens colors:

Color	Legend
Green	Running, Open
Red	Stopped, Closed
Amber	Alarm
Blue	Power
White	Status

10. Selector Switches:
 - a. Provide legend plates for identification of functions.
 - b. Provide nameplates for identification of controlled equipment.
11. Panel Mounted Instruments:
 - a. Provide nameplates for identification of function.
12. Interiors of Cabinets, Consoles, Panels, Terminal Boxes, and Other Enclosures:
 - a. Provide nameplates for identification.
 - b. Provide each item inside cabinet, console, panel, terminal box, or enclosure with laminated plastic nameplate as shown on approved Shop Drawings and CONTRACTOR's other submittals. Install nameplates with adhesive.
 - c. Interior items requiring nameplates include:

Identification for Electrical Systems

- 1) Terminal blocks and strips.
 - 2) Bus bars.
 - 3) Relays.
 - 4) Rear of face-mounted items.
 - 5) Rear of door-mounted items.
 - 6) Interior mounted items that require identification when mounted externally.
 - d. Circuit Breaker Directory:
 - 1) Provide engraved laminated plastic directory listing function and load controlled for each circuit breaker within panel used for power distribution.
13. Re-label existing equipment whose designation have changed.
- C. Safety Signs and Voltage Markers:
1. Provide safety signs and voltage markers on and around electrical equipment as shown or indicated.
 - a. Install rigid safety signs using stainless steel fasteners.
 - b. Clean surfaces before applying pressure-sensitive signs and markers.
 2. Install high voltage safety signs on all equipment doors providing access to uninsulated conductors, including terminal devices, greater than 600 volts.
 3. Provide cable tray safety signs on both sides of cable trays at maximum intervals of 20 feet. Install signs on side rails of tray as acceptable to ENGINEER.
 - a. Label cable trays that contain conductors greater than 600 volts with cable tray safety signs.
 - b. Cable trays that contain conductors greater than 208 volts and less than 600 volts shall be labeled with low voltage safety signs.
 - c. Cable trays that contain conductors of 120/208 volts shall be labeled with low voltage markers.
 - d. Do not label cable trays that contain only instrument signal cables.
 - e. Label cable trays that contain intrinsically safe wiring or cables in accordance with NEC Article 504.

Identification for Electrical Systems

4. Install low voltage safety signs on equipment doors that provide access to uninsulated 480-volt conductors, including terminal devices.
5. Install low voltage markers on each terminal box, safety disconnect switch, and panelboard installed, modified, or relocated as part of the Work and containing 120/208 volt conductors.

D. Voltage System Identification Directories

1. Provide voltage system identification directories as required by NEC Article 210 and NEC Article 215.
2. Provide in each electrical room voltage system identification directory mounted on wall or door at each entrance to room.
3. For panelboards, switchboards, motor control centers, and other branch circuit or feeder distribution equipment that are not located in electrical rooms, provide voltage system identification directory mounted on equipment.
 - a. Directories shall be affixed using epoxy glue. Screws or bolts shall not penetrate equipment enclosures.
 - b. Directories shall be readily visible and not obscure labels and other markings on equipment.

E. Arc-flash Safety Signs:

1. Provide arc-flash safety signs as required by NEC Article 110.
2. Provide signs for switchboards, panelboards, motor control centers, and industrial control panels. Provide signs for control panels that contain 480-volt equipment. Provide arc flash warning signs on other equipment where the incident energy is greater than 1.2 calories per square centimeter.

F. Conduit Labels:

1. Provide conduits with conduit labels unless otherwise shown or indicated.
2. Do not label flexible conduit.
3. Do not label exposed single conduit runs of less than 25 feet between local disconnect switches and their associated equipment.
4. Conduit labels shall indicate the following information:
 - a. Contract Number: Alphanumeric, three or four digits, as applicable.
 - b. Conduit Number: Alphanumeric as shown on the Drawings, as assigned by CONTRACTOR for unlabeled conduits, and in accordance with approved submittals.

Identification for Electrical Systems

5. Conduits that contain intrinsically safe wiring shall have an additional pipe marker provided that has blue letters on white background and reads, "INTRINSICALLY SAFE WIRING."
 - a. Install intrinsically safe pipe markers in accordance with NEC Article 504 along entire installation. Spacing between labels shall not exceed 25 feet.
 6. Provide conduit labels at the following locations:
 - a. Where each conduit enters and exits walls, ceilings, floors, or slabs.
 - b. Where conduit enters or exits boxes, cabinets, consoles, panels, or enclosures, except pull boxes and conduit bodies used for pull boxes.
 - c. At maximum intervals of 50 feet along length of conduit.
 7. Orient conduit labels to be readable.
- G. Wire and Cable Identification:
1. Color-coding of insulated conductors shall comply with Section 26 05 19, Low Voltage Electrical Power Conductors and Cables.
 2. Use heat-shrinkable wire labels where wire or cable is terminated. Use wrap-around labels where wire or cable is to be labeled but is not terminated.
 3. Do not provide labels for the following:
 - a. Bare (uninsulated) conductors, unless otherwise shown or indicated as labeled.
 4. Provide wire and cable labels for the following:
 - a. New, rerouted, or revised wire or cable.
 - b. Insulated conductors.
 - c. Wire and cable terminations:
 - 1) Wire labels shall be applied between 1/2-inch and one inch of completed termination.
 - 2) Apply cable labels between 1/2-inch and one inch of cable breakout into individual conductors.
 - a) Label individual conductors in a cable after breakout as specified for wires.
 - b) Wire or cable existing cabinets, consoles, panels, terminal boxes, and enclosures.
 - 1) Label wires or cables withing two inches of entrance to conduit.

Identification for Electrical Systems

- c) Wire or cable in junction boxes and pull boxes.
 - 1) Label wires or cables within two inches of entrance to conduit.
 - d) Wire and cable installed in cable tray.
 - 1) Wire and cable shall have labels at maximum intervals of 20 feet.
 - e) Wire and cable installed without termination in electrical manholes.
 - 1) Wire and cable shall have wrap-around labels applied within one foot of existing manhole.
- 5. Wire and Cable Identification System:
 - a. Wire and cable labels shall be imprinted with an identifying designator.
 - 1) Wire and cable extending between two devices or items and that does not undergo a change of function shall be identified by a single unique designator as specified below.
 - b. Field Wiring:
 - 1) Wire or cable designator shall consist of.
 - a) Three left most characters shall consist of the contract number under which wiring, or cable was installed.
 - b) Fourth character from the left shall be an asterisk (*), a plus sign (+) or a hyphen (-). Do not use other punctuation symbols in a wire designator.
 - c) Remaining characters shall be alphanumeric and make wire designator unique.
 - d) Numbering shall reflect actual designations used in the Work and shall be documented in record documents.
 - c. Cabinet, Console, Panel, and Enclosure Wiring, Internal:
 - 1) New Cabinets, Consoles, Panels, and Enclosures:
 - a) Wire and cable inside cabinets, consoles, panels, and enclosures shall have

Identification for Electrical Systems

designators as specified in Section 40 60 05, Instrumentation and Control for Process Systems.

6. Modified Cabinets, Consoles, Panels, and Enclosures
 - a. New or rerouted wire or cable in existing cabinets, consoles, panels, and enclosures shall be labeled as shown on the Drawings or be assigned a ten-character designator equivalent to field wire designator.

H. Wire and Cable Identification:

1. Label panel side of terminal to match panel wire number.
2. Label field side of terminal to match field wire number. Terminal number shall not include the Contract number.

I. Terminal Strip Labeling:

1. Label panel side of terminal to match panel wire number.
2. Label field side of terminal to match field wire number. Terminal number shall not include the Contract number.

+ + END OF SECTION + +

SECTION 26 22 14

DRY-TYPE LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install dry type low-voltage distribution transformers.

B. Related Sections:

1. Section 26 05 05, General Provisions for Electrical Systems.
2. Section 26 05 26, Grounding and Bonding for Electrical Systems.
3. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. NEMA ST-20, Dry Type Transformers for General Applications.
2. NEMA TP-1, Guide for Determining Energy Efficiency for Distribution Transformers.
3. NEMA TP-2, Standard Test Method for Measuring the Energy Consumption for Distribution Transformers.
4. UL 1561, Dry Type General Purpose, and Power Transformers.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. NEC Article 450, Transformers and Transformer Vault (Including Secondary Ties).

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

- a. Schedule of transformers to be furnished with ratings and other required technical data.
- b. Proposed location for each transformer, including pad layout, dimensions, and appurtenances.

2. Product Data:
 - a. Supplier's technical information for transformers proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Dry Type Two-Winding Transformer:

1. Type: Dry type, air cooled, low temperature rise. Transformers 15 kVA and larger shall be energy efficient, complying with NEMA TP-1 Class 1 efficiency levels. Transformers less than 15 kVA shall be general purpose. Transformer must have copper windings.
2. Rating: KVA, primary voltage and connection, secondary voltage and connection, frequency and number of phases shall be as shown on the Drawings.
3. Insulation: Insulation and average winding temperature rise (in a 40 degree C maximum ambient) for rated kVA per the following table. Energy efficient transformers shall be capable of 15 percent continuous overload at 150 degrees C temperature rise.

kVA Rating	Insulation Class (Degrees C)	Temperature Rise (Degrees C)
1 to 15 kVA	185	115
25 to 500 kVA	220	115

4. Winding Taps, Transformers 15 kVA and Less: Two 5-percent below rated voltage, full capacity taps on primary winding.
5. Winding Taps, Transformers 25 kVA and Larger: Two 2-1/2-percent above rated voltage and four 2-1/2+ percent below rated voltage, full capacity taps on primary.
6. Basic impulse level shall be 10 kV.
7. Sound Level: NEMA ST-20 standard.
8. Enclosure: UL listed for the application.
9. Identification: Identify transformers in accordance with Section 26 05 53, Identification for Electrical Systems, with the transformer number and voltages, connection data, kVA ratings, impedance, and overload capacity.
10. Transformers shall comply with NEMA ST-20, NEMA TP-1, NEMA TP-2, and UL 1561.

11. Transformers shall bear the label of the Underwriters' Laboratories, Inc.
- B. Manufacturers: Provide products of one of the following:
 1. Cutler-Hammer.
 2. General Electric Company.
 3. Square D Company.
 4. Siemens.
 5. Or approved equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the conditions under which the dry type transformers are to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install transformers on walls or floors at locations shown. Install floor mounted transformers on raised concrete bases. Provide sufficient access and working space for convenient and safe operation and maintenance.
- B. Mount transformers so that vibrations are not transmitted to the building structural parts and other equipment. Make connections to transformers with flexible conduit.
- C. Adjust tap settings to provide proper voltage at panelboards.
- D. Install dry type transformers in conformance with governing codes and manufacturer's instructions and recommendations, and the Contract Documents.

++ END OF SECTION ++

SECTION 26 24 16

PANELBOARDS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install panelboards.

B. Related Sections:

1. Section 26 05 05, General Provisions for Electrical Systems.
2. Section 26 05 53, Identification for Electrical Systems.
3. Section 26 22 14, Dry-Type Low-Voltage Distribution Transformers
4. Section 26 43 00, Surge Protective Devices.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. NEMA PB 1, Panelboards.
2. UL 67, Panelboards.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Listing of panelboards to be furnished with identification of their proposed location, and all electrical characteristics, including number and rating of branch circuit breakers and enclosure type.
2. Product Data:
 - a. Manufacturer's technical information for panelboards proposed for use, including product literature and specifications. Indicate options and features to be provided.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements; Comply with the following:

1. NEC Article 408, Switchboards and Panelboards.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:

1. Packing:
 - a. Inspect prior to packing to assure that assemblies and components are complete and undamaged.
 - b. Protect mating connections.
 - c. Cover all openings into enclosures with-vapor inhibiting, water-repellent material.
2. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work. Upon deliver, check materials and equipment for evidence of water that may have entered equipment during transit.
3. Comply with Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:

1. Store panelboards in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.
2. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Panelboards:

1. Manufacturers: Provide products of one of the following:
 - a. General Electric Company.
 - b. Eaton/Cutler-Hammer.
 - c. Schneider Electric/Square D Company.
 - d. Or approved equal.
2. Rating: Voltage rating, current rating, number of phases, number of wires and number of poles as shown or indicated on the Drawings.
3. Circuit Breakers: Molded case, bolt-in thermal magnetic type with number of poles and trip ratings as shown or indicated. Where indicated on the Drawings, circuit breakers shall be ground fault

circuit interrupting type equipped with solid state sensing and five-milliamp sensitivity.

4. Circuit breakers for 480-volt panelboards shall have minimum interrupting rating of 35,000 ampere RMS symmetrical, unless otherwise indicated on the Drawings. Circuit breakers for other panelboards shall also have minimum interrupting rating of 35,000 ampere RMS symmetrical, unless otherwise indicated on the Drawings.
5. Bus Bars: Bus bars shall be 98 percent conductivity copper. Four-wire panelboards shall have solid neutral bar. Each panel shall have ground bus bar.
6. Main: Panelboards shall have main circuit breaker unless the Drawings specifically indicate main lugs only.
7. Connect branch circuit breakers for sequence phasing.
8. Enclosures: Panel enclosures shall be as required for the area classifications indicated in Section 26 05 05, General Provisions for Electrical Systems, unless otherwise indicated on the Drawings.
9. Construction: Code-grade steel, ample gutter space, flush door, flush snap latch and lock. Panelboards shall comply with NEMA PB 1 and UL 67.
10. Trim: Surface or flush as required.
11. Directory: Typed or computer-printed card, with transparent protective cover in frame on back of door giving circuit numbers and area or equipment served.
12. Identification: Identify panelboards in accordance with Section 26 05 53, Identification for Electrical Systems. Identification shall indicate panel number and voltage.
13. Directory of Existing Panelboards: When adding or removing breakers or loads from existing panelboards, provide a new typed or computer-generated directory card, indicating the circuit numbers and equipment served.
14. Provide surge protective device in accordance with Section 26 43 00, Surge Protective Devices, for each panelboard shown or indicated on the Drawings. Surge protective device shall be included and factory-mounted within panelboard-by-panelboard manufacturer. Surge protective device monitoring and display shall be visible from front of panelboard.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Mounting: Install panelboards at locations shown or indicated. Set cabinets so that top branch circuit breaker is not over six feet above the floor.
- B. Directory: Complete typewritten or computer-printed directory indicating items controlled by each circuit breaker and the size of feeder serving the panel.
- C. Arrange circuits to balance the loads on the panelboards.
- D. Identify panelboards in accordance with Section 26 05 53, Identification for Electrical Systems.
- E. Install in accordance with Laws and Regulations, manufacturer's recommendations, and the Contract Documents. Verify proper installation prior to energizing panelboards.

+ + END OF SECTION + +

SECTION 26 27 26.13

LOW-VOLTAGE RECEPTACLES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install low-voltage receptacles.

B. Related Sections:

1. Section 26 05 05, General Provisions for Electrical Systems.
2. Section 26 05 53, Identification for Electrical Systems.
3. Section 26 05 33.36, Outlet Boxes.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. UL 498, Standard for Attachment Plugs and Receptacles.
2. UL 514D, Cover Plates for Flush-Mounted Wiring Devices.
3. UL 943, Standard for Ground-Fault Circuit-Interrupters.
5. UL 1449, Standard for Surge Protective Devices.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:

1. Americans with Disabilities Act.
2. NEC Article 406, Receptacles, Cord Connectors, and Attachment Plugs (Caps).

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data: Manufacturer's technical information for receptacles and cover plates proposed for use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Ground Fault Interrupting Receptacles:

1. Duplex grounding receptacle, two-pole, three-wire, NEMA 5-20R configuration, 125-volt AC, 20 amperes, gray color with ground fault circuit interrupting (GFCI) protection.

2. Ground fault interrupting receptacles shall comply with UL 943.
 3. Provide Type 302 stainless steel cover-plate conforming to UL 514D. Provide weatherproof-while-in-use cover where shown on the Drawings as “WIP” or “WPU” and provide where located in wet or corrosive location.
 4. Products and Manufacturers: Provide one of the following:
 - a. GFR5362SGY by Hubbell, Inc.
 - b. 2091-GRY by Pass & Seymour.
 - c. Or approved equal.
 5. Weather-resistant Ground Fault Interrupting Receptacles
 - a. Products and Manufacturers: Provide one of the following:
 - 1) 2095TRWRGRY by Pass & Seymour.
 - 2) Or approved equal.
- B. Weatherproof-While-in-Use Covers:
1. Where receptacles are shown on the Drawings as “WIP” or “WPU”, and where receptacles are installed in wet locations as defined in area classification portion of Section 26 05 05, General Provisions for Electrical Systems, provide receptacles as specified in Paragraph 2.1.A of this Section, as applicable, with weatherproof-while-in-use covers as specified below.
 2. Provide covers that are UL-listed, weatherproof while receptacle is in use, and are of ultraviolet-resistant construction suitable for outdoor use in accordance with NEC 406.
 3. Material:
 - a. Non-metallic box with hinged, non-metallic cover.
 - b. Sealing gaskets between box and cover.
 - c. Stainless steel screws and hardware.
 - d. Color: Gray finish
 4. Products and Manufacturers: Provide one of the following:
 - a. TayMac Corporation.
 - b. Pass and Seymour Type WIU
 - c. Or approved equal.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Non-hazardous Locations: Install receptacles at locations shown, in outlet or device boxes in accordance with Section 26 05 33.36, Outlet Boxes.
- B. Install receptacles with ground pole in the down position.

- C. Mount receptacles 18 inches above finished floor in non-hazardous locations and 4.5 feet above finished floor in hazardous locations, in accordance with the Americans with Disability Act, unless otherwise shown or indicated in the Contract Documents.
- D. Install in conformance with Laws and Regulations.
- E. Identification:
 - 1. Identify each conductor with circuit number and lighting panel number in accordance with Section 26 05 53, Identification for Electrical Systems.
 - 2. Identify each receptacle with permanent phenolic tag. Tags shall include circuit number and lighting panel number.

+ + END OF SECTION + +

SECTION 26 07 26.23

SNAP SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. The CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install snap switches for lighting and other systems.

B. Related Sections:

1. Section 26 05 53, Identification for Electrical Systems
2. Section 26 05 33.36, Outlet Boxes.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. UL 20, General Use Snap Switches.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data: Manufacturer's technical information for switches proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Switches for Non-Hazardous Locations:

1. Single pole AC toggle switch, quiet type, 120/277-volt AC, 20 amperes, Ivory, specification grade.
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Catalog No. 1221-I, by Harvey Hubbel, Inc.
 - 2) Catalog No. 1991-I, by Arrow-Hart, Inc.
 - 3) Catalog No. 20AC1-I, by Pass & Seymour
 - 4) Or approved equal.
2. Single pole, three-way AC toggle switch, quiet type, 120/277-volt AC, 20 amperes, Ivory, specification grade.
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Catalog No. 1223-I, by Harvey Hubbell, Inc.
 - 2) Catalog No. 1993-I, by Arrow-Hart, Inc.

- 3) Catalog No. 20AC3-I, by Pass & Seymour
 - 4) Or approved equal.
3. Two-pole AC toggle switch, quiet type, 120/277-volt AC, 20 amperes, Ivory, specification grade.
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Catalog No. 1222-I, by Harvey Hubbel, Inc.
 - 2) Catalog No. 1992-I, by Arrow-Hart, Inc.
 - 3) Catalog No. 20AC2-I, by Pass & Seymour
 - 4) Or approved equal.
 4. Switches in non-hazardous areas shall be UL-listed in accordance with UL 20.
- B. Switch Covers:
1. Indoor covers shall be Type 304 stainless steel.
 2. Outdoor, wet, or corrosive location covers shall be weatherproof and corrosion resistant.
- C. Key Operated On-Off Switches:
1. Key operated switches shall be complete with legend plate and NEMA 4 enclosure and two keys for each switch.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switches at locations as shown or indicated in the Contract Documents in outlet or device boxes, in accordance with Section 26 05 33.36, Outlet Boxes.
- B. Mount wall switches 4.0 feet above finished floor unless otherwise noted.
- C. Identify each conductor with circuit number and lighting panel number. Identification shall be in accordance with Section 26 05 53, Identification for Electrical Systems.

+ + END OF SECTION + +

SECTION 26 28 16.33

DISCONNECT SWITCHES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. The CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install disconnect switches.
- B. Related Sections:
 - 1. Section 26 05 05, General Provisions for Electrical Systems.
 - 2. Section 26 05 53, Identification for Electrical Systems.
 - 3. Section 26 27 26.23, Snap Switches.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. UL 98, Enclosed and Dead-Front Switches.
 - 2. NEMA KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 3. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. NEC Article 404, Switches.
 - 2. Disconnect switches shall bear the UL label.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Listing of each switch to be furnished, including location, rating, and NEMA enclosure type for each.
 - 2. Product Data:
 - a. Manufacturer's technical information for disconnect switches proposed for use.
- B. Maintenance Material Submittals: Submit the following:
 - 1. Extra Stock Materials:

- a. Furnish one set of spare fuses for each fused disconnect switch to be installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide products of one of the following:
 1. Square-D Company.
 2. Cutler-Hammer.
 3. General Electric Company.
 4. Siemens.
 5. Or approved equal.

2.2 MATERIALS

- A. Service Disconnect Switches:
 1. Type: Fused, heavy-duty, single throw, quick-make, quick-break mechanism, visible blades in “OFF” position and safety handle.
 2. Rating: Voltage, current and short circuit ratings and number of poles as shown or indicated on the Drawings. Switch shall bear UL label indicating suitability for use as service equipment and shall comply with UL 98, NEMA KS 1, and NEMA 250.
 3. Provide auxiliary dry contacts to indicate switch position where shown on the Drawings.
- B. Single Throw, Circuit Disconnect Switches:
 1. Type: Fused or unfused, horsepower rated, heavy-duty, single throw, quick-make, quick-break mechanism, visible blades in the "OFF" position and safety handle.
 2. Rating: Voltage and current ratings and number of poles as required for motor or equipment circuits being disconnected. Switches shall bear a UL label and shall comply with the requirements of UL 98, NEMA KS 1 and NEMA 250.
 3. Provide auxiliary dry contacts to indicate switch position.
- C. Disconnect Switches for 120-volt, Single-phase Circuits:
 1. Refer to Section 26 27 26.23, Snap Switches.
- D. Enclosures: NEMA rating shall be as required for area classifications specified in Section 26 05 05, General Provisions for Electrical Systems.
- E. Identification:
 1. Identify enclosures in accordance with Section 26 05 53, Identification for Electrical Systems.

2. Provide nameplate to identify the equipment served by disconnect switch and associated source of power.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
- B. Securely fasten equipment to walls or other structural supports on which they are mounted. Provide independent stainless-steel supports where no wall or other structural surface exists. Mount disconnect enclosures at a height not exceeding six feet.
- C. Provide suitable 1/4-inch spacers to prevent mounting enclosure directly against walls.

++ END OF SECTION ++

SECTION 26 29 37

LOW-VOLTAGE COMBINATION MAGNETIC MOTOR STARTERS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install low-voltage combination magnetic motor starters.
- B. Related Sections:
 - 1. Section 26 05 05, General Provisions for Electrical Systems.
 - 2. Section 26 05 53, Identification for Electrical Systems.
 - 3. Section 26 29 33, Control Stations.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. NEMA ICS 2, Controllers, Contactors and Overload Relays Rated 600 Volts.
 - 2. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Listing of low-voltage combination magnetic motor starters to be furnished, listing for each the installation location, NEMA rating and enclosure size, and equipment to be controlled.
 - b. Customized wiring diagrams for low-voltage combination magnetic motor starters.
 - 2. Product Data:
 - a. Manufacturer's technical information, specifications, and standardized wiring diagrams for low-voltage combination magnetic motor starters proposed.

PART 2 – PRODUCTS

2.1 EQUIPMENT

- A. Manufacturers: Provide products of one of the following:
 - 1. Square D Company.

2. Allen Bradley Company.
 3. General Electric Company.
 4. Cutler-Hammer.
 5. Or approved equal.
- B. Design, fabricate, and test low-voltage combination magnetic motor starters in accordance with NEMA ICS 2 and NEMA 250.
- C. General:
1. Type: Combination type with magnetic-only motor circuit protector with interrupting rating of not less than 65,000 ampere RMS symmetrical, unless otherwise indicated on the Drawings. Magnetic coil operated, NEMA horsepower rated, with thermal overload protection. Coil shall be rated 120 vac.
 2. Enclosures: Panel enclosures shall be as required for area classifications specified in Section 26 05 05, General Provisions for Electrical Systems, unless otherwise indicated on the Drawings.
 3. Functional Type: Full-voltage, single speed, non-reversing, unless otherwise shown or indicated on the Drawings.
 4. Control power transformer fused and grounded on low-voltage (120 vac) side for each starter.
 5. Auxiliary contacts for motor space heaters, remote status signals, and interlocks as shown or indicated on the Drawings and as required.
 6. Overload Relays: Provide an overload relay for each motor starter. Overload relays shall be in accordance with:
 - a. Thermal Overload Relays: Relays shall be thermal, bimetallic type, direct or current sensing. Relays shall include ambient compensation and be equipped with separate heater elements sized for full load amperes and service factor of actual motors furnished.
 - b. Each overload relay shall be manual-reset type and include provisions for resetting by an insulating button on front of starter unit door.
 - c. Overload relay shall include normally-open auxiliary contact for remote alarm purposes.
 - d. Size overload relay for full-load amperes and service factor of actual motors installed.
 7. Pushbuttons, selector switches, pilot lights, and other devices shall be as shown on the Drawings and in accordance with Section 26 29 33, Control Stations.
 8. Provide nameplate identifying equipment controlled in accordance with Section 26 05 53, Identification for Electrical Systems.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. General:
 - 1. Install equipment in accordance with the Contract Documents, Laws and Regulations, and manufacturer's installation instructions.
 - 2. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
 - 3. Securely fasten equipment to walls or other surfaces on which equipment is mounted. Provide suitable 1/4-inch spacers so that enclosure is not installed directly against walls. Provide supports to rigidly support equipment reasonably close to motor where no wall or surface capable of supporting equipment exists.

++ END OF SECTION ++

SECTION 26 43 00

SURGE PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install surge protective devices (SPD).
2. SPDs furnished under this Section shall be ANSI/UL 1449 Type 2 integrating both surge suppression and high-frequency noise filtering suitable for use on low-voltage distribution systems.

B. Related Sections:

1. Section 26 05 05, General Provisions for Electrical Systems.
2. Section 26 24 16, Panelboards.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI/UL 1449, Surge Protective Devices.
2. IEEE C62.41, Recommended Practice on Surge Voltages in Low-voltage AC Power Circuits.
3. IEEE C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 V and Less) AC Power Circuits.
4. UL 1283, Electromagnetic Interference Filters.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Shall have at least five years experience manufacturing and servicing products substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section regardless of component manufacturer from a single SPD manufacturer.
2. SPD manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.

3. Components shall be suitable for the specified service conditions and shall be integrated into overall assembly by SPD manufacturer.
- C. Regulatory Requirements: Comply with the following:
1. NEC 110.9, Requirements for Electrical Installations, Interrupting Rating.
 2. NEC 240.21, Overcurrent Protection, Location in Circuit.
- 1.4 SUBMITTALS
- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Electrical and mechanical drawings for each type of unit, showing electrical ratings, dimensions, mounting provisions, connection details, and layout diagrams.
 - b. Components list and nameplate schedule.
 - c. Summary sheets with schedules of equipment.
 2. Product Data:
 - a. Manufacturer's technical information, including catalog information.
 - b. Manufacturer's technical specifications with assembly and component ratings.
- B. Informational Submittals: Submit the following:
1. Certifications:
 - a. Certification that SPD devices comply with standards referenced in this Section.
 2. Source Quality Control Submittals:
 - a. Report of results of testing and inspections performed at manufacturer's shop.
 3. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
 4. Qualifications Statements:
 - a. Manufacture, when requested by ENGINEER.
- C. Closeout Submittals: Submit the Following
1. Operations and Maintenance Data:
 - a. Submit in accordance with Section 01 78 23, Operations and Maintenance Data.
 - b. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.

2. Warranty Documentation: Submit example warranty at time of shipment of the equipment. Include final warranty accepted by ENGINEER in the operations and maintenance manual for the equipment.

1.5 DELIVERY, STORAGE, AND HANDLING.

- A. Delivery:
 1. Upon delivery, check for evidence of water that may have entered equipment during transit.
- B. Storage:
 1. Store SPD equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.
 2. Protect equipment from corrosion and deterioration.

1.6 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the CONTRACTOR under the Contract Documents. The obligations of the CONTRACTOR under the Contract Documents shall not be limited in any way by the provisions of the specified special warranty.
- B. Special Warranty on Materials and Equipment:
 1. Provide manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct, or at option of OWNER, remove or replace materials or equipment specified in this Section found to be defective during a period of five years after the date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide equipment of one of the following:
 1. General Electric.
 2. Schneider Electric/Square-D Company.
 3. Eaton/Cutler-Hammer.
 4. Or approved equal.

2.2 EQUIPMENT

- A. General:

1. The power system shall be protected from voltage surges at the power service point, and other points within the electrical system as noted. The SPD shall be provided integral to panelboard enclosure wherever shown on drawings.
 2. SPD shall be modular, high-energy, parallel design with fast-acting transient voltage suppression using metal oxide varistors. Equipment shall provide noise attenuation with electromagnetic interference filter.
 3. SPD shall comply with requirements of the following:
 - a. ANSI/UL 1449.
 - b. UL 1283.
 - c. IEEE C62.11, IEEE C62.41 and IEEE C62.45.
 4. SPD shall be suitable for operation under the following environmental conditions:
 - a. Relative Humidity: Zero to 95 percent, non-condensing.
 - b. Frequency: 47 to 63 Hertz.
 - c. Temperature: Zero to 149 degrees F.
 5. SPD operating voltage and IEEE C62.41 and IEEE C62.45 Category A, B, and C application environments shall be suitable for the associated SPD location(s) shown or indicated on the Drawings.
 6. SPD shall be suitable for internal and external mounting. Where shown on the Drawings, SPD shall be factory-mounted and integrated into distribution equipment specified under the following Sections:
 1. Section 26 24 16, Panelboards.
- B. SPD shall include a surge suppression path for each mode as required for the system configuration shown on the Drawings. Each mode shall be individually fused and equipped with thermal cutouts. SPD short-circuit rating shall be 200 kA. Protection modes shall include, to the extent applicable, the following:
1. Line-to-line.
 2. Line-to-neutral.
 3. Line-to-ground.
 4. Neutral-to-ground.
- C. SPD shall include electromagnetic interference/radio frequency interference (EMI/RFI) noise rejection filter with attenuation up to 30 dB from 10 kHz to 100 MHz.
- D. SPDs and components in the operating path shall have maximum continuous operating voltage greater than 115 percent of nominal system operating voltage.
- E. ANSI/UL 1449 minimum withstand rating shall be 20 kA per pole, and ANSI/UL 1449 voltage protection rating for SPD shall not exceed the following:

Modes	208Y/120	480Y/277
L-N,L-G, N-G	800	1200

L-L	1200	2000

- F. SPD surge capacity based upon IEEE C62.41 location category shall, as a minimum, be the following:

Category	Application	Per Phase	Per Mode
C	Service entrance	240 kA	120 kA
B	High exposure locations (Distribution equipment)	160 kA	80 kA
A	Branch locations	120 kA	60 kA

2.3 ACCESSORIES

- A. Provide SPD equipped with the following accessories:
1. Surge counter with display for indicating the number of surges detected.
 2. LED indicators for monitoring device status.
 3. Audible alarm and silence switch for indicating an inoperative condition.
 4. Dry contacts, "Form C", for remote annunciation of unit status.
 5. Indicators, counter, alarm, and silence switch shall be visible and accessible from front of the SPD. When SPD is integral to switchgear, motor control center, panelboard, or other equipment, indicators, counter, alarm, and silence switch shall be visible and accessible from front of the equipment in which the SPD is installed.
 6. Enclosure for each externally mounted SPD: NEMA rating shall be as required for area classifications specified in Section 26 05 05, General Provisions for Electrical Systems.

2.4 SOURCE QUALITY CONTROL

- A. Perform manufacturer's standard factory tests on equipment. Tests shall be in accordance with IEEE C62.45 and ANSI/UL 1449.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install SPD at locations shown on the Drawings in accordance with equipment manufacturer's recommendations, Laws, and Regulations, and the Contract Documents.
- B. Conductor length between suppressor and connection point shall be as short and as straight as possible.

+ + END OF SECTION + +

SECTION 26 50 00

LIGHTING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. The CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install lighting fixtures and associated controls.

B. Coordination:

1. Coordinate location of fixtures with piping, ductwork, openings, and other systems and equipment and locate clear of interferences.
2. Coordinate fixtures to be mounted in hung ceilings with the ceiling suspension system proposed.

C. Related Sections:

1. Section 26 05 05, General Provisions for Electrical Systems.
2. Section 26 05 53, Identification for Electrical Systems.

1.2 REFERENCES

A. Standard referenced in this section are:

1. UL 1598, Safety of Luminaires.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:

1. NEC Article 410, Luminaires, Lamp holders, and Lamps.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Schedule of light fixtures to be furnished, indicating fixture type and location for each.
 - b. Customized wiring diagrams.
2. Product Data:
 - a. Manufacturer's technical information, specifications, standard wiring diagrams, and catalog cuts for lighting fixtures proposed.
 - b. Fixture construction details.
 - c. ETL photometric and isocandle curves for each fixture proposed.

- d. Verification that recessed fixtures to be mounted in hung ceilings are compatible with ceiling suspension system proposed.
- B. Informational Submittals: Submit the following:
 - 1. Manufacturer's Instructions:
 - a. Instructions and recommendations for handling, storing, and protecting the equipment.
 - b. Installation instructions for the equipment, including setting drawings, templates, and directions and tolerances for installing anchorage devices.
- C. Maintenance Material Submittals: Submit the following:
 - 1. Spare Parts and Extra Stock Materials: Furnish spare parts for each type of unit required as indicated in Part 2 of this Section.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery:
 - 1. Upon delivery, inspect equipment for evidence of water that may have entered equipment during transit.
- B. Storage:
 - 1. Store lighting fixtures, controls, related materials and equipment in clean, dry location with controls for uniform temperature and humidity. Protect materials and equipment with coverings and maintain environmental controls.
 - 2. Store materials and equipment for easy access for inspection and identification. Keep materials and equipment off ground, using pallets, platforms, or other supports. Protect materials and equipment from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Lighting fixtures required shall be in accordance with the Lighting Fixture Schedule shown on respective drawings. Fixtures shall be complete with supports, and incidentals, as required.
- B. Type: Lighting fixtures required shall be in accordance with the Lighting Fixture Schedule on the Drawings. Fixtures shall be complete with supports, ballasts, lamps, and incidentals, as required.
 - 1. LED fixtures shall be modular and allow for separate replacement of LED lamps and drivers. User serviceable LED lamps and drivers shall be replaceable from the room side.
 - 2. Dimmable LED fixtures shall have either a 0-10 volt, 3-wire dimming driver, or a two-step (50%-100%) line voltage, two switch controlled dimming driver,

as shown on the drawings.

- C. Fixtures shall be listed in accordance with UL 1598.
- D. Hardware: Provide necessary hangers, supports, conduit adaptors, reducers, hooks, brackets, and other hardware required for safe fixture mounting. Hardware shall have protective, non-corrosive finish.
- E. Outdoor Fixtures: Provide each fixture to be installed outdoors with cut-off lens to reduce the fixture's light pollution emissions.
- F. Time Switch:
 - 1. Type: Astronomic dial time switch with day-omitting device.
 - 2. Products and Manufacturers: Provide of one of the following:
 - a. Z Series by Tork Time Controls, Inc.
 - b. Or equal.
 - 3. Timing Motor: Heavy-duty, synchronous, self-starting, high torque, 120-volt or 277-volt, 60 Hertz, as shown on the Drawings.
 - 4. Capacity: 40 amps per pole at 277 volts.
 - 5. Dial: 24-hour rotation, with gear to provide one revolution per year that automatically raises the "ON" and "OFF" settings each day according to seasonal changes of sunset and sunrise.
 - 6. Reserve Power: Spring driven reserve sufficient to operate time switch contacts for not less than 30 hours after power failure. On restoration of power, time switch shall transfer to synchronous motor drive and automatically rewind reserve.
- G. Lighting Contactor and Controls:
 - 1. Provide a lighting contactor and control system for control of each area where shown on the Drawings.
 - 2. Product and Manufacturer: Provide products of one of the following:
 - a. Type SM03 by Square D Company.
 - b. Or approved equal.
 - 3. System shall include:
 - a. Enclosure sized as required, complete with input control fuse and screw type terminal blocks rated 300-volt, 20-amp quantity for all circuits, unless indicated otherwise on the Drawings.
 - b. Single coil, electrically operated, mechanically-held contactor. Contactor shall be rated 30-amp, 600-volt, with 120-volt operating coil, unless indicated otherwise on the Drawings. Number of poles shall be as shown on the Drawings. Provide multiple contactors when necessary.
 - c. Where lighting contactors are controlled by photocell, provide a 120-volt, two-pole control relay, enclosure mounted to convert the two-wire photocell control to three-wire control required by contactor. Control shall include a cover mounted on-off-auto selector switch for "manual" or

“auto” selection of operation. In “auto” position, contactor shall respond to photocell.

- d. Enclosure: As required for area classification per Section 26 05 05, General Provisions for Electrical Systems.
- e. Identify panel in compliance with Section 26 05 3, Identification for Electrical Systems.

H. Photocell:

- 1. Products and Manufacturers: Provide one of the following:
 - a. 2100 Series by Tork Time Controls, Inc.
 - b. Or approved equal.
- 2. Cadmium sulfide hermetically sealed cell, fully temperature compensated, with time delay of not less than 15 seconds to prevent false switching.
- 3. Built-in fail safe light level selector, adjustable within limits of two to 50 foot-candles and factory set at 25 foot-candles.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:

- 1. Fixture mounting heights and locations indicated on the Drawings are approximate and are subject to revision in the field where necessary to clear conflicts and obstructions.
- 2. Mounting Heights: Mounting heights or elevations are to bottom of fixture or to centerline of device.
- 3. Install fixtures in accordance with Laws and Regulations, the Contract Documents, and manufacturer instructions and recommendations.
- 4. Mount fixtures so that sufficient access is available for ready and safe maintenance.
- 5. Securely fasten equipment to walls or other surfaces on which equipment is mounted.

B. Suspended Fixtures:

- 1. Pendant-mount using 1/2-inch diameter conduit stems.
- 2. Ground to outlet box.
- 3. Attach mounting to building structure with expansion anchors.
- 4. Fixtures shall not be dependent on the outlet box cover screws for support.

C. Surface Mounted Fixtures:

1. Attach to appropriate outlet box.
 2. Attach to surface using fasteners and sealing washers when mounting fixture in damp or wet locations.
- D. Boxes and Fixtures:
1. For units mounted against masonry or concrete walls, provide suitable 1/4-inch spacers to prevent mounting back of box directly against wall.
 2. Bolt units rigidly to building with expansion anchors, toggle bolts, hangers, or Unistrut.
 3. Do not install boxes with open conduit holes.
 4. Cable each circuit and identify with tag.
- E. Mount photocells as required and adjust foot-candle setting for proper dusk and dawn photo-control. Provide wiring in conduit from photocell to controls.

++ END OF SECTION ++

SECTION 31 20 00

EARTH MOVING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals required to perform all excavating, filling, and grading, and disposing of earth materials as shown, specified, and required for construction of structures, Underground Facilities, roads, and other facilities required to complete the Work.
2. Preparation of subgrade for slabs and pavements is included under this Section.
3. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof, except rock requiring drilling, blasting or special equipment for removal which is under Section 31 23 16.26, Rock Removal.

B. Related Sections:

1. Section 03 00 05, Concrete

D. General:

1. Refer to *Report of Subsurface Exploration and Geotechnical Engineering Evaluation – South Fayette and Crosstown WTP*. .

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI/AISC 360, Specification for Structural Steel for Buildings.
2. ASTM D422, Test Method for Particle-Size Analysis of Soils.
3. ASTM D698, Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³)).
4. ASTM D1556, Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
5. ASTM D1557, Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
6. ASTM D2216, Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
7. ASTM D4253, Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

8. ASTM D4254, Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
9. ASTM D4318, Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
11. ASTM D6938, Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
12. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.

1.3 TERMINOLOGY

- A. The following words or terms are not defined but, when used in this Section, have the following meaning:
1. "Subgrade" is the uppermost surface of native soil material unmoved from cuts; the bottom of excavation.

1.4 QUALITY ASSURANCE

- A. Qualifications:
1. Contractor's Testing Laboratory:
 - a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials specified in this Section.
 - b. Testing laboratory shall comply with ASTM E329 and requirements of Section 01 45 29.13, Testing Laboratory Services Furnished by Contractor.
 - c. Testing laboratory shall be experienced in the types of testing required.
 - d. Selection of testing laboratory is subject to Engineer's acceptance.
- B. Quality Assurance Testing:
1. Quality assurance testing is in addition to field quality control testing required under Part 3 of this Section.
 2. Materials used in the Work may require testing and retesting, as directed by Engineer, during the Project. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be performed at Owner's expense, including retesting of rejected materials and installed Work, shall be performed at Contractor's expense.
 3. Contractor's Testing Laboratory Scope:
 - a. Collect samples and perform testing of proposed fill materials in the laboratory and in the field to demonstrate compliance of the Work with the Contract Documents.
 - b. Testing laboratory shall perform testing required to obtain data for selecting moisture content for placing and compacting fill materials.
 - c. Submit to Engineer and Contractor written report results of each test.
 4. Required Quality Assurance Material Testing by Contractor's Testing Laboratory:

- a. Gradation in accordance with ASTM D422. Perform one test for every 1,000 cubic yards of each material incorporated into the Work.
- b. Atterberg limits in accordance with ASTM D4318. Perform one test for every 1,000 cubic yards of the following types of materials incorporated into the Work: general fill, and pipe bedding material.
- c. Moisture/density relations in accordance with ASTM D698, ASTM D1557, ASTM D4253, or ASTM D4254, as applicable. Perform one test for every 5,000 cubic yards of each material incorporated into the Work.
- d. Moisture content of stockpiled or borrow material in accordance with ASTM D2216. Perform one test for every 1,000 cubic yards of each material incorporated into the Work.

C. Regulatory Requirements:

1. Perform excavation work in compliance with requirements of authorities having jurisdiction and Laws and Regulations, including:
 - a. OSHA, 29 CFR Part 1926, Section .650 (Subpart P – Excavations).
2. Obtain required permits and approvals for excavation and fill Work, including work permits from right-of-way owners and permits from environmental authorities having jurisdiction over discharge of water from excavations.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Modifications to the Work proposed due to intended excavation plan.

B. Informational Submittals: Submit the following:

1. Procedure Submittals:
 - a. Excavation Plan: Prior to starting excavation operations, submit written plan to demonstrate compliance with OSHA 29 CFR Part 1926.650. As a minimum, excavation plan shall include:
 - 1) Name of Contractor's "competent person" in responsible charge of excavation and fill Work.
 - 2) Excavation method(s).
 - 3) Copies of required permits and approvals, from authorities having jurisdiction and affected utility owners, for excavation methods proposed.
 - b. Proposed compaction procedure and compaction equipment proposed for use. Where different procedures or equipment will be used for compacting different types of material or at different locations at the Site, indicate where each procedure and equipment item will be used.
2. Quality Assurance Test Results Submittals:
 - a. Submit results of quality assurance testing performed by in accordance with Paragraph 1.4.B of this Section, unless included as part of another submittal under this Section. Submit results for the following quality assurance testing:

- 1) Tests on borrow fill material.
- 2) Optimum moisture – maximum dry density curve for each type of fill material.
3. Field Quality Control Submittals:
 - a. Submit results of testing and inspection performed in accordance with the field quality control Article in Part 3 of this Section, including:
 - 1) Field density testing.
4. Qualifications Statements:
 - a. Quality Assurance Testing laboratory. Submit name and qualifications of testing laboratory to be employed, and qualifications of testing laboratory's personnel that will perform quality assurance testing required in this Section.
 - b. Field Quality Control Testing Laboratory: Names and qualifications of testing laboratory employed, and qualifications of testing laboratory's personnel that will perform field quality control testing as required under this Section.

1.6 SITE CONDITIONS

- A. Subsurface Information: The Supplementary Conditions indicate information available relative to subsurface conditions at the Site. Such information and data is not intended as a representation or warranty of continuity of conditions between soil borings or test pits, nor of groundwater levels at dates and times other than date and time when measured, nor that purpose of obtaining the information and data were appropriate for use by Contractor. Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor.
- B. Soil borings and other exploratory operations may be made by Contractor, at no additional cost to Owner. Coordinate Contractor-performed test borings and other exploratory operations with Owner and utility owners as appropriate. Perform such explorations without disrupting or otherwise adversely affecting operations of Owner or utility owners. Comply with Laws and Regulations relative to required notifications.
- C. Existing Structures:
 1. The Contract Documents show or indicate certain structures and Underground Facilities adjacent to the Work. Such information was obtained from existing records and is not guaranteed to be correct or complete. Contractor shall explore ahead of the excavation to determine the exact location of all existing structures and Underground Facilities. Existing structures and Underground Facilities shall be supported and protected from damage by Contractor. Immediately repair and restore existing structures and Underground Facilities damaged by Contractor without additional cost to Owner.
 2. Movement or operation of construction equipment over Underground Facilities shall be at Contractor's sole risk and only after Contractor has prepared and submitted to Engineer and utility owners (as applicable), and

received acceptance therefrom, a plan describing Contractor's analysis of the loads to be imparted and Contractor's proposed measures to protect structures and Underground Facilities during the Project.

3. Coordinate with utility owners for shut-off of services in active piping and conduits. When required by utility owner, Owner will assist Contractor with utility owner notifications. Completely remove buried piping and conduits indicated for removal and not otherwise indicated as being abandoned or to remain in place.
5. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when such interruption is indicated in the Contract Documents or when allowed in writing by Engineer after acceptable temporary utility services are provided by Contractor for the affected structure or property.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Structural Fill:

1. Material shall mineral soil free of organic material, loam, debris, frozen soil or other deleterious material which may be compressible, or which cannot be properly compacted and consists of the following gradation::

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
3-inch	100
No. 4	20 to 90
No. 40	5 to 75
No. 200	0 to 50

2. Structural Fill shall have a maximum liquid limit of 45 percent and a maximum plasticity index of 15 percent.

B. General Fill:

1. Material shall be free of rock and gravel larger than three inches in any dimension, debris, waste, frozen materials, organic material, and other deleterious matter.
2. Fill shall have a liquid limit not greater than 50, and plasticity index not greater than 25.
3. Previously-excavated materials complying with the Contract Documents requirements for general fill may be used for general fill.
4. When on-Site materials are found unsuitable for use as general fill, provide select fill or approved off-Site general fill materials. Prior to using off-Site material as general fill, furnish submittal for and obtain ENGINEER's approval of the material proposed for use.

C. Subbase Material:

1. Material shall be naturally- or artificially-graded mixture of natural or crushed gravel, crushed stone, or natural or crushed sand. Crushed slag is unacceptable. Material shall meet the requirement of Georgia Department of Transportation's Specifications - Section 815—Graded Aggregate.
 2. Crushed Recycled Concrete Subbase Material:
 - a. CONTRACTOR may use crushed recycled concrete material as subbase material.
 - b. Recycled concrete material shall be crushed and screened and shall comply with subbase gradation requirements of this Section. Before using in the Work, remove existing reinforcing steel from recycled concrete material.
 - c. Crushed recycled concrete material shall not contain chloride ions or aggregates susceptible to alkali-silica reaction.
 - d. The pH of recycled concrete material shall not exceed 11.
- D. Drainage Fill:
1. Material shall be washed, uniformly-graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing 1.5-inch sieve and not more than five percent passing a No. 4 sieve.
- E. Pipe Bedding Material:
1. Aggregate material shall be crushed stone and gravel, free of: rock or gravel larger than 1.5-inch in any dimension, debris, waste, frozen materials, organic material and other deleterious matter. Material shall comply with AASHTO #57 Stone wrapped with a geotextile fabric

2.2 SOURCE QUALITY CONTROL

- A. Perform quality assurance testing, and submit results to Engineer, in accordance with the 'Quality Assurance' Article in Part 1 of this Section.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Provide Engineer with sufficient notice and with means to examine areas and conditions under which excavating, filling, and grading will be performed. Engineer will advise Contractor in writing when Engineer is aware of conditions that may be detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 TEST PITS

- A. General:
1. In advance of the construction, excavate, make observations and measurements, and fill test pits to determine conditions or location of the existing Underground Facilities and structures. Perform all work required in

connection with excavating, stockpiling, maintaining, sheeting, shoring, filling, and replacing pavement for test pits. Contractor shall be responsible for the definite location of each existing Underground Facility involved within the area of excavation for the Work. Exercise care during such location work to avoid damaging and disrupting the affected Underground Facility or structure. Contractor shall be responsible for repairing, at his expense, damage to Underground Facility or structure caused during the Work.

3.3 PREPARATION

A. Site Preparation:

1. Clear areas to be occupied by permanent construction of all trees, brush, roots, stumps, logs, wood and other materials and debris. Clean and strip vegetation, sod, topsoil, and organic matter from subgrades where fills will be placed, and from areas where structures will be constructed. Remove from the Site and properly dispose of all waste materials.
2. Burning is not allowed at the Site.

B. Use of Explosives:

1. Use of explosives is not allowed.

C. Dust Control:

1. Control objectionable dust caused by Contractor's operation of vehicles and equipment, clearing, and other actions. To minimize airborne dust, apply water or use other methods subject to Engineer's acceptance and approval of authorities having jurisdiction.

D. Maintenance and Protection of Traffic:

1. Keep all streets and traffic ways open for passage of traffic and pedestrians during the Project, unless otherwise approved by owner of the street, traffic way, or right-of-way, as applicable. Construction traffic shall access the Site only via entrance(s) indicated in Section 01 55 13, Access Roads and Parking Areas.
2. When required to cross, obstruct, or temporarily close a street or traffic way, provide and maintain suitable bridges, detours, and other acceptable temporary expedients to accommodate traffic. Closings of street or traffic way shall be for shortest time practical, and passage shall be restored immediately after completion of fill and temporary paving or bridging.
3. Give required advance notice to fire department, police department, and other emergency services as applicable of proposed construction operations.
4. Give reasonable notice to owners or tenants of private property who may be affected by construction operations. Give such notice not less than 5 days prior to construction that will affect the property.

5. Hydrants, valves, fire alarm boxes, postal boxes and delivery service boxes, and other facilities that may require access during construction shall be kept accessible for use.
6. Provide temporary signage, signals, barricades, flares, lights and other equipment, service, and personnel required to regulate and protect traffic and warn of hazards. Such Work shall comply with requirements of owner of right-of-way and authorities having jurisdiction at the Site. Remove temporary equipment and facilities when no longer required, and restore grounds to original or to specified conditions, as applicable.

3.4 DEWATERING

A. Dewatering – General:

1. Provide and maintain adequate drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work and work areas. Keep each excavation dry during excavation, subgrade preparation, and continually thereafter until the structure to be built therein is acceptable to Engineer and backfilling operations are completed and acceptable to Engineer.
2. Keep all working areas at the Site free of surface water at all times. Provide temporary drainage ditches and temporary dikes, and provide required temporary pumping and other work necessary for diverting or removing rainfall and all other accumulations of surface water from excavations and fill areas. Perform diversion and removal of surface water in manner that prevents accumulation of water behind permanent or temporary structures and at any other locations in the construction area where such accumulations may be detrimental.
3. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the surface water or groundwater downstream of the point of discharge, shall not be directly discharged. Divert such waters through temporary settling basin or filter before discharging to surface water, groundwater, or drainage routes.
4. Contractor shall be responsible for condition of piping, conduits, and channels used for drainage and such piping, conduits, and channels shall be clean and free of sediment.
5. Remove water from excavations as fast as water collects.

B. Disposal of Water Removed by Dewatering System:

1. Contractor's dewatering system shall discharge to Sludge Holding Ponds, in accordance with Laws and Regulations.
2. Dispose of water removed from excavations in a manner that does not endanger health and safety, property, the Work, and other portions of the Project.
3. Dispose of water in manner that causes no inconvenience to Owner, others involved in the Project, and adjacent and downstream properties.

3.5 EXCAVATION

- A. Perform all excavation required to complete the Work as shown, specified, and required. Excavations shall include removing and handling of earth, sand, clay, gravel, hardpan, soft, weathered or decomposed rock, pavements, rubbish, and other materials within the excavation limits.
- B. Excavation Protection:
 - 1. Provide excavation protection system(s) in accordance with Laws and Regulations to prevent injury to persons and property, including Underground Facilities.
 - 2. Excavation Less Than Five Feet Deep: Excavations in stable rock or in soil conditions where there is no potential for a cave-in may be made with vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced.
 - 3. Excavations Greater Than Five Feet Deep: Excavations in stable rock may be made with vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced.
- C. Maintain excavations in dry condition in accordance with “Dewatering” Article in Part 3 of this Section.
- D. Elevation of bottom of footings shown is approximate. Engineer may direct such minor changes in dimensions and elevations as may be required to secure a satisfactory footing.
- E. When excavations are made below required grades without written order of Engineer, fill such excavations with compacted select fill, as directed by Engineer, at Contractor’s expense.
- F. Extend excavations sufficiently on each side of structures, footings, and similar construction to allow setting of forms, installation of excavation supports, and the safe sloping of banks, as necessary.
- G. Subgrades – General:
 - 1. Subgrades shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades that are otherwise solid but become soft or mucky on top due to construction operations shall be reinforced with Structural Fill. Finished elevation of stabilized subgrades shall not be above subgrade elevations shown.
 - 2. If, in Engineer’s opinion, subgrade becomes softened or mucky because of construction delays, failure to dewater properly, or other cause within Contractor’s control, subgrade shall be excavated to firm material, trimmed, and backfilled with select fill material at Contractor’s expense.

H. Pipe Trench Preparation:

1. Not more than 150 feet of trench may be opened in advance of installing pipe in trench.
2. Trench width shall be minimized to greatest extent practical, and shall comply with the following:
 - a. Trench width shall be sufficient to provide space for installing, jointing and inspecting piping. Refer to the Drawings for trench requirements. In no case should trench be wider at top of pipe than pipe barrel OD plus two feet, unless otherwise shown or indicated.
 - b. Enlargement of trench width at pipe joints may be made when required and approved by Engineer.
 - c. Trench width shall be sufficient for shoring and bracing, or shielding and dewatering.
 - d. Trench width shall be sufficient to allow thorough compaction of fill adjacent to bottom half of pipe.
 - e. Do not use excavating equipment that requires the trench to be excavated to excessive width.
3. Depth of trench shall be as shown or indicated. If required and approved by Engineer in writing, depths may be revised.
4. Where Engineer considers existing material beneath bedding material unsuitable, remove and replace such unsuitable material with select fill material.

3.6 UNAUTHORIZED EXCAVATION

- A. All excavations outside lines and grades shown or indicated and that are not approved by Engineer, together with removing and disposing of the associated material, shall be at Contractor's expense. Fill unauthorized excavations with properly-compacted select fill material at Contractor's expense.

3.7 EROSION AND SEDIMENT CONTROLS

- A. Provide temporary erosion and sediment controls in accordance with Section 01 57 05, Temporary Controls. When applicable, also comply with requirements of the erosion and sediment control plan approved by authorities having jurisdiction.

3.8 SHEETING, SHORING, AND BRACING

- A. General:
 1. Provide sheeting, shoring, bracing, and similar excavation supports as shown, specified, and required for the Work.
 2. Contractor is responsible for adequacy of all sheeting, shoring, bracing, and similar excavation supports.
 3. Materials:
 - a. Previously-used materials shall be in good condition, and shall not be damaged or excessively pitted. All steel or wood sheeting designated

to remain in place shall be new. New or used sheeting may be used for temporary sheeting, shoring, and bracing.

- b. All steel work for sheeting, shoring, bracing, cofferdams and other excavation supports, shall be in accordance with ANSI/AISC 360, except that field welding will be allowed.
 4. As excavation progresses, carry down shoring, bracing, and similar excavation supports to required elevation at bottom of excavation.
 5. Comply with Laws and Regulations regarding sheeting, shoring, bracing, and similar excavation supports.
 6. Maintain sheeting, shoring, bracing, bracing, and other excavation supports in excavations regardless of time period excavations will be open.
 7. Unless otherwise shown, specified, or directed, remove materials used for temporary construction when the Work is completed. Perform such removal in manner not injurious to the structures and Underground Facilities, their appearance, and adjacent construction.
- B. Removal of Sheeting and Bracing:
1. Remove sheeting and bracing from excavations, unless otherwise directed by Engineer in writing. Perform removal to avoid damaging the Work and adjacent construction. Removal shall be equal on both sides of excavation to ensure no unequal loads on structures and Underground Facilities.
 2. Defer removal of sheeting and bracing, where removal may cause soil to come into contact with concrete, until the following conditions are satisfied:
 - a. Concrete has cured for not less than seven days.
 - b. Wall and floor framing, up to and including grade level floors, is in place.

3.9 TRENCH SHIELDS

- A. Excavation of earth material below bottom of trench shield shall not exceed the limits established in Laws and Regulations.
- B. When using a shield for installing piping:
 1. Portions of trench shield extending below the mid-diameter of an installed, rigid pipe, such as prestressed concrete pipe and other types of rigid pipe, shall be raised above the pipe's mid-diameter elevation prior to moving the shield along the trench for further construction.
 2. Bottom of shield shall not at any time extend below mid-diameter of installed pipe that is flexible or has flexing capability, such as steel, ductile iron, PVC, CPVC, polyethylene, and other pipe that has flexing capability.
- C. When using a shield for installing structures, bottom of the shield shall not extend below the top of the bedding for the structures.
- D. When removing the shield or moving the shield ahead, exercise extreme care to prevent moving piping, structures, and other Underground Facilities, and prevent disturbance of bedding material for piping, structures, and other Underground

Facilities. When piping, structures, or Underground Facilities are disturbed, remove and reinstall the disturbed items in accordance with the Contract Documents.

3.10 FILL AND COMPACTION – GENERAL PROVISIONS

- A. Provide and compact all fill required for the finished grades as shown and as specified in this Section.
- B. Place fill in excavations as promptly as progress of the Work allows, but not until completing the following:
 - 1. Engineer's authorization after observation of construction below finish grade, including dampproofing, waterproofing, perimeter insulation, and similar Work.
 - 2. Inspection, testing, approval, and recording of locations of Underground Facilities.
 - 3. Removal of concrete formwork.
 - 4. Removal of shoring and bracing, and filling of voids with satisfactory materials.
 - 5. Removal of trash and debris.
 - 6. Permanent or temporary horizontal bracing is in place on horizontally-supported walls.
 - 7. Field testing of tanks, Underground Facilities including piping and conduits, and water-retaining structures.
- C. Fill that includes organic materials or other unacceptable material shall be removed and replaced with approved fill material in accordance with the Contract Documents.
- D. Placement – General:
 - 1. Place fill to the grades shown or indicated. Bring up evenly on all sides fill around structures and Underground Facilities.
 - 2. Place fill materials at moisture content and density as specified in this Article's requirements on compaction density. Furnish and use equipment capable of adding measured amounts of water to the fill materials to bring fill materials to a condition within required moisture content range. Furnish and use equipment capable of discing, aerating, and mixing the fill materials to ensure reasonable uniformity of moisture content throughout the fill materials, and to reduce moisture content of borrow materials by air drying, when necessary. When subgrade or lift of fill materials requires moisture-conditioning before compaction, fill material shall be sufficiently mixed or worked on the subgrade to ensure uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of specified limit shall be dried by aeration or stockpiled for drying.
 - 3. Perform compaction with equipment suitable for the type of fill material placed. Select and use equipment capable of providing the minimum density required in the Contract Documents. Use light compaction equipment, with

equipment gross weight not exceeding 7,000 pounds within horizontal distance of ten feet from the wall of completed, below-grade structures. Furnish and use equipment capable of compacting in restricted areas next to structures and around piping and Underground Facilities. Effectiveness of the equipment selected by Contractor shall be tested at start of compacted fill Work by constructing a small section of fill within the area where fill will be placed. If tests on the test section of fill indicate that required compaction is not obtained, do one or more of the following: increase the amount of coverages, decrease the lift thicknesses, or use different compactor equipment.

4. Place fill materials in horizontal, loose lifts, not exceeding specified uncompacted thickness. Place fill in a manner ensuring uniform lift thickness after placing. Mechanically compact each lift, by not less than two complete coverages of the compactor. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of compactor's compacting surface. Compaction of fill materials by inundation with water is unacceptable.
5. Do not place fill materials when standing water is present on surface of the area where fill will be placed. Do not compact fill when standing water is present on the fill to be compacted. Do not place or compact fill in a frozen condition or on top of frozen material. Fill containing organic materials or other unacceptable material previously described shall be removed and replaced prior to compaction.
6. If required densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly-functioning compaction equipment, Contractor shall perform all work required to provide the required densities. Such work shall include, at no additional cost to Owner, complete removal of unacceptable fill areas and replacement and re-compaction until acceptable fill is provided.
7. Repair, at Contractor's expense, observed or measured settlement. Make repairs and replacements as required within 30 days after being so advised by Engineer.

E. Fill Against Concrete:

1. Placing fill against concrete below finished grade is not allowed until the concrete has attained its specified strength, as determined by duration of concrete curing and testing of field-cured concrete cylinders. Requirements for strength and curing time are in Section 03 30 00, Cast-in-Place Concrete.
2. Elevation of fill placed against concrete walls shall not differ by more than two feet on each side of walls, unless walls are adequately braced or all floor framing is in place up to and including grade level slabs.
3. Backfill structural foundation units as soon as practicable, in accordance with this Section, after concrete has gained sufficient strength to avoid damage, to avoid ponding of surface water and accumulation of debris.
4. Where fill is placed against waterproofed surface, exercise care that waterproofing material is not damaged.

- F. Fill in Electrical Ductbank Trenches:
1. Provide general fill for full depth of electrical ductbank trench, below and above electrical ductbank. Where one ductbank passes beneath another pipe or ductbank, provide select fill to the elevation of the bottom of upper ductbank or pipe, as applicable.
 2. Placing and compacting fill in electrical ductbank trenches shall comply with requirements of Paragraph "G. Fill in Pipe Trenches", of this Article.
- G. Fill in Pipe Trenches:
1. Piping Installed in Fills Above Pre-construction Grade:
 - a. Prior to installing piping, place the fill in accordance with the Contract Documents until the fill reaches a minimum elevation two feet higher than the top of piping to be installed. Excavate the trench; install the piping, and backfill. Subsequently provide the remainder of the fill required for the Work.
 2. Piping trenches may be backfilled prior to testing of piping, unless nature of the test requires observation of pipe during testing. Do not construct building or structure over piping until piping has been successfully tested and passed.
 3. Pipe Bedding: Pipe bedding material shall be as follows:
 - a. Install PVC, CPVC, HDPE, and FRP piping on a layer of sand. Sand shall extend to 12 inches above top of pipe and to the trenchwalls on each side of the pipe.
 - b. Unless otherwise shown, install other types of piping on not less than six-inch layer of aggregate pipe bedding material. Aggregate pipe bedding material shall extend 12 inches above top of the pipe.
 4. Placing and Compacting Pipe Trench Fill: Unless otherwise shown, placement and compaction of pipe trench fill materials shall comply with the following:
 - a. Pipe bedding material shall be spread and the surface graded to provide a uniform and continuous support beneath piping at all points between bell holes or pipe joints. Slight disturbance of installed pipe bedding material surface during withdrawal of pipe slings or other lifting tackle is acceptable.
 - b. After each pipe's bedding material has been graded, and the piping has been aligned, joined in accordance with the Contract Documents, and placed in final position on bedding material, provide and compact sufficient pipe trench fill material under and around each side of the pipe and back of the bell or end thereof to hold piping in proper position and maintain alignment during subsequent pipe jointing and embedment operations. Deposit and compact pipe trench fill material uniformly and simultaneously on each side of piping to prevent lateral displacement of piping. Place and compact pipe trench fill material to an elevation 12 inches above top of pipe, unless otherwise shown or specified.
 - c. Each layer of pipe trench fill material shall be compacted by at least two complete coverages of all portions of surface of each lift using appropriate compaction equipment.

- d. Method of compaction and compaction equipment used shall be appropriate for material to be compacted and shall not transmit damaging shocks to the piping.
- H. Temporary Pavement:
- 1. Place 1.5 inches of temporary asphalt concrete pavement immediately after filling excavations in paved roadways and other paved areas that will remain for permanent use.
 - 2. Maintain surface of paved area over the fill in good and safe condition during progress of the Work, and promptly fill depressions over and adjacent to the fill area caused by settlement of fill.
 - 3. Permanent replacement pavement shall be equal to that of the existing roadways, unless otherwise shown or specified.
- I. Subbase Placement:
- 1. Provide subbase material where shown to the limits shown or indicated.
 - 2. Place subbase material in compacted lifts not exceeding depth of six inches each.
- J. Drainage Fill Placement:
- 1. Provide drainage fill material where shown to the limits shown or indicated.
 - 2. Place drainage fill material in compacted layers of uniform thickness not exceeding depth of six inches each. Compact lifts of drainage fill using suitable compaction equipment.
- K. Compaction Density Requirements:
- 1. Compaction required for all types of fills shall be in accordance with Table 31 23 05-A of this Section. Moisten material or aerate the material as necessary to provide the moisture content that will facilitate obtaining the required compaction.

TABLE 31 23 05-A
REQUIRED MINIMUM DENSITY

Material	Percent Compaction (ASTM D698)	Uncompacted Lift (inches)
General Fill		
More than five feet below final grade	98	8
Less than five feet below final grade	95	8
Structural Fill		
Below concrete slabs or mats	98	8
Below pavement and sidewalks	98	8
Behind concrete walls	95	8
Subbase Material		
Below pavement and sidewalks	98	8

All other locations	98	8
Pipe Bedding Material		
Below structures or pavement	98	8
All other locations	95	6
Drainage Fill	N/A	6

3. Fill shall be wetted and thoroughly mixed to achieve optimum moisture content plus-or-minus three percent, with the following exceptions:
 - a. On-site clayey soils: Optimum to plus three percent.
 4. Replace natural, undisturbed soils or compacted soil subsequently disturbed or removed by construction operations with materials compacted as indicated.
 5. Field quality control testing for density; to verify that specified density was obtained, will be performed during each day of compaction Work. Responsibility for field quality control testing is specified in the “Field Quality Control” Article in Part 3 of this Section.
 6. When field quality control testing indicates unsatisfactory compaction, provide additional compaction necessary to obtain the specified compaction. Perform additional compaction Work at no additional cost to Owner until specified compaction is obtained. Such work includes complete removal of unacceptable (as determined by Engineer) fill areas and replacement and re-compaction until acceptable fill is provided in accordance with the Contract Documents.
- L. Replacement of Unacceptable Excavated Materials: In cases where over-excavation to replace unacceptable soil materials is required, backfill the excavation to required subgrade with select fill material and thoroughly compact in accordance with the “Compaction Density Requirements” in this Article. Slope the sides of excavation in accordance with the maximum inclinations specified for each structure location.

3.11 GRADING

- A. General:
1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas.
 2. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
- B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free of irregular surface changes, and shall comply with the following:
1. Grassed Areas or Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than one inch above or below the required subgrade elevations.

2. Sidewalks: Shape surface of areas under sidewalks to line, grade, and cross section, with finish surface not more than one inch above or below the required subgrade elevation.
 3. Pavements: Shape surface of areas under pavement to line, grade, and cross section, with finish surface not more than 1/2-inch above or below the required subgrade elevation.
- C. Grading Surface of Fill Under Concrete Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a ten foot straight edge.
- D. Compaction:
1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

3.12 PAVEMENT SUBBASE COURSE

- A. General:
1. Place subbase material, in layers of specified thickness, over ground surface to support pavement base course.
 2. After completing filling and grading, shape and compact pavement subgrade to an even, firm foundation in accordance with this Section. Remove unsuitable subgrade materials, including soft materials, boulders, vegetation, and loose stones, and replace with compacted fill material as directed by Engineer.
- B. Grade Control:
1. During construction, maintain lines and grades including crown and cross-slope of subbase course.
- C. Placing of Pavement Subbase Course:
1. Place subbase course material on prepared subgrade in layers of uniform thickness, in accordance with indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placing operations.
 2. After completing compaction, other than that necessary for bringing material for the next course, do not haul or drive over the compacted subbase.
 3. Do not install pavement subbase in excess of 500 feet in length without compacting to prevent softening of the subgrade.
 4. If subgrade material becomes churned up into or mixed with the subbase material, remove the mixed material and replace with clean, compacted subbase material.

3.13 DISPOSAL OF EXCAVATED MATERIALS

- A. General:

1. Contractor shall haul away material removed from excavations that does not comply with requirements for fill, or is in excess of the quantity required for fill.
2. Disposal of materials shall be in compliance with Laws and Regulations, at no additional cost to Owner.

3.14 FIELD QUALITY CONTROL

A. Site Tests: Employ a testing laboratory to perform field quality control testing.

1. Testing Laboratory Scope:
 - a. Perform field moisture content and density tests to ensure that the specified compaction of fill materials has been obtained.
 - b. Tests of actual unconfined compressive strength or bearing tests on each stratum.
 - c. Report results of each test to Engineer and Contractor.
2. Required Material Tests:
 - a. Compaction: Comply with ASTM D1556 and ASTM D6938, as applicable.
3. Authority and Duties of Testing Laboratory:
 - a. Technicians representing the testing laboratory shall inspect the materials in the field, perform testing, and report findings to Engineer and Contractor. When materials furnished or the Work performed does not comply with the Contract Documents, technician will direct attention of Engineer and Contractor to such failure.
 - b. Technician will not act as foreman or perform other duties for Contractor. Work will be checked as it progresses, but failure to detect defective Work or non-complying materials shall not in any way prevent later rejection when defect is discovered, nor shall it obligate Engineer for Substantial Completion or final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release requirements of the Contract Documents, or to approve or accept any portion of the Work.
4. Responsibilities and Duties of Contractor:
 - a. Use of testing laboratory shall in no way relieve Contractor of the responsibility to provide materials and Work in full compliance with the Contract Documents.
 - b. To facilitate testing laboratory, Contractor shall advise testing laboratory at least two days in advance of filling operations to allow for completion of field quality control testing and for assignment of personnel.
 - c. It shall be Contractor's responsibility to accomplish the specified compaction for fill and other earthwork. Contractor shall control construction operations by confirmation tests to verify and confirm that Contractor has complied, and is complying at all times, with the Contract Documents relative to compaction, control.
 - d. Contractor shall demonstrate adequacy of compaction equipment and procedures before exceeding one or more of the following quantities of

- earthwork. Each test location shall include tests for each layer, type, or class of fill to finish grade.
- 1) 200 linear feet of trench fill.
 - 2) 10 cubic yards of select fill.
 - 3) 100 cubic yards of general fill.
 - 4) 50 cubic yards of subbase material.
5. Testing laboratory will inspect and indicate acceptable subgrades and fill layers before construction work is performed thereon. Testing of subgrades and fill layers shall be taken as follows:
- a. Trenches for Structures, and Underground Facilities (including buried ductbanks):
 - 1) In Open Fields: Two locations every 1,000 linear feet.
 - 2) Along Dirt or Gravel Roads or Off Traveled Right-of-Way: Two locations every 500 linear feet.
 - 3) Crossing Paved Roads: Two locations along each crossing.
 - 4) Under Pavement Cuts or Within Two Feet of Pavement Edges: One location every 400 linear feet.
 - b. Footing Subgrade: For each stratum of soil on which footings will be placed, perform not less than one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to Engineer.
 - c. For Select Fill: On 30-foot intervals on all sides of the structure for every compacted lift, but not less than one per lift on each side of the structure for structures less than 60 feet long on a side.
 - d. For General Fill: One per 1,000 square feet on every compacted lift.
 - e. Subbase Material: One per 1,000 square feet on every compacted lift.
6. Periodic compliance tests will be made by Engineer to verify that compaction is complying with the requirements specified, at no cost to Contractor. Contractor shall remove the overburden above the level at which Engineer wishes to test and shall fill and re-compact the excavation after testing is complete.
7. If testing laboratory reports or inspections indicate subgrade, fills, or bedding compaction below specified density, Contractor shall remove unacceptable materials as necessary and replace with specified materials and provide additional compaction at Contractor's expense until subgrades, bedding, and fill are acceptable. Costs for retesting of subgrade, fills, or bedding materials that did not originally comply with specified density shall be paid by Contractor.

++ END OF SECTION ++

SECTION 33 05 05

BURIED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all buried piping, fittings, and specials. The Work includes the following:
 - a. All types and sizes of buried piping, except where buried piping installations are specified under other Sections or other contracts.
 - b. Unless otherwise shown or specified, this Section includes all buried piping Work required, beginning at the outside face of structures or structure foundations, including piping beneath structures, and extending away from structures.
 - c. Work on or affecting existing buried piping.
 - d. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, cathodic protection, and other Work required for a complete, buried piping installation.
 - e. Supports, restraints, and thrust blocks.
 - f. Pipe encasements, with the exception of piping embedded in concrete within a structure or foundation specified under Section 40 05 05, Exposed Piping Installation.
 - g. Field quality control, including testing.
 - h. Cleaning and disinfecting.
 - i. Incorporation of valves, meters, and special items shown or specified into piping systems in accordance with the Contract Documents and as required.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before buried piping Work.
2. Coordinate with appropriate piping Sections of Division 40, Process Integration.

C. Related Sections:

1. Section 31 05 16, Aggregates for Earthwork.
2. Section 03 30 00, Cast-In-Place Concrete.
3. Section 09 91 00, Painting.

1.2 REFERENCES

- A. Standards referenced in this Section are:
1. ASME Boiler and Pressure Vessel Code.
 2. ASME B31.3, Process Piping.
 3. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.
 4. ASTM B32, Specification for Solder Metal.
 5. ASTM C12, Practice for Installing Vitrified Clay Pipe Lines.
 6. ASTM C425, Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
 7. ASTM C828, Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines.
 8. ASTM C924, Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Test Method.
 9. ASTM D2321, Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.
 10. ASTM D2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
 11. ASTM D4174, Practice for Cleaning, Flushing and Purification of Petroleum Fluid Hydraulic Systems.
 12. ASTM F1417, Test Method for Installation Acceptance of Plastic Gravity Sewer Lines using Low-Pressure Air.
 13. ASTM F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.
 14. ANSI/AWWA C105, Polyethylene Encasement for Ductile-Iron Pipe Systems.
 15. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 16. ANSI/AWWA C206, Field Welding of Steel Water Pipe.
 17. ANSI/AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
 18. ANSI/AWWA C603, Installation of Asbestos-Cement Pressure Pipe.
 19. ANSI/AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
 20. ANSI/AWWA C606, Grooved and Shouldered Joints.
 21. ANSI/AWWA C651, Disinfecting Water Mains.
 22. AWWA M9, Concrete Pressure Pipe.
 23. AWWA M11, Steel Water Pipe - A Guide for Design and Installation.
 24. AWWA M23, PVC Pipe - Design and Installation.
 25. AWWA M41, Ductile-Iron Pipe and Fittings.
 26. AWWA M45, Fiberglass Pipe Design.
 27. AWWA M55, PE Pipe - Design and Installation.
 28. ASCE 37, Design and Construction of Sanitary and Storm Sewers.
 29. American Concrete Pipe Association, Concrete Pipe Handbook.
 30. Chlorine Institute, Inc., Piping Systems for Dry Chlorine, Pamphlet No. 6.

31. NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Comply with requirements and recommendations of authorities having jurisdiction over the Work, including.
 - a. Fayette County Water System.
 - b. Georgia Environmental Protection Division.
 2. Obtain required permits for Work in roads, rights-of-way, railroads, and other areas of the Work.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Details of piping, specials, joints, harnessing and thrust blocks, and connections to piping, structures, equipment, and appurtenances.
 2. Product Data:
 - a. Manufacturer's literature and specifications, as applicable, for products specified in this Section.
 3. Testing Procedures:
 - a. Submit proposed testing procedures, methods, apparatus, and sequencing. Obtain ENGINEER's approval prior to commencing testing.
- B. Informational Submittals: Submit the following:
 1. Certificates:
 - a. Certificate signed by manufacturer of each product certifying that product conforms to applicable referenced standards.
 2. Field Quality Control Submittals:
 - a. Results of each specified field quality control test.
- C. Closeout Submittals: Submit the following:
 1. Record Documentation:
 - a. Maintain accurate and up-to-date record documents showing modifications made in the field, in accordance with approved submittals, and other Contract modifications relative to buried piping Work. Submittal shall show actual location of all piping Work and appurtenances at same scale as the Drawings.
 - b. Show piping with elevations referenced to Project datum and dimensions from permanent structures. For each horizontal bend in piping, include dimensions to at least three permanent structures, when possible. For straight runs of piping provide offset dimensions as required to document piping location.

- c. Include profile drawings with buried piping record documents when the Contract Documents include piping profile drawings.
- d. Conform to Section 01 78 39, Project Record Documents.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Upon delivery inspect pipe and appurtenances for cracking, gouging, chipping, denting, and other damage and immediately remove from Site and replace with acceptable material.
- B. Storage:
 - 1. Store materials to allow convenient access for inspection and identification. Store material off ground using pallets, platforms, or other supports. Protect packaged materials from corrosion and deterioration.
 - 2. Pipe and fittings other than PVC and CPVC may be stored outdoors without cover. Cover PVC and CPVC pipe and fittings stored outdoors.
- C. Handling:
 - 1. Handle pipe, fittings, specials, and accessories carefully in accordance with pipe manufacturer's recommendations. Do not drop or roll material off trucks. Do not drop, roll or skid piping.
 - 2. Avoid unnecessary handling of pipe.
 - 3. Keep pipe interiors free from dirt and foreign matter.
 - 4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Piping materials are specified in the Buried Piping Schedule at end of this Section. Piping materials shall conform to Specifications for each type of pipe and piping appurtenances in applicable Sections of Division 40, Process Integration.
- B. General:
 - 1. Pipe Markings:
 - a. Manufacturer shall cast or paint on each length of pipe and each fitting pipe material, diameter, and pressure or thickness class.
- C. Polyethylene Encasement:
 - 1. Polyethylene may be supplied in tubes or sheets.
 - 2. Polyethylene encasement materials shall be in accordance with ANSI/AWWA C105.

2.2 BURIED PIPING IDENTIFICATION

- A. Polyethylene Underground Warning Tape for Metallic Pipelines:
 - 1. Tracer tape shall be of inert, acid- and alkali-resistant, polyethylene, four mils thick, six inches wide, suitable for direct burial. Tape shall be capable of stretching to twice its original length.
 - 2. Message shall read, "CAUTION [insert customized name of pipe service, i.e., "POTABLE WATER", "SANITARY SEWER", "CHLORINE GAS", or other service as appropriate, as indicated in the Buried Pipe Schedule at the end of this Section] PIPE BURIED BELOW", with bold letters approximately two inches high. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored the same as pipeline colors specified for associated pipe service in Section 09 91 00, Painting.
 - 3. Manufacturer: Provide products of one of the following:
 - a. Brady Corporation
 - b. Seton Identification Products
 - c. Marking Services, Inc.
 - d. Or equal.
- B. Detectable Underground Warning Tape for Non-Metallic Pipelines:
 - 1. Tape shall be of inert, acid- and alkali-resistant, polyethylene, five mils thick, six inches wide, with aluminum backing, and have 15,000 psi tensile strength and 80 percent elongation capability. Tape shall be suitable for direct burial.
 - 2. Message shall read, "CAUTION [insert customized name of pipe service, i.e., "POTABLE WATER", "SANITARY SEWER", "CHLORINE GAS", or other appropriate service, as indicated in the Buried Pipe Schedule at the end of this Section] PIPE BURIED BELOW" with bold letters approximately two inches high. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored the same as the pipeline colors as specified for the associated pipe service in Section 09 91 00, Painting.
 - 3. Manufacturer: Provide products of one of the following:
 - a. Brady Corporation
 - b. Seton Identification Products
 - c. Marking Services, Inc.
 - d. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install piping as shown, specified, and as recommended by pipe and fittings manufacturer.

2. In event of conflict between manufacturer's recommendations and the Contract Documents, request interpretation from ENGINEER before proceeding.
3. ENGINEER will observe excavations and bedding prior to laying pipe by CONTRACTOR. Notify ENGINEER in advance of excavating, bedding, pipe laying, and backfilling operations.
4. Minimum cover over buried piping shall be 3 feet, unless otherwise shown or approved by ENGINEER.
5. Earthwork is specified in Section 31 20 00, Earth Moving
6. Excavation in excess of that required or shown, and that is not authorized by ENGINEER shall be filled at CONTRACTOR's expense with granular material furnished, placed, and compacted in accordance with Section 31 05 16, Aggregates for Earthwork.
7. Comply with NFPA 24 for "Outside Protection", where applicable to water piping systems used for fire protection.

C. Separation of Sewers and Potable Water Piping:

1. Horizontal Separation:
 - a. Where possible, existing and proposed potable water mains and service lines, and sanitary, combined, and storm sewers shall be separated horizontally by clear distance of at least ten feet.
 - b. If local conditions preclude the specified clear horizontal separation, installation will be allowed if potable water main is in separate trench or on undistributed earth shelf on one side of sewer and with bottom of potable water main at least 18 inches above top of sewer.
 - c. Exception:
 - 1) Where it is not possible to provide minimum horizontal separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe complying with public water supply design standards of authority having jurisdiction. Hydrostatically test water main and sewer as specified in this Section prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.
2. Vertical Separation:
 - a. Provide minimum vertical distance of 18 inches between outside of potable water main and outside of sewer when sewer crosses over potable water main.
 - b. Center a section of potable water main pipe at least 17.5 feet long over sewer so that sewer joints are equidistant from potable water main joints.

- c. Provide adequate structural support where potable water main crosses under sewer. At minimum, provide compacted select backfill for ten feet on each side of crossing.
- d. Exceptions:
 - 1) Where it is not possible to provide minimum vertical separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe. Hydrostatically test water main and sewer as specified in this Section, prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.
 - 2) Encase either potable water main or sewer in watertight carrier pipe extending ten feet on each side of crossing, measured perpendicular to potable water main.

D. Plugs:

- 1. Temporarily plug installed pipe at end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
- 2. Install standard plugs in bells at dead ends, tees, and crosses. Cap spigot and plain ends.
- 3. Fully secure and block plugs, caps, and bulkheads installed for testing to withstand specified test pressure.
- 4. Where plugging is required for phasing of the Work or subsequent connection of piping, install watertight, permanent type plugs, caps, or bulkhead acceptable to ENGINEER.

E. Bedding Pipe: Bed pipe as specified and in accordance with details on the Drawings.

- 1. Trench excavation and backfill, and bedding materials shall conform to Section 31 20 00 Earth Moving, as applicable.
- 2. Where ENGINEER deems existing bedding material unsuitable, remove and replace existing bedding with approved granular material furnished, placed, and compacted in accordance with Section 31 05 16, Aggregates for Earthwork. Payment for additional excavation and providing granular material will be made under the unit price payment items in the Contract.
- 3. Where pipe is installed in rock excavation, provide minimum of three inches of granular bedding material underneath pipe smaller than four-inch nominal diameter, and minimum of six inches of granular bedding material underneath pipes four-inch nominal diameter and larger.
- 4. Excavate trenches below bottom of pipe by amount shown and indicated in the Contract Documents. Remove loose and unsuitable material from bottom of trench.
- 5. Carefully and thoroughly compact pipe bedding with hand held pneumatic compactors.
- 6. Do not lay pipe until ENGINEER approves bedding condition.

7. Do not bring pipe into position until preceding length of pipe has been bedded and secured in its final position.

F. Laying Pipe:

1. Conform to manufacturer's instructions and requirements of standards and manuals listed below, as applicable:
 - a. Ductile Iron Pipe: ANSI/AWWA C600, ANSI/AWWA C105, AWWA M41.
 - d. Thermoplastic Pipe: ASTM D2321, ASTM D2774, ANSI/AWWA C605, AWWA M23, AWWA M45, AWWA, M55.
2. Install pipe accurately to line and grade shown and indicated in the Contract Documents, unless otherwise approved by ENGINEER. Remove and reinstall pipes that are not installed correctly.
3. Slope piping uniformly between elevations shown.
4. Keep groundwater level in trench at least 24 inches below bottom of pipe before laying pipe. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete. Keep clean and protect interiors of pipe, fittings, valves, and appurtenances.
5. Start laying pipe at lowest point and proceed towards higher elevations, unless otherwise approved by ENGINEER.
6. Place bell and spigot-type pipe so that bells face the direction of laying, unless otherwise approved by ENGINEER.
7. Place concrete pipe containing elliptical reinforcement with minor axis of reinforcement in vertical position.
8. Excavate around joints in bedding and lay pipe so that pipe barrel bears uniformly on trench bottom.
9. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by ENGINEER.
10. For PVC and CPVC piping with solvent welded joints, 2.5-inch diameter and smaller, and copper tubing, snake piping in trench to compensate for thermal expansion and contraction.
11. Carefully examine pipe, fittings, valves, and specials for cracks, damage, and other defects while suspended above trench before installation. Immediately remove defective materials from the Site and replace with acceptable products.
12. Inspect interior of all pipe, fittings, valves, and specials and completely remove all dirt, gravel, sand, debris, and other foreign material from pipe interior and joint recesses before pipe and appurtenances are moved into excavation. Bell and spigot-type mating surfaces shall be thoroughly wire brushed, and wiped clean and dry immediately before pipe is laid.
13. Field cut pipe, where required, with machine specially designed for cutting the type of pipe being installed. Make cuts carefully, without damage to pipe, coating or lining, and with smooth end at right angles to axis of pipe. Cut ends on push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.

14. Do not place blocking under pipe, unless specifically approved by ENGINEER for special conditions.
15. Touch up protective coatings in manner satisfactory to ENGINEER prior to backfilling.
16. Notify ENGINEER in advance of backfilling operations.
17. On steep slopes, take measures acceptable to ENGINEER to prevent movement of pipe during installation.
18. Thrust Restraint: Where required, provide thrust restraint conforming to Article 3.3 of this Section.
19. Exercise care to avoid flotation when installing pipe in cast-in-place concrete, and in locations with high groundwater.

G. Polyethylene Encasement:

1. Provide polyethylene encasement for ductile iron piping to prevent contact between pipe and surrounding bedding material and backfill.
2. Polyethylene encasement installation shall be in accordance with ANSI/AWWA C105.

H. Jointing Pipe:

1. Ductile Iron Mechanical Joint Pipe:
 - a. Immediately before making joint, wipe clean the socket, plain end, and adjacent areas. Taper cut ends and file off sharp edges to provide smooth surface.
 - b. Lubricate plain ends and gasket with soapy water or manufacturer's recommended pipe lubricant, in accordance with ANSI/AWWA C111, just prior to slipping gasket onto plain end of the joint assembly.
 - c. Place gland on plain end with lip extension toward the plain end, followed by gasket with narrow edge of gasket toward plain end.
 - d. Insert plain end of pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.
 - e. Push gland toward socket and center gland around pipe with gland lip against gasket.
 - f. Insert bolts and hand-tighten nuts.
 - g. If deflection is required, make deflection after joint assembly and prior to tightening bolts. Alternately tighten bolts approximately 180 degrees apart to seat gasket evenly. Bolt torque shall be as follows:

Pipe Diameter (inches)	Bolt Diameter (inches)	Range of Torque (ft-lbs)
4 to 24	3/4	75 to 90

- h. Bolts and nuts, except those of stainless steel, shall be coated with two coats, minimum dry film thickness of eight mils each, of high build solids epoxy or bituminous coating manufactured by Tnemec, or equal.
- i. Restrained mechanical joints shall be in accordance with Section 40 05 19, Ductile Iron Process Pipe.

2. Ductile Iron Push-On Joint Pipe:
 - a. Prior to assembling joints, thoroughly clean with wire brush the last eight inches of exterior surface of spigot and interior surface of bell, except where joints are lined or coated with a protective lining or coating.
 - b. Wipe clean rubber gaskets and flex gaskets until resilient. Conform to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
 - c. Insert gasket into joint recess and smooth out entire circumference of gasket to remove bulges and to prevent interference with proper entry of spigot of entering pipe.
 - d. Immediately prior to joint assembly, apply thin film of pipe manufacturer's recommended lubricant to surface of gasket that will come in contact with entering spigot end of pipe, or apply a thin film of lubricant to outside of spigot of entering pipe.
 - e. For assembly, center spigot in pipe bell and push pipe forward until spigot just makes contact with rubber gasket. After gasket is compressed and before pipe is pushed or pulled in the rest of the way, carefully check gasket for proper position around the full circumference of joint. Final assembly shall be made by forcing spigot end of entering pipe past gasket until spigot makes contact with base of the bell. When more than a reasonable amount of force is required to assemble the joint, remove spigot end of pipe to verify proper positioning of gasket. Do not use gaskets that have been scored or otherwise damaged.
 - f. Maintain an adequate supply of gaskets and joint lubricant at the Site when pipe jointing operations are in progress.
3. Ductile Iron Proprietary Joints:
 - a. Install pipe that utilizes proprietary joints for restraint specified in Section 40 05 19, Ductile Iron Process Pipe, or other such joints, in accordance with manufacturer's instructions.
4. Thermoplastic Pipe Joints:
 - a. Solvent Cement Welded Joints:
 - 1) Bevel pipe ends and remove all burrs before making joints. Clean pipe and fittings thoroughly. Do not attempt to make solvent cement joints if temperature is below 40 degrees F. Do not make solvent cement welded joints in wet conditions.
 - 2) Use solvent cement supplied or recommended by pipe manufacturer.
 - 3) Apply joint primer and solvent cement and assemble joints in accordance with recommendations and instructions of manufacturer of joint materials and pipe manufacturer.
 - 4) Take appropriate safety precautions when using joint primers and solvent cements. Allow air to circulate freely through pipelines to allow solvent vapors to escape. Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes.
 - b. Bell and Spigot Joints:
 - 1) Bevel pipe ends, remove all burrs, and provide a reference mark at

correct distance from pipe end before making joints.

- 2) Clean spigot end and bell thoroughly before making the joint. Insert O-ring gasket while ensuring that gasket is properly oriented. Lubricate spigot with manufacturer's recommended lubricant. Do not lubricate bell and O-ring. Insert spigot end of pipe carefully into bell until reference mark on spigot is flush with bell.

9. Copper Tubing Joints:

a. Soldered Joints:

- 1) Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony solder conforming to ASTM B32.
- 2) Ream or file pipe to remove burrs.
- 3) Clean and polish contact surfaces of joints.
- 4) Apply flux to both male and female ends.
- 5) Insert end of tube into full depth of fitting socket.
- 6) Heat joint evenly.
- 7) Form continuous solder bead around entire circumference of joint starting at the bottom.

I. Backfilling:

1. Conform to applicable requirements of Section 31 20 00 Earth Moving
2. Place backfill as Work progresses. Backfill by hand and use power tampers until pipe is covered by at least one foot of backfill.

J. Connections to Valves and Hydrants:

1. Install valves and hydrants as shown and indicated in the Contract Documents.
2. Provide suitable adapters when valves or hydrants and piping have different joint types.
3. Provide thrust restraint at all hydrants and at valves located at pipeline terminations.

K. Transitions from One Type of Pipe to Another:

1. Provide necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

L. Closures:

1. Provide closure pieces shown or required to complete the Work.

3.2 TRACER TAPE INSTALLATION

A. Polyethylene Underground Warning Tape for Metallic Pipelines:

1. Provide polyethylene tracer tape for buried metallic piping, which includes pipe that is ductile iron and copper.
2. Provide tracer tape 12 to 18 inches below finished grade, above and parallel

- to buried pipe.
 - 3. For pipelines buried eight feet or greater below finished grade, provide second line of magnetic tracer tape 2.5 feet above crown of buried pipe, aligned along pipe centerline.
 - 4. Tape shall be spread flat with message side up before backfilling.
- B. Detectable Underground Warning Tape for Non-Metallic Pipelines:
- 1. Provide polyethylene tracer tape with aluminum backing for buried, non-metallic piping, which includes pipe that is PVC, CPVC, and polyethylene.
 - 2. Provide magnetic tracer tape 12 to 18 inches below finished grade, above and parallel to buried pipe.
 - 3. For pipelines buried eight feet or greater below finished grade, provide second line of magnetic tracer tape 2.5 feet above crown of buried pipe, aligned along the pipe centerline.
 - 4. Tape shall be spread flat with message side up before backfilling.

3.3 THRUST RESTRAINT

- A. Provide thrust restraint on pressure piping systems where shown or indicated in the Contract Documents.
- B. Thrust restraint may be accomplished by using restrained pipe joints, concrete thrust blocks, or harnessing buried pipe. Thrust restraints shall be designed for axial thrust exerted by test pressure specified in the Buried Piping Schedule at the end of this Section.
- C. Place concrete thrust blocks against undisturbed soil. Where undisturbed soil does not exist, or for projects where the Site consists of backfill material, thrust restraint shall be provided by restrained pipe joints.
- D. Restrained Pipe Joints:
- 1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
 - a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with proprietary restrained joint system as specified in Section 40 05 19, Ductile Iron Process Pipe; lugs and tie rods; or other joint restraint systems approved by ENGINEER.
 - b. Steel Pipe Joints: Provide butt-welded joints, lap welded joints, flanged joints, or mechanical coupling connections as shown and specified in Buried Piping Schedule in this Section. Provide tie rods connected to lugs welded to the steel pipe for restraint at mechanical couplings.
 - c. Thermoplastic and HDPE Joints: Where bell and spigot-type or other non-restrained joints are utilized, provide tie rods across joint or other suitable joint restraint system, subject to the approval of ENGINEER.
 - d. Prestressed Concrete Cylinder Pipe Joints: Restrain utilizing clamp type restrained joint, snap ring-type restrained joint, or by welding. Concrete

pipe requiring restraint shall have sufficient longitudinal steel reinforcement provided to handle thrust forces at maximum design stress of 12,500 psi. Thrust forces in longitudinales must be transmitted directly to steel joint bands using welded connections sufficient to carry stresses involved. No allowance for the concrete to handle tensile forces is allowed. Thrust restraint shall be in accordance with ANSI/AWWA Manual M9.

- e. Joints for Concrete Pipe Other than Prestressed Concrete Cylinder Pipe: Restrain joints utilizing clamp type restrained joint or snap ring-type restrained joint.

E. Concrete Thrust Blocks:

1. Provide concrete thrust blocks on pressure piping at changes in alignment of 15 degrees or more, at tees, plugs and caps, and where shown or indicated in the Contract Documents. Construct thrust blocks of Class B concrete, conforming to 03 30 00, Cast-In-Place Concrete.
2. Install thrust blocks against undisturbed soil. Place concrete so that pipe and fitting joints are accessible for repair.
3. Concrete thrust block size shall be as shown on the Drawings or as approved by ENGINEER.

3.4 WORK AFFECTING EXISTING PIPING

A. Location of Existing Underground Facilities:

1. Locations of existing Underground Facilities shown on the Drawings should be considered approximate.
2. Determine the true location of existing Underground Facilities to which connections are to be made, crossed, and that could be disturbed, and determine location of Underground Facilities that could be disturbed during excavation and backfilling operations, or that may be affected by the Work.

B. Taking Existing Pipelines and Underground Facilities Out of Service:

1. Conform to Section 01 14 16, Coordination with Owner's Operations.
2. Do not take pipelines or Underground Facilities out of service unless specifically listed in Section 01 14 16, Coordination with Owner's Operations, or approved by ENGINEER.
3. Notify ENGINEER in writing prior to taking pipeline or Underground Facilities out of service. Shutdown notification shall be provided in advance of the shutdown in accordance with the General Conditions and Section 01 14 16, Coordination with Owner's Operations.

C. Work on Existing Pipelines or Underground Facilities:

1. Cut or tap piping or Underground Facilities as shown or required with machines specifically designed for cutting or tapping pipelines or Underground Facilities, as applicable.

2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.
3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.
4. Conform to applicable requirements of Section 01 14 16, Coordination with Owner's Operations, Section 01 73 29, Cutting and Patching, and Section 01 73 24, Connections to Existing Facilities.

3.5 FIELD QUALITY CONTROL

A. General:

1. Test all piping, except as exempted in the Buried Piping Schedule in this Section.
2. When authorities having jurisdiction are to witness tests, notify ENGINEER and authorities having jurisdiction in writing at least 48 hours in advance of testing.
3. Conduct all tests in presence of ENGINEER.
4. Remove or protect pipeline-mounted devices that could be damaged by testing.
5. Provide all apparatus and services required for testing, including:
 - a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain OWNER's operations.
 - b. Temporary bulkheads, bracing, blocking, and thrust restraints.
6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
7. Unless otherwise specified, OWNER will provide fluid required for hydrostatic testing. CONTRACTOR shall provide means to convey fluid for hydrostatic testing into piping being tested. CONTRACTOR shall provide fluid for other types of testing required.
8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.
9. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest valve. Piping not installed by CONTRACTOR and that fails the test shall be repaired upon authorization of OWNER. Unless otherwise included in the Work, repair of existing piping or Underground Facilities will be paid as extra Work.
10. When testing existing chlorine gas and sulfur dioxide gas systems to nearest isolation valve, provide a tee in the line adjacent to valve. Branch outlet on tee shall be provided with valve and used for cleaning, testing, draining, and drying the pipe. Unless otherwise indicated, existing chlorine or sulfur dioxide system shall not be shut down during testing or for installing tee and valve. Prior to placing pipeline in service, valve on branch outlet of tee shall be plugged or sealed with blind flange or threaded plug. Repair damage to system resulting from this Work at no extra cost to OWNER.

B. Test Schedule:

1. Refer to the Buried Piping Schedule in this Section for type of test required and required test pressure.
2. Unless otherwise specified, required test pressures are at lowest elevation of pipeline segment being tested.
3. For piping not listed in Buried Piping Schedule in this Section:
 - a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum, except chlorine gas, which requires separate test.
 - b. Use exfiltration testing, low-pressure air testing, or vacuum testing for other piping.
 - c. Disinfect for bacteriological testing piping that conveys potable water.
4. Test Pressure:
 - a. Use test pressures listed in Buried Piping Schedule in this Section.
 - b. If test pressure is not listed in Buried Piping Schedule, or if test is required for piping not listed in the Buried Piping Schedule, test pressure will be determined by ENGINEER based on maximum anticipated sustained operating pressure and methods described in applicable ANSI/AWWA manual or standard that applies to the piping system.

C. Hydrostatic Testing:

1. Preparation for Testing:
 - a. For thermoplastic pipe and fiberglass pipe, follow procedures described in Section 7 of ANSI/AWWA Standard C605.
 - b. For HDPE pipe, follow procedures described in ASTM F2164. Test duration, including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize, shall not exceed eight hours. If re-testing of a test section or pipeline is required, at least eight hours shall elapse between tests.
 - c. For steel pipe, follow procedures described in ANSI/AWWA Manual M11. Wetting period is not required for pipe that is not cement-lined.
 - d. For other piping follow procedures described in ANSI/AWWA Manual M9, except that minimum wetting period required immediately prior to testing for asbestos cement pipe shall be 24 hours rather than the 48 hours prescribed for concrete pipe. Wetting period is not required for pipe that is not cement mortar-lined.
 - e. Prior to testing, ensure that adequate thrust protection is in place and joints are properly installed.
2. Test Procedure:
 - a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in pipe being tested.
 - b. Expel air from pipe as required. Obtain approval of ENGINEER prior to tapping pipe for expelling air.

- c. Examine exposed joints and valves, and make repairs to eliminate visible leakage.
 - d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
 - e. HDPE Pipe: After filling pipeline, gradually pressurize pipe to test pressure and maintain required test pressure for three hours for pipe to expand. During expansion, add fluid to maintain required test pressure. Begin timed test period after expansion period and other requirements are met.
 - f. Timed test period shall not begin until after pipe has been filled, exposed to required wetting period, air has been expelled, and pressure stabilized.
 - g. Timed Test Period: After stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure. For HDPE pipe, after three hour expansion phase, reduce test pressure by ten psig and do not add liquid. Test pressure shall then remain steady for one hour, indicating no leakage.
 - h. Pump from test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at 15 minute intervals for duration of test.
3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of test pressure during timed test period. Allowable leakage rates for piping are:
- a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.
 - b. Rates based on formula or table in ANSI/AWWA Manual M41:
 - 1) Metal and fiberglass pipe joined with rubber gaskets as sealing members, including the following joint types:
 - a) Bell and spigot and push-on joints.
 - b) Mechanical joints.
 - c) Bolted sleeve type couplings.
 - d) Grooved and shouldered couplings.
 - c. Rates based on make-up allowance in ANSI/AWWA Manual M9:
 - 1) Prestressed concrete cylinder pipe and other types of concrete pipe joined with O-ring rubber gasket sealing members.
 - d. Rates based on formula or table in ANSI/AWWA C605:
 - 1) Plastic pipe joined with O-ring gasket sealing members.
 - e. Rates based on formula or table in ANSI/AWWA C603:
 - 1) Asbestos-cement pipe.

D. Exfiltration Testing:

- 1. Plug and bulkhead ends and lateral connections of pipe segment to be tested and admit fluid until the pipe is full. Admit fluid slowly to minimize air

- entrapment. Groundwater level shall be below the pipe during exfiltration test.
2. Before measuring leakage, allow fluid to wet pipe interior for the following period:
 - a. Concrete Pipe: 48 hours.
 - b. Cement Mortar-lined Pipe: 24 hours.
 - c. Asbestos-cement Pipe: 24 hours.
 - d. Other Pipe: Wetting period not required.
 3. Maintain hydrostatic head during test to equal an elevation two feet above present and future maximum groundwater elevation at pipe segment tested. ENGINEER will determine test water surface elevation for each pipe segment.
 4. Provide minimum hydrostatic head during test of two feet above crown of upstream end of pipe segment tested.
 5. Add fluid from test container or from metered supply as required to maintain test water level within three inches of test head throughout the test.
 6. Test duration shall be at least two hours.
 7. Allowable Leakage Rates:
 - a. Leakage is defined as the quantity of fluid that must be supplied to pipe segment tested to maintain hydrostatic head within three inches of test head during the test after pipe has been filled and exposed to required wetting period, plus quantity required to refill to original head at end of test.
 - b. Leakage shall not exceed that allowed by authority having jurisdiction.
- E. Vertical Deflection Test for Thermoplastic, FRP, and HDPE Pipe:
1. Conduct vertical deflection test at least thirty days after backfill has been placed.
 2. Manually pull pin-type vertical gauge mounted on sled through pipe. Gauge shall be manufactured by Quality Test Products, or equal. Set gauge so that sled will stop if vertical deflection of pipe exceeds five percent. Excavate and re-install piping that fails deflection test, and retest.
 3. Use rigid ball or mandrel for deflection test, which shall have diameter of at least 95 percent of base inside diameter or average inside diameter of piping, depending on which is specified in applicable ASTM standard, including appendix, to which pipe is manufactured. Perform test without mechanical pulling devices. Re-install and retest pipe segments that exceed deflection of five percent.
- H. Chlorine Piping:
1. Scope: Applicable to chlorine gas piping and liquid chlorine piping systems that are under vacuum or positively pressurized.
 2. General:

- a. Complete testing includes pressure testing, drying, and air or nitrogen leak testing as specified, and service gas leak testing. Pressure-test system after cleaning.
 - b. Complete testing prior to backfilling trench. Maintain groundwater level below bottom of trench until test is successfully completed.
 - c. Relative to chlorine testing, the term “plastic piping” includes the following types of pipe: PVC, CPVC, ABS, FRP, polypropylene (PP), PTFE, PFA, PVDF, ethylene chlorotrifluoroethylene (ECTFE), and ethylene tetrafluoroethylene (ETFE).
 - d. Do not attempt to repair leaks until pressure has dissipated from system.
 - e. Repair and retest system until successful test is performed.
 - f. When piping is filled with chlorine, take appropriate precautions relative to safety and minimizing potential for leaks.
3. Evaporator-supplied Systems:
 - a. Disconnect vent from discharge side of pressure relief valve of each evaporator, plug resultant opening, inspect, and secure all joints, close valves that discharge to atmosphere, and open all inline valves. Open valve in bypass line around pressure reducing valve on downstream side of each evaporator to provide through-path around valve.
 - b. Test system as specified in this Section.
 - c. After testing, restore equipment, valves, and piping to pre-test positions and close inline valves. Reconnect vent line to downstream side of pressure relief valve of each evaporator and close valve in bypass line around pressure reducing valve on downstream side of each evaporator.
4. Pressure Testing:
 - a. Fill pipe with water and hydrostatically test in accordance with Paragraph 3.5.C of this Section.
 - b. Hydrostatic test pressure shall be in accordance with the Buried Piping Schedule in this Section. When hydrostatic test pressure is not specified in Buried Piping Schedule, for pressure piping use test pressure of 1.5 times maximum operating pressure to which system may be subjected. If not otherwise specified in the Buried Piping Schedule, hydrostatically test vacuum piping to at least 25 psig.
 - c. After hydrostatic testing, replace all moisture absorbing gaskets and valve packing.
 - d. Steel Pipe: If drying after hydrostatic testing is impractical or cannot be accomplished, test steel piping by either pneumatic testing or alternate testing (weld examination) in accordance with Chlorine Institute Pamphlet No. 6. When performing pneumatic test, implement precautions to safeguard personnel and minimize risk.
5. Drying:
 - a. Dry out chlorine piping systems prior to placing in service. Drying is required for all piping regardless of whether water has been purposely introduced to system.
 - b. Steel Pipe: Accomplish drying by passing steam through piping from high end of system until piping is heated to approximately 200 degrees

- F unless lower temperature is required to protect system from damage. While steaming, allow condensate and foreign matter to drain from pipe. Disconnect steam supply and drain pockets and low spots in pipe. While pipe is still warm, blow dry, oil-free air with dew point of -40 degrees F or below, or nitrogen, through pipe until exiting air dew point is equal to supply air dew point. Valves shall be at half-open position during drying. Valves removed temporarily from system during drying must be free of moisture before being re-installed.
- c. Plastic Pipe: Dry gas piping only. Drain and remove all water and moisture from system. After draining, "pig" the pipe to remove excess water. Dry system with air or nitrogen in accordance with requirements for steel pipe, except that steam shall not be used on plastic pipe.
6. Air or Nitrogen Leak Testing:
 - a. Do not leak-test plastic piping with nitrogen or air.
 - b. Use nitrogen gas or oil-free dry air to test steel piping. Gradually introduce nitrogen or dry air and pressurize to 50 psig. Maintaining this pressure while testing all joints along pipe for leaks with soapy water solution. When system is free from leaks at this pressure, increase test pressure in increments of approximately 50 psig up to the lower of either 150 psig or 110 percent of maximum system operating pressure. After each increase in pressure, check for leaks using soapy water solution and implement corrective action as necessary.
 - c. When system has no leaks at final test pressure, depressurize the system, disconnect the test source, and cap the system to prevent entrance of water.
 - d. Nitrogen Gas: Use cylinders of dry, high-purity nitrogen gas, nitrogen handling cylinder mounted pressure regulator with zero to 300 psig range, and necessary fittings and adapters to connect source to pipe being tested. Pressure regulator shall be self-relieving type, venting to atmosphere, and include throttling valve.
 - e. Dry Air: Provide oil-free air with relative humidity of zero. Fittings, adapters, and accessories, pressure regulator, and throttling valve shall be suitable for pressure testing with air and rated for 300 psig.
 7. Service Gas (Chlorine Gas) Leak Testing:
 - a. After pressure testing and immediately after chlorine system has been dried, gradually introduce service gas to pipe; service gas is gas that will be conveyed through pipe when pipe is in use. After gas has completely filled pipe, increase service gas pressure to five psig and check all joints for leaks.
 - b. Implement precautions to safeguard personnel and minimize risk when performing service gas leak test.
 - c. Use liquid ammonia solution or chlorine gas detector to check for chlorine leaks. When using liquid ammonia solution, spray solution at pipe joints and connections. Do not squirt liquid on pipe or fittings. Chlorine gas and ammonia solution will react to produce a dense, white cloud. Leaks in piping and equipment, if detected, shall not be repaired

until all gas has been purged from system being tested. Upon completion of repairs, repeat cleaning, drying, nitrogen or air leak testing, and service gas leak testing.

- d. Do not perform service gas leak testing on liquid chlorine piping.

J. Bacteriological Testing:

1. Bacteriological testing for potable water lines, finished water lines, and other piping in accordance with the Buried Piping Schedule, is specified in Article 3.6 of this Section.

3.6 CLEANING AND DISINFECTION

A. Cleaning, General: Clean pipe systems as follows:

1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in manner approved by ENGINEER, prior to placing in service. Flush chlorine solution and sodium hypochlorite piping with water.
2. Piping 24-inch diameter and larger shall be inspected from inside and debris, dirt and foreign matter removed.
3. For piping that requires disinfection and has not been kept clean during storage or installation, swab each section individually before installation with five percent sodium hypochlorite solution.

B. Cleaning of Chlorine Gas and Liquid Chlorine Systems:

1. General: All portions of system shall be cleaned free of oil and grease.
2. Clean chlorine piping in accordance with procedures in Chlorine Institute Pamphlet No. 6.
3. Steel Pipe:
 - a. Pipe threads shall be washed clean and free from cutting oil.
 - b. Remove from inside of pipe and fittings all pipe dope, oil, and grease by drawing cloth wetted with solvent through each pipe segment, or other method acceptable to ENGINEER.
 - c. Valves shall be dismantled, thoroughly cleaned with solvents, and repacked, if necessary, prior to installation.
 - d. Cap or plug openings in pipe at end of each workday.
 - e. When using solvents such as carbon tetrachloride or trichloroethylene, exercise caution to minimize solvent exposure, and provide proper handling and disposal. Do not use solvents containing hydrocarbons or alcohols.
4. Plastic Pipe: Clean vacuum and liquid piping with a detergent and water and thoroughly rinse to remove all detergent, after which cleaning ball or swab shall be drawn through pipe.

D. Cleaning of Hydraulic and Fluid Power Oil Systems: Upon completion of field piping, but before connection to control components, hydraulic and fluid power oil systems shall be flushed and cleaned by circulating special flushing oil through

system. Flushing oil and procedures shall comply with ASTM D4174. Clean system such that internal contamination of system, when tested using procedures specified in SAE J1227, Section 2.3, shall not exceed the Allowable Cleanliness Level (ACL). Unless otherwise specified, ACL value shall be established by manufacturer of major hydraulic system components in accordance with SAE J1227, Section 9.1.

E. Disinfection:

1. Disinfect all potable and finished water piping.
2. Suggested procedure for accomplishing complete and satisfactory disinfection is specified below. Other procedures may be considered for acceptance by ENGINEER.
 - a. Prior to disinfection, clean piping as specified and flush thoroughly.
 - b. Conform to procedures described in ANSI/AWWA C651. Use continuous feed method of disinfecting, unless alternative method is acceptable to ENGINEER.
3. Water for initial flushing, testing, and disinfection will be furnished by OWNER. CONTRACTOR shall provide all temporary piping, hose, valves, appurtenances, and services required. Cost of water required for redisinfection will be paid by CONTRACTOR to OWNER at water utility's standard rates.
4. Chlorine shall be provided by CONTRACTOR.
5. Bacteriologic tests will be performed by OWNER. Certified test laboratory report will be provided to CONTRACTOR, if requested.
6. Chlorine concentration in water entering the piping shall be between 50 and 100 ppm, such that minimum residual concentration of 25 mg/L remains after 24-hour retention period. Disinfect piping and all related components. Repeat as necessary to provide complete disinfection.
7. After required retention period, flush chlorinated water to closed drain line, unless otherwise acceptable to ENGINEER. Properly dispose of chlorinated water in accordance with Laws and Regulations. Do not discharge chlorinated water to storm sewers, ditches, or overland.

3.8 SCHEDULES

A. Schedules listed below, following the "End of Section" designation, are part of this Specification section.

1. Table 33 05 05-A, Buried Piping Schedule.

+ + END OF SECTION + +

TABLE 33 05 05-A, BURIED PIPING SCHEDULE

Service	Diameter (inch)	Material	Interior Lining	Exterior Coating	Pressure Class/ Thickness	Joint	Test	Remarks
DR	3"	PVC	---	---	SCH 80	SW	EX/ VD	
PLW	¾" – 2"	PVC	---	---	C900 13.5/ SCH 80	BS/SW	HYD (150)	
PLW	6"	DIP	CL	AC	350	RMJ	HYD (150)	
TW	1 ¼"	CU	---	---	"Type K"	Sd	HYD (100)	

The following abbreviations are used in the Buried Piping Schedule.

A. Service Abbreviations

Service	Abbrev		Service	Abbrev.
Drain	DR		Tepid Water	TW
Plant Water	PLW		Carrier Pipe	CP

B. Material Abbreviations

Material	Abbrev		Material	Abbrev.
Ductile Iron	DI		Polyvinyl Chloride	PVC
Copper	CU			

C. Lining/Coating Abbreviations

Lining	Abbrev		Coating	Abbrev.
Cement Mortar Lined	CL		Asphaltic Coated	AC

D. Joint Abbreviations

Joint Type	Abbrev		Joint Type	Abbrev.
Soldered	Sd		Restrained Mech. Joint	RMJ
Solvent Weld	SW			

E. Test Abbreviations

Test	Abbrev		Test	Abbrev.
Hydrostatic Test (test pressure in psig)	HYD ()		Process Air Pipe Test (test pressure in psig)	PA ()
Exfiltration	EX		Chlorine Pipe Test	CL
Low-pressure Air Sewer Test	AIR		Disinfection and Bacteriological Testing	DBT
Vacuum Test	VAC		Examination of Welds	EW
Vertical Deflection	VD		No Test Required	NR
Televised Inspection	TV			

SECTION 40 05 05

EXPOSED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to install and test all exposed piping, fittings, and specials. The Work includes the following:
 - a. All types and sizes of exposed piping, except where exposed piping installations are specified under other Sections.
 - b. Unless otherwise shown or specified, this Section includes all piping beginning at the outside face of structures or structure foundations and extending into the structure. Piping embedded in concrete within a structure or foundation shall be considered as exposed and is included herein. Piping that is permanently or intermittently submerged, or installed in sub-aqueous environments, is considered as exposed and is included in this Section.
 - c. Work on or affecting existing exposed piping.
 - d. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all Work required for a complete exposed piping installation.
 - e. Supports, restraints, and other anchors.
 - f. Field quality control, including testing.
 - g. Cleaning and disinfecting.
 - h. Incorporation of valves, meters, and special items shown or specified into the piping systems per the Contract Documents and as required

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before exposed piping Work.
2. Coordinate with appropriate piping Sections of Division 40, Mechanical.

C. Related Sections:

1. Section 09 91 00, Painting.
2. Section 10 14 00, Signage.
3. Section 40 05 06, Couplings, Adapters, and Specials for Process Piping
4. Section 40 05 07, Pipe Hangers and Supports..
5. Section 40 05 08, Wall Pipes, Floor Pipes and Pipe Sleeves.
6. Section 40 05 31, Thermoplastic Process Pipe

6. Section 40 05 96, Vibration, Seismic, and Wind Controls.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 1. ASME B31.3, Process Piping.
 2. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.
 3. ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
 4. ASTM F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
 5. ANSI/AWWA C651, Disinfecting Water Mains.
 6. AWWA M23, PVC Piping - Design and Installation.
 7. AWWA M41, Ductile-Iron Pipe and Fittings.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Comply with requirements and recommendations of authorities having jurisdiction over the Work, including:
 - a. Comply with requirements of UL, FM and other jurisdictional authorities, where applicable.
 - b. Refer to the General and Supplementary Conditions regarding requirements for this project.
 - c. Comply with the requirements of the International Building Code as supplemented by the local authority having jurisdiction.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Detailed drawings in plan and, as applicable, section.
 - b. Details of piping, valves, supports, accessories, specials, joints, harnessing, and main anchor supports, and connections to existing piping, structures, equipment, and appurtenances.
 2. Testing Plans, Procedures, and Testing Limitations
 - a. Submit description of proposed testing methods, procedures, and apparatus, and obtain Engineer's approval prior to testing.
- B. Informational Submittals: Submit the following:
 1. Certificates:
 - a. Submit a certificate, signed by manufacturer of each product, certifying that product complies with applicable referenced standards.
 2. Source Quality Control Submittals:
 - a. Submit copies of testing report for each test.

3. Site Quality Control Reports:
 - a. Submit copies of testing report for each test.
- C. Closeout Submittals: Submit the following:
 1. Record Documentation:
 - a. Maintain accurate and up-to-date record documents showing field and Shop Drawing modifications. Record documents for exposed piping Work shall show actual location of all piping and appurtenances on a copy of the Drawings, unless otherwise approved by Engineer.
 - b. Record documents shall show piping with elevations referenced to the project datum and dimensions from permanent structures. For straight runs of pipe provide offset dimensions as required to document pipe location.
 - c. Include section drawings with exposed piping record documents when the Contract Documents include section Drawings.
 - d. Conform to Section 01 78 39, Project Record Documents.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery:
 1. Deliver products to Site to ensure uninterrupted progress of the Work.
 2. Upon delivery, inspect pipe and appurtenances for cracked, gouged, chipped, dented, and other damage and immediately remove damaged products from Site.
 3. Conform to requirements of Section 01 65 00, Product Delivery Requirements.
- B. Storage:
 1. Store products for convenient access for inspection and identification. Store products off the ground using pallets, platforms, or other supports. Protect packaged products from corrosion and deterioration.
 2. Pipe and fittings other than thermoplastic materials may be stored outdoors without cover. Thermoplastic pipe and fittings stored outdoors shall be covered.
 3. Conform to requirements of Section 01 66 00, Product Storage and Handling Requirements.
- C. Handling:
 1. Handle pipe, fittings, specials, and accessories carefully with approved handling devices. Do not drop or roll material of delivery vehicles. Do not otherwise drop, roll, or skid piping.
 2. Avoid unnecessary handling of pipe.
 3. Keep pipe interiors free of dirt and foreign matter.
 4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage. Repair damaged coatings.
 5. Conform to requirements of Section 01 65 00, Product Delivery Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Piping materials are specified in the Exposed Piping Schedule at the end of this Section. Piping materials shall conform to Specification for each type of pipe and piping appurtenances in applicable sections of Division 40, Process Integration.
- B. Markings and Identification:
 - 1. Pipe Markings:
 - a. Clearly mark each piece of pipe or fitting with a designation conforming to that shown on the approved Shop Drawings.
 - b. Manufacturer shall cast or paint on each length of pipe and each fitting the pipe material, diameter, and pressure or thickness class.
 - 2. Pipe Identification Markers and Arrows: Refer to Section 10 14 00, Signage.
- C. Appurtenances: Provide products that comply with:
 - 1. Section 40 05 07, Pipe Hangers and Supports.
 - 2. Section 40 05 06, Couplings, Adapters, and Specials for Process Piping.
 - 3. Section 40 05 08, Wall Pipes, Floor Pipes and Pipe Sleeves.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 - 1. Install piping as shown, specified and as recommended by the pipe and fittings manufacturer.
 - 2. If there is a conflict between manufacturer's recommendations and the Contract Documents, request in writing instructions from Engineer before proceeding.
 - 3. Provide pipe manufacturer's installation specialist at Site as specified on this Section.
- B. Temporary Blind Flanges, Plugs, Caps, and Bulkheads:
 - 1. Temporarily plug installed pipe at the end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
 - 2. Install standard plugs in all bells at dead ends, tees, and crosses. Cap all spigot and plain ends.

3. Fully secure and block blind flanges, plugs, caps, and bulkheads installed for testing, designed to withstand specified test pressure.
4. Where plugging is required for phasing of Work or subsequent connection of piping, install watertight, permanent type blind flanges, plugs, caps, or bulkhead acceptable to Engineer.

C. Piping Installation:

1. Conform to manufacturer's instructions and requirements of standards and manuals listed in this Section, as applicable:
 - a. Ductile Iron Pipe: ANSI/AWWA C600, AWWA M41.
 - b. Thermoplastic Pipe: AWWA M23
2. Install straight runs true to line and elevation.
3. Install vertical pipe truly plumb in all directions.
4. Install piping parallel or perpendicular to walls of structures. Piping at angles and 45 degree runs across corners of structures will not be accepted unless specifically shown on the Contract Documents or approved by the Engineer.
5. Install small diameter piping generally as shown when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, and other obstructions.
6. Install piping to leave all corridors, walkways, work areas, and similar spaces unobstructed. Unless otherwise approved by Engineer provide a minimum headroom clearance under piping and pipe supports of 7.5 feet. Clearances beneath piping shall be measured from the outermost edge of piping, flanges or other type of joint that extends beyond the nominal outside diameter of piping.
7. Protect and keep clean interiors, fittings, and valves of pipe that will convey potable water, chemicals, and other pipe designated by Engineer.
8. Cutting: Cut pipe from measurements verified at Site. Field cut pipe, where required, with a machine specially designed for cutting type of pipe being installed. Make cuts carefully without damage to pipe, coating, or lining, and with a smooth end at right angles to axis of pipe. Cut ends of push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.

D. Jointing Pipe:

1. General:
 - a. Make joints in accordance with pipe manufacturer's recommendations and Contract Documents.
 - b. Cut piping accurately and squarely and install without forcing or springing.
 - c. Ream out pipes and tubing to full inside diameter after cutting. Remove all sharp edges on end cuts.
 - d. Remove all cuttings and foreign matter from inside of pipe and tubing before installation. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.
2. Ductile Iron Mechanical Joint Pipe:

- a. Wipe clean the socket, plain end and adjacent areas immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.
- b. Lubricate plain end and gasket with soapy water or pipe manufacturer's recommended pipe lubricant, per ANSI/AWWA C111, just prior to slipping gasket onto plain end of joint assembly.
- c. Place gland on plain end with lip extension toward plain end, followed by gasket with narrow edge of gasket toward the plain end.
- d. Insert pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.
- e. Push gland toward socket and center it around pipe with the gland lip against the gasket.
- f. Insert bolts and hand tighten nuts.
- g. Deflect joint only after assembled when approved by Engineer.
- h. Make deflection after joint assembly, if approved by Engineer, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly. Bolt torque shall be:

Pipe Diameter (inches)	Bolt Diameter (inches)	Range of Torque (ft-lbs)
3	5/8	45 to 60
4 to 24	3/4	75 to 90

3. Ductile Iron and Steel Flanged Joints:
 - a. Assemble flanged joints using ring-type gaskets, with thickness as recommended by pipe manufacturer but not less than 1/8-inch thick, for raised-face flanges. Use full-face gaskets for flat-face flanges, unless otherwise approved by Engineer or recommended by pipe manufacturer. Gaskets shall be suitable for the service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.
 - b. Tighten bolts in a sequence that provides equal distribution of bolt loads.
 - c. Length of bolts shall be uniform. Bolts shall not project beyond the nut more than 1/4-inch or fall short of the nut when fully taken up. Machine-cut ends of bolts to be neatly rounded. Do not use washers.
 - d. Prior to assembly of flanged joints, lubricate bolt threads and gasket faces.
 - e. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.
 - f. After assembly, coat all bolts and nuts, except stainless steel bolts and nuts, with same coating specified in Section 09 91 00, Painting, for material of pipe and fittings being joined.
4. Thermoplastic Pipe Joints:
 - a. Solvent Cement Welded Joints:
 - 1) Bevel pipe ends and remove all burrs before making joint. Clean pipe and fittings thoroughly. Do not make solvent cement joints if temperature is below 40 degrees F. Do not make solvent cement welded joints in wet conditions.

- 2) Use solvent cement supplied or recommended by pipe manufacturer.
- 3) Apply joint primer and solvent cement and assemble joints in accordance with recommendations and instructions of manufacturer of joint materials and pipe manufacturer.
- 4) Implement appropriate safety precautions when using joint primers and solvent cements. Allow air to circulate freely through pipelines to allow solvent vapors to escape. Slowly admit fluid when flushing or filling pipelines to prevent compression of gases within pipes.
- b. Threaded Joints:
 - 1) Cut pipe square and smooth and remove burrs or raised edges with a knife or file.
 - 2) Hold pipe firmly in a pipe vise. Protect pipe at the point of grip by inserting a rubber sheet or other material between pipe and vise.
 - 3) Thread pipe in accordance with pipe manufacturer's recommendations. Brush threads clean of chips and ribbons.
 - 4) After threading pipe, starting with second full thread, and continuing over thread length, wrap 100-percent virgin TFE (Teflon) thread tape in direction of threads. Overlap each wrap by one-half width of tape.
 - 5) After application of the TFE thread tape, screw fitting or coupling onto the pipe end to be joined and tighten by hand. Using a strap wrench only, further tighten connection an additional one to two threads past hand tightness.
- c. Bell and Spigot Joints:
 - 1) Bevel pipe ends, remove all burrs, and provide a reference mark at correct distance from pipe end before making joint.
 - 2) Clean spigot end and bell thoroughly before making the joint. Insert O-ring gasket while ensuring that gasket is properly oriented. Lubricate spigot with manufacturer's recommended lubricant. Do not lubricate bell and O-ring. Insert spigot end of pipe carefully into bell until reference mark on spigot is flush with bell.
5. Copper Tubing Joints:
 - a. Soldered Joints:
 - 1) Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony solder conforming to ASTM B32.
 - 2) Ream or file pipe to remove burrs.
 - 3) Clean and polish contact surfaces of joints.
 - 4) Apply flux to both male and female ends.
 - 5) Insert end of tube into full depth of fitting socket.
 - 6) Heat joint evenly.
 - 7) Form continuous solder bead around entire circumference of joint starting at the bottom.
 - b. Threaded Joints:
 - 1) When open flames for soldering are impractical, or at unions and connections to equipment and appurtenances, assemble copper tubing with flared ends as permitted by authority having jurisdiction.
 - 2) Ends of tubing shall be flared at an angle of 45 degrees with flaring tool recommended by pipe manufacturer. Flaring tool shall have same

outside diameter as tube to be flared.

- 3) Tubing to be flared shall be soft temper or annealed prior to flaring.
- 4) Cut end of tube square and ream to remove burrs.
- 5) Resize back to round tube that is out-of-round.
- 6) Clean and polish contact surfaces of joints using an abrasive cloth.
- 7) Place flare nut over end of tube with threads closest to end being flared.
- 8) Insert appropriate length of tube between flaring bar of flaring tool and position yolk with flaring cone over tube end and clamp yoke in place.
- 9) Turn handle of yolk clockwise without over-tightening. Cracked or deformed tubes will be rejected.
- 10) Do not apply jointing compounds to mating surfaces of flare fitting and flared tube end before attaching flare nut to threaded connection.

E. Installing Valves and Accessories:

1. Provide supports for large valves, flow meters, and other heavy items as shown or required to prevent strain on adjoining piping.
2. Position flow measuring devices in pipe lines so that they have the amount of straight upstream and downstream runs recommended by the flow measuring device manufacturer, unless specific location dimensions are shown.
3. Position swing check valves and butterfly valves so that they do not conflict with upstream and downstream elements of the piping system.

F. Unions:

1. Install dielectric unions as specified in Section 40 05 06, Couplings, Adapters, and Specials for Process Piping, where dissimilar metals are connected, except for bronze or brass valves in ferrous piping.
2. Provide a union downstream of each valve with screwed connections.
3. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

G. Transitions from One Type of Pipe to Another:

1. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

H. Closures:

1. Provide closure pieces, such as blind flanges and caps, shown or required to complete the Work.

3.2 THRUST RESTRAINT

- A. Provide thrust restraint on all pressure piping systems and where otherwise shown or specified.

- B. Thrust restraints shall be designed for axial thrust exerted by test pressure specified in the Exposed Piping Schedule at end of this Section.
- C. Restrained Pipe Joints:
 - 1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
 - a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with a proprietary restrained joint system as specified in Section 40 05 19. Ductile iron pipe, lugs, and tie rods, or other joint restraint systems approved by Engineer. Restrain ductile iron pipe connected by flexible couplings or flanged coupling adapters by harnessing across the coupling or adapter using tie rods or extended bolts connecting between flanges.
 - b. Thermoplastic, FRP and HDPE Joints: Where bell and spigot-type or other non-restrained joints are utilized, provide tie rods across the joint or other suitable joint restraint system, subject to approval of Engineer.

3.3 WORK AFFECTING EXISTING PIPING

- A. Location of Existing Piping:
 - 1. Locations of existing piping shown on Drawings is approximate.
 - 2. Determine the true location of existing piping to which connections are to be made, crossed, and that could be disturbed, and determine location of other facilities that could be affected by the Work.
- B. Taking Existing Pipelines Out of Service:
 - 1. Conform to Section 01 14 16, Coordination with Owner's Operations.
- C. Work on Existing Pipelines:
 - 1. Cut or tap pipes as shown or required with machines and tools specifically designed for cutting or tapping pipelines.
 - 2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.
 - 3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.
 - 4. Conform to applicable requirements of Section 01 14 16, Coordination with Owner's Operations and Section 01 73 24, Connections to Existing Facilities.

3.4 PAINTING

- A. Field painting shall conform to Section 09 91 00, Painting.

3.5 FIELD QUALITY CONTROL

- A. Testing, General:
 - 1. Test all piping, except as exempted in the Exposed Piping Schedule.
 - 2. Notification:

- a. Notify Engineer at least 48 hours prior to testing.
- b. When authorities having jurisdiction are to witness tests, notify Engineer and authorities having jurisdiction in writing at least 48 hours in advance of testing.
3. Conduct all tests in presence of Engineer.
4. Remove or protect pipeline-mounted devices that could be damaged by testing.
5. Provide all apparatus and services required for testing, including:
 - a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain Owner's operations.
 - b. Temporary bulkheads, bracing, blocking, and thrust restraints.
6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
7. Unless otherwise specified, Owner will provide fluid required for hydrostatic testing. Contractor shall provide means to convey fluid for hydrostatic testing into the pipe being tested. Contractor shall provide fluid for other types of testing required.
8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.
9. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest valve. Piping not installed by Contractor and that fails the test shall be repaired upon authorization of Engineer or Owner. Repair of existing piping will be paid as extra work unless otherwise specified.
10. When testing existing chlorine gas and sulfur dioxide gas systems to the nearest isolation valve, provide a tee in the line adjacent to valve. Branch outlet on tee shall be provided with a valve and used for cleaning, testing, draining, and drying pipe. Unless otherwise indicated, existing chlorine or sulfur dioxide system shall not be shut down during testing or for installing tee and valve. Prior to placing the pipeline in service, valve on the branch outlet of tee shall be plugged or sealed with a blind flange or threaded plug. Repair damage to system as a result of this Work at no extra cost to Owner.

B. Test Schedule:

1. Refer to the Exposed Piping Schedule for type of test required and required test pressure.
2. Unless otherwise specified, the required test pressures are at lowest elevation of pipeline segment being tested.
3. For piping not listed in Exposed Piping Schedule:
 - a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum, except chlorine gas, which requires a separate test.
 - b. Disinfect for bacteriological testing piping that conveys potable water.
4. Test Pressure:
 - a. Use test pressures listed in Exposed Piping Schedule.

- b. If test pressure is not listed in Exposed Piping Schedule, or if a test is required for piping not listed in the Exposed Piping Schedule, test pressure will be determined by the Engineer based on the maximum anticipated sustained operating pressure and the methods described in the applicable ANSI/AWWA manual or standard that applies to the piping system.
- C. Hydrostatic Testing:
- 1. Preparation for Testing:
 - a. For thermoplastic pipe and FRP pipe, follow procedures described in Section 7 of ANSI/AWWA Standard C605.
 - b. For HDPE pipe, follow procedures described in ASTM F2164. Test duration, including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize, shall not exceed eight hours. If re-testing of a test section or pipeline is required, at least eight hours shall elapse between tests.
 - c. For steel pipe, follow procedures described in AWWA Manual M11. Wetting period is not required for pipe that is not cement-lined.
 - d. For other piping follow procedures described in AWWA Manual M9. A wetting period is not required for pipe that is not cement mortar-lined.
 - e. Prior to testing, ensure that adequate thrust protection is in place and all joints are properly installed.
 - 2. Test Procedure:
 - a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in the pipe being tested.
 - b. Expel air from pipe as required. Obtain approval of Engineer prior to tapping pipe for expelling air.
 - c. Examine joints and valves, and make repairs to eliminate visible leakage.
 - d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
 - e. HDPE Pipe: After filling pipeline, gradually pressurize pipe to test pressure and maintain required test pressure for three hours for pipe to expand. During expansion, add fluid to maintain required test pressure. Begin timed test period after expansion period and other requirements are met.
 - f. Timed test period shall not begin until after the pipe has been filled, exposed to the required wetting period, air has been expelled, and pressure stabilized.
 - g. Timed Test Period: After the stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure. For HDPE pipe, after three hour expansion phase, reduce test pressure by ten psig and do not add liquid. The test pressure shall then remain steady for one hour, indicating no leakage.

- h. Pump from a test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at fifteen minute intervals for duration of test.
 - 3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of the test pressure during timed test period. Allowable leakage rates for piping are:
 - a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.
 - b. Rates based on formula or table in ANSI/AWWA C605:
 - 1) Plastic pipe joined with O-ring gasket sealing members.
- D. Process Air Pipe Testing:
 - 1. General:
 - a. Required test pressure is listed in Exposed Piping Schedule.
 - 2. Preparation for Testing:
 - a. Provide temporary tie rods at expansion joints as required.
 - b. Verify that pipe supports, where present, are secure.
 - c. Test one pipe segment at a time. Use temporary blind flanges and isolators as required.
 - d. Install corporation cocks for filling and relieving air. Provide temporary automatic pressure relief valve and pressure gauge with range suitable for test pressure.
 - 3. Test Procedure:
 - a. Pressurize pipe segment being tested with air to the required test pressure. Maintain pressure for at least two hours.
 - b. Apply a soapy water solution to all joints to check for leakage, indicated by presence of bubbles, while test pressure is maintained.
 - c. Allowable Leakage: Zero
 - 4. Repair and retest pipelines that fail the test.
 - 5. After testing is complete remove temporary measures provided for testing and provide Type 304 stainless steel threaded plugs at taps used for testing.
- E. Examination of Welds:
 - 1. Personnel performing examination of welds shall be qualified to at least Level II, in accordance with ASNT SNT-TC-1A.
 - 2. Conform to ASME Boiler and Pressure Vessel Code Section V and applicable articles for examination of welds.
 - 3. Visually examine all welds, Category D Fluid Service, in conformance with ASME B31.3.
 - 4. Examine at least ten percent of welds using liquid penetrant examination.
 - 5. If a defect is detected, all welds shall be examined by liquid penetrant examination.
 - 6. At conclusion of liquid penetrant examination, remove penetrant test materials by flushing, washing, or wiping clean with applicable solvents.
- F. Bacteriological Testing:
 - 1. Bacteriological testing for potable water lines, finished water lines, and other piping per Exposed Piping Schedule, is specified in Article 3.6 of this Section.

3.6 CLEANING AND DISINFECTION

- A. Cleaning, General: Clean pipe systems as follows:
 - 1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in a manner approved by Engineer, prior to placing in service. Flush chlorine solution and sodium hypochlorite piping with water.
 - 2. Piping 24-inch diameter and larger shall be inspected from inside and debris, dirt and foreign matter removed.
 - 3. For piping that requires disinfection and has not been kept clean during storage or installation, swab each section individually before installation with a five percent hypochlorite solution.
- C. Cleaning of Chlorine Gas and Liquid Chlorine Systems:
 - 1. General: All portions of system shall be cleaned free of oil and grease.
 - 2. Clean chlorine piping per procedures in Chlorine Institute Pamphlet No. 6.
 - 3. Steel Pipe:
 - a. All pipe threads shall be washed clean and free from cutting oil.
 - b. Remove from inside of pipe and fittings all pipe dope, oil, and grease by drawing a cloth wetted with solvent through each pipe segment, or other method acceptable to Engineer.
 - c. Valves shall be dismantled, thoroughly cleaned with solvents, and repacked, if necessary, prior to installation.
 - d. Cap or plug openings in pipe at end of each workday.
 - e. When using solvents such as carbon tetrachloride or trichloroethylene, exercise caution times to minimize solvent exposure, and provide proper handling and disposal. Do not use solvents containing hydrocarbons or alcohols.
 - 4. Plastic Pipe: Clean vacuum and liquid piping with a detergent and water and thoroughly rinse to remove all detergent, after which a cleaning ball or swab shall be drawn through the pipe.
- B. Disinfection:
 - 1. Disinfect all potable and finished water piping.
 - 2. A suggested procedure for accomplishing complete and satisfactory disinfection is specified below. Other procedures may be considered for acceptance by Engineer.
 - a. Prior to disinfection, clean piping as specified and flush thoroughly.
 - b. Conform to procedures described in ANSI/AWWA C651. Continuous feed method of disinfecting shall be used, unless alternative method is acceptable to Engineer.
 - 3. Water for initial flushing, testing, and disinfection will be furnished by Owner. Contractor shall provide all temporary piping, hose, valves, appurtenances, and services required. Cost of water required for re-disinfection will be paid by Contractor to Owner at the water utility's standard rates.
 - 4. Chlorine shall be provided by Contractor.
 - 5. Bacteriologic tests will be performed by Owner. A certified test laboratory report will be provided to Contractor, if requested.

6. Chlorine concentration in the water entering the piping shall be between 50 and 100 ppm, such that a minimum residual concentration of 25 mg/l remains after a 24-hour retention period. Disinfect the piping and all related components. Repeat as necessary to provide complete disinfection.
7. After required retention period, the chlorinated water shall be flushed to a closed drain line, unless otherwise directed by Engineer. Properly dispose of chlorinated water in accordance with applicable regulations. Do not discharge chlorinated water to storm sewers, ditches, or overland.

3.7 EXPOSED PIPING SCHEDULE

- A. The schedules listed below, following the “End of Section” designation, are a part of this Specification section.
 1. Table 40 05 05-A, Exposed Piping Schedule.

TABLE
40 05 05-A, EXPOSED PIPING SCHEDULE

Service	Diameter (inch)	Material	Interior Lining	Exterior Coating	Pressure Class/ Thickness	Joint	Test (psig)	Remarks
HFSA	1" – 2	CPVC	None	None	SCH 80	SW	HYD (100)	Hydrofluorosilicic Acid
HFSA	2"	RPVC	None	None	250	COMP	HYD (100)	Hydrofluorosilicic Acid
PLW	1" – 2"	PVC	None	None	SCH 80	SW	HYD (100)	Plant Water
SCH	1" – 3"	PVC	None	None	DR 13.5	SW	HYD (100)	Sodium Hypochlorite
SCH	2" – 3"	RPVC	None	None	250	COMP	HYD (100)	Sodium Hypochlorite
SWE	2"	PVC	None	None	SCH 80	SW	HYD (100)	Softened Water
SWE	2"	RPVC	None	None	250	COMP	HYD (100)	Softened Water
DR	2"	PVC	None	None	SCH 40	SW	HYD (10)	Drain
VT	4"-6"	PVC	None	None	SCH 40	SW	PA (5)	Bulk and Day Tank Vents

Exposed Piping Installation

The following abbreviations are used in the Exposed Piping Schedule.

A. Service Abbreviations

Service	Abbrev.		Service	Abbrev.
Hydrofluorosilicic Acid	HFSA		Softened Water	SWE
Plant Water	PLW		Sodium Hypochlorite	SCH
Drain	DR		Vent	VT

B. Material Abbreviations

Material	Abbrev		Material	Abbrev.
Braided Clear PVC	RPVC		Polyvinyl Chloride	PVC

C. Joint Abbreviations

Joint Type	Abbrev		Joint Type	Abbrev.
Solvent Weld	SW		Compression Crimp	COMP

D. Test Abbreviations

Test	Abbrev		Test	Abbrev.
Hydrostatic Test (test pressure in psig)	HYD ()		Process Air Pipe Test (test pressure in psig)	PA ()

SECTION 40 05 06

COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all couplings, adapters, and specials for process piping.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before couplings, adapters, and specials for process piping Work.

C. Related Sections:

1. Section 09 91 00, Painting.
2. Section 33 05 05, Buried Piping Installation
3. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
2. ANSI B16.39, Malleable Iron Threaded Pipe Unions.
3. ASME B31, Standards of Pressure Piping.
4. ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-dipped, Zinc-Coated, Welded and Seamless.
5. ASTM A105/A105M, Specification for Carbon Steel Forgings and Piping Applications.
6. ASTM B169/B169M Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar.
7. ASTM B650, Specification for Electro-Deposited Engineering Chromium Coatings of Ferrous Substrates.
8. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
9. AWWA C606, Grooved and Shouldered Joints.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer shall have at least five years experience producing substantial similar products to those specified and shall be able to provide documentation

of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain each type of coupling, adapter, and special for process piping product included in this Section, regardless of component manufacturer, from a single couplings, adapters, and specials manufacturer.
2. Supplier shall prepare, or review, and approve all submittals for components furnished under this Section.
3. Components shall be suitable for specified service conditions and be integrated into overall assembly by the Supplier.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Submit piping layout Shop Drawings in accordance with Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
2. Product Data:
 - a. Submit product data on each type of coupling, expansion joint, and other piping specialties and accessories, including gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. When requested by Engineer submit certificate attesting to compliance with standards referenced in this Section, signed by manufacturer.
2. Manufacturer's Instructions:
 - a. Provide instructions for handling, storing, installing, and adjusting of products.
3. Source Quality Control:
 - a. When requested by Engineer, submit results of source quality control tests.
4. Qualifications Statements:
 - a. Submit qualifications of manufacturer when requested by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 COUPLINGS

2.2 EXPANSION JOINTS

A. Rubber-type Expansion Joints:

1. General:
 - a. Use rubber-type expansion joints at all expansion joint locations, except where other types of expansion joints are shown or specified.
2. Manufacturers: Provide products of one of the following:
 - a. Mercer Rubber Company.
 - b. U.S. Rubber Supply Company, USA
 - c. Or equal.
3. Liquid Service:
 - a. Construct expansion joints of neoprene or Buna-N suitable for temperatures up to 180 degrees F.
 - b. Expansion joints shall be filled arch type. Provide backup or retaining rings as recommended by expansion joint manufacturer.
 - c. Expansion joints shall be yoked in manner to provide transmission of tension loading to which expansion joint may be subjected during system operation. Compressive or lateral movement of expansion joint shall not be impaired by yoking system. Details of expansion joint yoking shall be submitted to Engineer for approval.
4. Air Service/ Vent:
 - a. Provide pipe expansion joints in air piping where shown as a minimum. Provide additional expansion joints if recommended by pipe manufacturer.
 - b. Air Service Expansion Joints – General:
 - 1) Except for expansion joints required at inlet and outlet connections of air blowers, construct expansion joints of chlorobutyl rubber, reinforced with embedded steel rings and strong synthetic fabric.
 - 2) Expansion joints six-inch diameter and smaller shall be double arch units. Expansion joints larger than six-inch diameter shall be triple arch units.
 - 3) Ends shall be flanged, with flanges conforming to ANSI B16.1, Class 125. Provide epoxy-coated split steel retaining rings to prevent damage to flanges when bolts are tightened.
 - 4) Expansion joints shall be suitable for temperatures up to 300 degrees F, and pressures to 40 psi.
5. Harnessing:
 - a. Harness each expansion joint against thrust for test pressure in piping, as specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
 - b. Harnessing shall be by control units consisting of two or more tie rods connected between flanges, set for maximum allowable elongation of expansion joint.
 - c. Provide epoxy-coated triangular plates to connect tie rods to flanges. Tie rods shall be Series 300 stainless steel. Rubber washers shall be used between triangular plates and tie rods.

- d. Provide control units in accordance with recommendations of expansion joint manufacturer.

2.3 MISCELLANEOUS SPECIALTIES AND ACCESSORIES

- A. Dielectric Connections:
 1. General: Where copper pipe connects to steel pipe, cast-iron pipe, or ductile iron pipe, provide either dielectric union or an insulating section of rubber or plastic pipe. When used, insulating section shall have minimum length of 12 pipe diameters.
 2. Manufacturers: Provide products of one of the following:
 - a. Epco Sales, Inc.
 - b. Watts Regulator Company.
 - c. Capitol Manufacturing Company.
 - d. Or equal.
 3. Dielectric Unions: Rated for 250 psi, ANSI B16.39.
 4. Insulating Sections: Rated for same pressure as associated piping test pressure. Material shall be suitable for the application and service.

2.4 PAINTING

- A. Shop Painting:
 1. Clean and prime-coat ferrous metal surfaces of products in the manufacturer's shop in accordance with Section 09 91 00, Painting, unless otherwise specified in this Section
 2. Coat machined, polished and non-ferrous surfaces bearing surfaces and similar unpainted surfaces with corrosion prevention compound that shall be maintained during storage and until products are placed into operation.
- B. Field painting shall conform to Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect materials for defects in material and workmanship. Verify compatibility of products with pipe, fittings, valves, and appurtenances.

3.2 INSTALLATION

- A. Installation:
 1. Install piping specialties in accordance with the Contract Documents and manufacturer's instructions.
 2. For buried installations, refer to Section 33 05 05, Buried Piping Installation.

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3. For exposed installations, refer to Section 40 05 05, Exposed Piping Installation.
- B. Adjust expansion joints as required to ensure that expansion joints will be fully extended when ambient temperature is at minimum operating temperature, and fully compressed at maximum operating temperature for the system in which expansion joints are installed.

+ + END OF SECTION + +

SECTION 40 05 07

PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified and required to design, furnish, and install all hangers, supports and appurtenances necessary to complete the Work.
- B. Coordination:
 - 1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the pipe hangers and supports Work.
- C. Related Sections:
 - 1. Section 03 00 05, Concrete.
 - 2. Section 05 50 13, Miscellaneous Metal Fabrications.
 - 3. Section 09 91 00, Painting.
 - 4. Section 40 05 06, Couplers, Adapters, and Specials for Process Piping.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American Society for Testing and Materials, (ASTM).
 - a. ASTM A 575, Specification for Steel Bars Carbon, Merchant Quality, M-Grades.
 - b. ASTM E 84, Test Method for Surface Burning Characteristics of Building Materials.
 - 2. Federal Specification, (FS).
 - a. FS A-A-1192, Hangers, Pipe.
 - 3. Manufacturers Standardization Society of the Valve and Fittings Industry, (MSS).
 - a. MSS SP 58, Pipe Hangers and Supports-Materials, Design and Manufacture.
 - b. MSS SP 69, Pipe Hangers and Supports - Selection and Application.
 - 4. Underwriters' Laboratories, Inc., (UL).
 - a. UL 203, Pipe Hanger Equipment for Fire Protection Service.

1.3 QUALITY ASSURANCE

- A. Each type of pipe hanger or support shall be the product of one manufacturer.

- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single pipe hangers and supports manufacturer.
 - 2. The pipe hangers and supports equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the pipe hangers and supports equipment manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Detailed drawings showing all hangers and supports for each piping system specified. Shop Drawings shall show location, installation, material, loads or forces, and deflection of all hangers and supports.
 - b. Each pipe system shall be analyzed for all loads and forces on the hangers and supports. Provide calculations of reaction forces to the structure to which they are fastened. Provide confirmation that hanger systems comply with support requirements and codes.
 - c. Submit and coordinate these with Shop Drawings required for all piping systems.
 - 2. Product Data:
 - a. Submit manufacturers' catalogs, literature, and engineering data on all hangers and supports. Load ratings, materials and installation shall be consistent with the recommendations of the MSS SP 58, MSS SP 69 and Federal Specification A-A-1192.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store materials in covered storage off the ground and prevent condensation.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss

or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Hangers and supports shall meet with the following requirements:
1. Standard and fabricated hangers and supports shall be furnished complete with necessary inserts, bolts, nuts, rods, washers, and other accessories.
 2. Generally, run piping in groups where practicable and parallel to building wall. Provide minimum clearance of 1-inch between pipe and other work.
 3. Install hangers or supports at all locations where pipe changes direction.
 4. All hangers and supports shall be capable of adjustment after placement of piping.
 5. Different types of hangers or supports shall be kept to a minimum.
 7. Support vertical piping at each floor and between floors by stays or braces to prevent rattling and vibration.
 8. Hanger rods shall be straight and vertical. Chain, wire, strap or perforated bar hangers shall not be used. Hangers shall not be suspended from piping.
 9. Maximum support spacing unless otherwise shown or approved for standard weight steel pipe shall be as follows:

Pipe Size (inches)	Maximum Pipe Span ¹ (feet)	
	Copper	Plastic ²
3/8 to 3/4	6	Cont. ³
1	6	5
1-1/4	6	5
1-1/2	6	5
2	10	5
2-1/2	10	5
3	10	5
4	12	5
6	12	5

¹Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.

²Span shown is for Schedule 80 CPVC pipe at 100°F. Spans for other plastics, other CPVC pipe Schedules and pipes at higher temperatures shall be shortened in accordance with the pipe manufacturer's recommendations.

³Continuous means pipe shall be in unistrut or similar channel.

10. Maximum support spacing, unless otherwise shown for plastic pipe at ambient temperature, shall be one-half of the values specified for steel pipe.
 11. Plastic pipe at temperature greater than 130°F shall be continuously supported in a metal cradle or tray.
 12. Where proper hanger or support spacing does not correspond with joist or rib spacing, structural steel channels may be attached to joists or ribs and pipes suspended there from.
 13. Prevent contact between dissimilar metals when supporting copper tubing, by use of copper plated, rubber or vinyl coated, or stainless steel hangers or supports.
 14. Isolate thin walled stainless steel piping from carbon steel by use of plastic coated hangers or supports or by taping at points of contact with PVC or vinyl.
 15. Supports and hangers shall be of a material that is compatible with the fluid being conveyed in such pipe being supported.
 16. Anchors for pipe support systems shall be compatible or protected by a coating system which is compatible with the fluid being conveyed in such pipe being supported.
- B. Expansion compensation shall be designed for individual exposed piping systems with the following Design Criteria:
1. $\Delta L = L \times \Delta T \times \alpha$
 - a. Where ΔL = pipe length change (inches).
 - b. L = pipe length between anchors (inches).
 - c. ΔT = 100 (F).
 - d. α = coefficient of thermal expansion (inches/inches/F).
 2. Expansion compensation shall be designed as an integral part of the piping hanger, support and anchorage system.
 3. Expansion compensation shall be achieved via expansion joints specified in Section 40 05 06, Couplers, Adapters, and Specials for Process Piping.

2.2 HANGERS AND SUPPORTS

- A. Hangers and supports where shown shall be in accordance with detail drawings. Hangers and supports not shown shall be in accordance with MSS SP 58.
- B. Copper Pipe, Sizes ½ inch through 4 inch:
1. Hangers for insulated pipe:
 - a. Type: Adjustable wrought clevis.
 - b. Product and Manufacturer:
 - 1.) Figure 260 by Anvil International
 - 2.) Figure B3100 or B3102 by B-Line.
 - 3.) Or Equal.
 2. Hangers for uninsulated pipe:
 - a. Type: Adjustable copper coated steel clevis.
 - b. Product and Manufacturer:
 - 1.) Figure CT65 by Anvil International

- 2.) Figure B3104CT by B-Line.
 - 3.) Or Equal.
 3. Riser Clamps:
 - a. Type: Copper Tubing riser clamp.
 - b. Product and Manufacturer:
 - 1.) Figure CT-121 by Anvil International
 - 2.) Figure B3373CT by B-Line.
 - 3.) Or Equal.
 4. Strut Mounted Clamp:
 - a. Type: Strut clamps for insulated copper tubing.
 - b. Product and Manufacturer:
 - 1.) Figure B2000 by B-Line.
 - 2.) Or Equal.
 5. Adjustable Strut Bracket:
 - a. Type: Fabricated steel bracket for strut mounting.
 - b. Factory Finish: Electro-plated or galvanized
 - c. Product and Manufacturer:
 - 1.) Figure 3064 by B-Line.
 - 2.) Or Equal.
 6. Calcium Silicate Shield:
 - a. Type: 360 with galvanized steel jacket.
 - b. Product and Manufacturer:
 - 1.) Figure B3383 by B-Line.
 - 2.) Or Equal.
- C. Chemical Piping Systems:
 1. All pipe supports and fasteners shall be glass fiber-reinforced plastic with a flame spread rating of 25, in accordance with ASTM E 84.
 2. Materials shall be manufactured by either the pultrusion or extrusion process.
 3. All pipe supports shall have a surface veil over 100 percent of the surface which, along with a filler system, shall protect against degradation from ultra-violet light.
 4. All fasteners shall be manufactured from long glass fiber-reinforced polyurethane to ensure strength and corrosion resistance.
 5. All-thread rods shall be made from vinylester resin.
 6. Manufacturers: Provide products of one of the following:
 - a. Unistrut Company.
 - b. Or equal.

2.3 ACCESSORIES

- A. Hanger rods shall be made from ASTM A 575, with square head nut on top and running thread on bottom end.
- B. Concrete Inserts:
 1. Concrete inserts shall be MSS SP 58 malleable Type 18.

*

2. Manufacturers: Provide products of one of the following:
 - a. Unistrut Corporation, Wayne, Michigan.
 - b. Elcan Metal Products, Company, Franklin Park, Illinois.
 - c. B-Line.
 - d. Anvil International, Inc.
 - e. Or equal.
- C. Steel Beam Clamps:
 1. Steel beam clamps shall be of malleable iron and conform to MSS SP 58 Type 26.
- D. Inserts for Pipe Insulation:
 1. Insulated pipe, larger than 1-1/2-inches in diameter, shall be supported by a rigid insert to protect the insulation. A steel metal saddle of sufficient gauge to carry the weight of the pipe and its fluid without deforming shall extend 2-inches minimum on each side of the rigid insert. The joints between insert and insulation shall be sealed before saddle is installed. Sizes up to 6-inches IPS shall be MSS SP 58, Type 40, and for sizes over 10-inches shall be MSS SP 58, Type 39.
- E. Brackets:
 1. Brackets for wall mounting shall conform to MSS SP 58 Type 32 pr 33 as required.
- F. Pipe Roll:
 1. To provide for pipe expansion, pipe shall be supported on adjustable malleable or steel pipe rolls, Type 46.
- G. Fabricated Pipe Rack:
 1. Pipes shall be supported and anchored to the fabricated pipe rack as shown. Clamps, rollers, and supports for piping shall conform to the general requirements of MSS SP 69.

2.4 PAINTING

- A. Clean and prime ferrous metal surfaces in the shop in accordance with the requirements of Section 09 91 00, Painting.
- B. Field painting shall conform to the requirements of Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Locate hangers, supports, and accessories to support piping, valves, and at all concentrated loads.
- B. Locate hangers, supports, and accessories within maximum span lengths specified to support continuous pipeline runs unaffected by concentrated loadings.
- C. Locate hanger, supports to prevent vibration or swaying and to provide for expansion and contraction.
 1. Temperature differential specified in this Section.
 2. Support piping independently so that equipment is not stressed by piping weight or expansion.
 3. For Uninsulated Copper Pipe or Tubing: Clamps and supports, electroplated copper finish. Instrumentation tubing shall be supported in steel or aluminum troughs with covers. All tubing layout and connections shall be as approved by the manufacturer of the equipment.
 4. Uncoated Hangers, Rods and Supports: Dip in zinc chromate primer before installation.
 5. Maximum spacing for horizontal piping:
 - a. Steel 1-Inch and Smaller: Seven feet.
 - b. Steel 1-1/2-Inch and Larger: Ten feet.
 - c. Brass or Copper 3-Inch and Smaller: Seven feet.
 - d. Brass or Copper 4-Inch and Larger: Ten feet.
 - e. Additional supports at:
 - 1) Change in direction.
 - 2) Branch piping and runouts over five feet.
 - 3) Concentrated loads due to valves, strainers or other similar items.
 - f. Maximum support spacing for plastic pipe at ambient temperature shall be one-half the above values.
 6. Hanger types for horizontal piping, except as noted and shown:
 - a. Forged steel adjustable clevis type, rod support for all services.
 - b. Slide Bases:
 - 1) Pipe stand, brackets, trapeze or other equivalent structural support.
 - 2) For piping 2-inches or larger.
 - c. For pipe and covering provide:
 - 1) Saddles for rollers or slide bases.
 - 2) Protective shields or saddles for all other types of supports.
 - d. Threaded Steel Rods:
 - 1) Two inch vertical adjustment with two nuts each end for positioning and locking.
 - 2) Size hanger rods according to the schedule below, unless otherwise noted:

Nominal Pipe (Inches)	Rod Diameter (Inches)
2 and less	3/8
2-1/2 to 3-1/2	1/2
4	5/8

6	3/4
8 through 12	7/8
14 through 18	1
20 through 30	1-1/4

- 3) For Double Rod Hangers: One size smaller than above.
- 4) Connection to Structure for Piping to 2-Inches: Concrete inserts, or expansion shields in shear into sides of beams.
- 5) Connection to Structure for Piping 2-1/2-Inch or Larger: Concrete inserts, beam clamps or suitable bridging.

- 7. Vertical Piping:
 - a. Base Support: Base elbow or welded equivalent.
 - 1) Bearing plate on structural support.
 - b. Guides not to exceed:
 - 1) 25 feet for piping to 2-inches.
 - 2) 36 feet for piping 2-1/2-inches or larger.
 - c. Top Support:
 - 1) Special hanger or saddle in horizontal connection.
 - 2) Provisions for expansion.
 - d. Intermediate Supports: Steel pipe clamp at floor.
 - 1) Bolted and welded to pipe.
 - 2) Extension ends bearing on structural steel or bearing plates.
 - e. For Multiple Pipes: Coordinate guides, bearing plates and accessory steel.
- 8. Insulated Piping:
 - a. Horizontal Pipe Shields at Supports:
 - 1) Minimum 120 degree arc.
 - 2) Length equal to diameter of insulation 12-inch minimum.
 - 3) To 6-Inch Pipe Size: No. 18 USSG galvanized steel.
 - b. Vertical Pipe Shields at Guides:
 - 1) Full 360 degree arc, securely banded.
 - 2) Length equal to diameter of insulation, 12-inch minimum.
 - 3) To 6-Inch Pipe Size: No. 18 USSG galvanized steel.

- D. Install items to be embedded before concrete placement.
- E. Fasten embedded items securely to prevent movement during concrete placement.
- F. Install hangers and support units on piping systems in accordance with manufacturer's recommendations.
- G. Adjust hangers and supports and place grout for concrete supports to bring pipelines to specified elevations.
- H. Bring all pipe systems up to operating pressures and temperatures. Cycle systems to duplicate operating conditions. Correct all support malfunctions.

++ END OF SECTION ++

SECTION 40 05 08

WALL PIPES, FLOOR PIPES, AND PIPE SLEEVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all floor pipes, pipe sleeves, wall pipes, other wall pieces, and escutcheons to complete the Work.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate with the installation of floor pipes, pipe sleeves, wall pipes, other wall pieces and escutcheons that must be installed with or within formwork, walls, partitions, ceilings and panels.

C. Related Sections:

1. Section 03 00 05 Concrete
2. Section 07 92 00, Joint Sealants.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American National Standards Institute, (ANSI).
 - a. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
 - b. ANSI B16.4, Gray-Iron Threaded Fittings.
2. American Water Works Association, (AWWA).
 - a. AWWA C104 (ANSI A21.4), Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - b. AWWA C110 (ANSI A21.10), Ductile-Iron and Gray-Iron Fittings, for Water.
 - c. AWWA C111 (ANSI A21.11), Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - d. AWWA C115 (ANSI A21.15), Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - e. AWWA C151 (ANSI A21.51), Ductile-Iron Pipe, Centrifugally Cast, for Water.
 - f. AWWA C200, Steel Water Pipe 6-Inches and Larger.

1.3 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single wall pipes, floor pipes and pipe sleeves manufacturer.
 - 2. The wall pipes, floor pipes and pipe sleeves manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the wall pipes, floor pipes and pipe sleeves manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Detailed drawings and data on all wall and floor pipe, and pipe sleeves. Submit and coordinate these with Shop Drawings required for all piping systems.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with the requirements of Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wall and Floor Pipes:
 - 1. Material: Same as specified for the piping connected to wall or floor pipe, unless otherwise approved by Engineer.
 - 2. End Connections: As shown.
 - 3. Thickness: Same as specified for the piping connected to wall or floor pipe.
 - 4. Collars: Provide collars at mid-point of wall for anchorage and watertightness.
 - 5. Pipes ends shall be flush with wall face, unless otherwise shown.
 - 6. Drill and tap flanged ends and mechanical joint bells for studs. Provide studs of same material as connected piping, except submerged and buried studs shall be of Type 316 stainless steel.
- B. Pipe Sleeves:
 - 1. Ferrous and Plastic Pipe: Use standard weight galvanized steel pipe, unless otherwise shown.
 - 2. Copper Pipe: Use Type K hard drawn copper pipe, unless otherwise shown.
- C. Cast Wall Sleeves:

1. Material: Ductile iron furnished with integral wall collar.
 2. Dimensions: As required for mechanical joint pipe to pass through sleeve. Length as required.
- D. Link Seals: Provide link type mechanical seals suitable for 20 psi working pressure, corrosive service and accessible from one side, with glass-reinforced nylon pressure plate and stainless steel bolts and nuts.
1. Products and Manufacturers: Provide one of the following:
 - a. Link-Seal, as manufactured by Thunderline Corporation.
 - b. Or equal.
- E. Wall and Ceiling Plates:
1. Bare pipes passing through walls and ceilings in finished rooms: Provide escutcheon plates of cast brass or cast-iron nickel plated, clevis or split ring and hinged with set screws.
 2. Provide plated escutcheon plates of 18-gauge steel for insulated pipes passing through walls and ceilings in finished rooms.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wall and Floor Pipes: Install as shown and in accordance with approved Shop Drawings.
- B. Pipe Sleeves:
1. Use sleeves wherever pipes pass through walls, partitions, floors, and roofs, unless otherwise shown.
 2. Extend all sleeves through floor slabs a minimum of 2-inches above finished floor.
 3. Anchor sleeves to concrete and masonry walls as shown or otherwise approved.
 4. All sleeves through walls shall be flush with wall face.
 5. All pipe joints and annular spaces in exterior walls or walls subjected to hydrostatic pressure shall be completely watertight.
 6. Use link type seals to seal sleeve against hydrostatic pressure. Size sleeves to provide annular space required to suit the link type mechanical seals that are used.
 7. Do not install sleeves and pipes through structural members, unless specifically shown and approved by Engineer.
 8. Size sleeves to provide annular space as follows:

	Sleeve ID Minus Pipe
<u>Pipe Size</u>	<u>Or Insulation OD</u>

Wall Pipes, Floor Pipes, and Pipe Sleeves

Less than 2-inches	1/2-inches to 3/4-inches
2-inches to 4-inches	3/4 inches to 1-1/4-inches.
6-inches to 12-inches	1-1/4 inches to 2-inches
Over 12-inches	2-inches to 3-inches

- C. Install wall and ceiling plates in accordance with the manufacturer's recommendations and approved Shop Drawings.

++ END OF SECTION ++

SECTION 40 05 19

DUCTILE IRON PROCESS PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish ductile iron pipe and fittings.
2. Extent of piping is shown on the Drawings. Piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, specify pipe service, diameter, material, lining, coating, pressure rating, joint type, and testing required.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before ductile iron pipe Work.

C. Related Sections:

1. Section 09 91 00, Painting.
2. Section 33 05 05, Buried Piping Installation.
3. Section 40 05 05, Exposed Piping Installation.
4. Section 40 05 06, Couplers, Adapters, and Specials for Process Piping.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series.
2. ANSI B18.2.2, Square and Hex Nuts. (Inch Series).
3. ASTM A193, Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service.
4. ASTM A194, Specification for Carbon Steel and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
5. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
6. ASTM A354, Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.
7. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
8. ASTM B117, Practice for Operating Salt Spray (Fog) Apparatus.
9. ASTM C283, Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
10. ASTM D714, Test Method for Evaluating Degree of Blistering of Paints.
11. ASTM D792, Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
12. ASTM D5162, Discontinuity (Holiday) Testing of Non-Conductive

- Protective Coating on Metallic Substrates.
13. ASTM E96, Test Methods for Water Vapor Transmission of Materials.
 14. ASTM G14, Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test).
 15. ASTM G62, Test Methods for Holiday Detection in Pipeline Coatings.
 16. ASTM G95, Test Methods for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method).
 17. ANSI/AWWA C104, Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
 18. ANSI/AWWA C110, Ductile Iron and Gray Iron Fittings for Water.
 19. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
 20. ANSI/AWWA C115, Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.
 21. ANSI/AWWA C116, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings for Water Service.
 22. ANSI/AWWA C151, Ductile Iron Pipe, Centrifugally Cast, for Water.
 23. ANSI/AWWA C153, Ductile Iron Compact Fittings, 3 inch through 24 inch and 54 inch through 64 inch for Water Service.
 24. ANSI/AWWA C606, Grooved and Shouldered Type Joints.
 25. European Standard (EN), EN 598: Ductile Iron Pipe, Fittings, Accessories and Their Joints for Sewerage Applications.
 26. MSS-SP 60, Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.
 27. NACE RP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
 28. NAPF 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.
 29. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 30. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
 31. SSPC Painting Manual, Volume 1, Para. XIV.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

- a. Manufacturer shall have a minimum of five years successful experience producing ductile iron pipe and fittings and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.
- b. Lining and coating products shall be manufactured by a firm with a minimum of five years successful experience in protecting pipelines exposed to the specified service conditions , and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.

- c. When not applied by the manufacturer, lining and coating Subcontractor shall have a minimum of five years successful experience in the application of the specified linings and coatings for similar applications for the specified service, and shall be able to show evidence of at least five installations in satisfactory operation in the United States.
- B. Supply and Compatibility:
 - 1. Unless otherwise approved, obtain all pipe, fittings, and appurtenances included in this Section from a single ductile iron pipe manufacturer.
 - 2. Ductile iron pipe manufacturer shall review and approve or prepare all Shop Drawings and other submittals for pipe, fittings, and appurtenances furnished under this Section.
 - 3. Pipe, fittings, and appurtenances shall be suitable for the specified service and shall be integrated into overall piping system by ductile iron pipe manufacturer.
 - 4. Ductile iron pipe manufacturer shall be responsible for all products and all factory-applied linings and coatings, whether installed at pipe manufacturer's facility or at manufacturer's Supplier's facility.
- C. Regulatory Requirements:
 - 1. Pipe and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, shall be certified by an accredited organization in accordance with NSF/ANSI 61 as being suitable for contact with potable water, and shall comply with requirements of authorities having jurisdiction at Site.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following with Shop Drawings required under Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation:
 - 1. Shop Drawings:
 - a. Detailed drawings and data for pipe, fittings, gaskets, appurtenances, linings, and coatings.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Submit certificate signed by manufacturer of each product that product conforms to applicable referenced standards and the Contract Documents.
 - 2. Source Quality Control Submittals:
 - a. Submit results of specified shop tests for pipe, fittings, linings, and coatings.
 - b. Lining and coating test coupons.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General:
1. Piping systems shall be suitable for their intended use.
 2. Joints shall be as specified in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation. If not specified, provide flanged joints for exposed piping and push-on or mechanical joints for buried piping. Provide couplings on pipe with plain or grooved ends where shown or where approved by Engineer.
- B. Ductile Iron Pipe, Joints, and Fittings:
1. Flanged Pipe: Fabricate in accordance with ANSI/AWWA C115.
 - a. Pressure Rating: As specified in piping schedule in Section 40 05 05, Exposed Piping Installation. If not otherwise specified, use Special Thickness Class 53 for three-inch to 54-inch diameter pipe and Pressure Class 350 for 60-inch and 64-inch diameter pipe.
 2. Non-Flanged Pipe: Conform to ANSI/AWWA C151 for material, pressure, dimensions, tolerances, tests, markings, and other requirements.
 - a. Pressure Class: As specified in piping schedules in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation.
 - b. Special Thickness Class: As specified in piping schedules in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation.
 3. Pipe Joints:
 - a. Flanged Joints: Conform to ANSI/AWWA C110 and ANSI/AWWA C111 capable of meeting the pressure rating or special thickness class, and test pressure specified in piping schedule in Section 40 05 05, Exposed Piping Installation.
 - 1) Gaskets: Unless otherwise specified, gaskets shall be at least 1/8-inch thick, ring or full-face as required for the pipe, of synthetic rubber compound containing not less than 50 percent by volume nitrile or neoprene, and shall be free from factice, reclaimed rubber, and other deleterious substances. Gaskets shall be suitable for the service conditions specified, specifically designed for use with ductile iron pipe and fittings.
 - 2) Bolts: Comply with ANSI B18.2.1.
 - a) Exposed: ASTM A307, Grade B.
 - b) Buried or Submerged: ASTM A193, Grade B8M, Class 2, Heavy hex, Type 316 stainless steel.
 - 3) Nuts: Comply with ANSI B18.2.2.

- a) Exposed: ASTM A563, Grade A, Heavy hex.
 - b) Buried or Submerged: ASTM A194, Grade B8M, Heavy hex, Type 316 stainless steel.
- b. Mechanical Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure rating or special thickness class, and test pressure specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
 - 1) Glands: Ductile iron.
 - 2) Gaskets: Plain tip.
 - 3) Bolts and Nuts: High strength, low alloy steel.
 - 4) Manufacturers: Provide products of one of the following:
 - a) Clow Water Systems Company
 - b) Atlantic States Cast Iron Pipe Company
 - c) Canada Pipe Company, Ltd.
 - d) McWane Cast Iron Pipe Company
 - e) Pacific States Cast Iron Pipe Company
 - f) Griffin Pipe Products Co.
 - g) American Cast Iron Pipe Co.
 - h) U.S. Pipe and Foundry Co.
 - i) Or equal.
- c. Push-On Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure class or special thickness class, and test pressure specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
 - 1) Gaskets: Vulcanized SBR, unless otherwise specified.
 - 2) Stripes: Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.
 - 3) Products and Manufacturers: Provide one of the following:
 - a) Tyton or Fastite Joint by Clow Water Systems, Atlantic States Cast Iron Pipe Company, Canada Pipe Company, Ltd., McWane Cast Iron Pipe Company, Pacific States Cast Iron Pipe Company, and Griffin Pipe Products Company.
 - b) Fastite Joint by American Cast Iron Pipe Company.
 - c) Tyton Joint by U.S. Pipe and Foundry Company.
 - d) Or equal.
- e. Restrained Joints: Restrained push-on joints shall be capable of being deflected after full assembly. Field cuts of restrained pipe are not allowed without approval of Engineer.
 - 1) Products and Manufacturers: Provide restrained joints for mechanical joint piping by one of the following:
 - a) Megalug, Series 1100, by EBBA Iron Sales, Inc.
 - b) MJ Coupled Joint, by American Cast Iron Pipe Co.
 - c) MJ Field Lok, by U.S. Pipe and Foundry Co.
 - d) Or equal.
 - 2) Products and Manufacturers: Provide restrained joints for push-on joint piping by one of the following:

- a) Super-Lock Joint Pipe, by Clow Water Systems, a division of McWane, Inc.
 - b) Lok-Ring Joint, or Flex-Ring Joint, by American Cast-Iron Pipe Company.
 - c) TR Flex Joint, by U.S. Pipe and Foundry Company.
 - d) Snap-Lok, by Griffin Pipe Products Company.
 - e) Or equal.
- 4. Flanged and Push-On Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111.
 - a. Material: Ductile iron.
 - b. Pressure rating, gaskets, bolts, and nuts shall be as specified for flanged joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of the connected pipe.
- 5. Mechanical Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111.
 - a. Material: Ductile iron.
 - b. Glands: Ductile iron.
 - c. Pressure rating, gaskets, bolts, and nuts shall be as specified for mechanical joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of connected pipe.
 - f. Mechanical Joint Bolt Holes: Orient bolt holes to straddle vertical centerline of the following fittings:

C. Lining, General:

- 1. Typical Service Conditions:

Property	PW	PLW
Fluid(s) Conveyed Through Pipe	Potable Water	Plant Use Water
pH range	6.5-8.5	6.5-8.5
Temperature Range (degrees F)	65-75	65-75
Maximum Fluid Velocity (fps)	10	10
Lining Type	Cement Mortar	Cement Mortar

D. Cement-mortar Lining:

- 1. Where specified in piping schedules included with Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation, pipe and fittings shall be lined with bituminous seal coated cement-mortar lining in accordance with ANSI/AWWA C104.

2.2 MARKING FOR IDENTIFICATION

- A. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify push-on joint and mechanical joint pipe with:
 - 1. Name or trademark of manufacturer.
 - 2. Weight, class or nominal thickness, and casting period.

3. Country where cast.
 4. Year the pipe was produced.
 5. Letters “DI” or “Ductile” shall be cast or metal stamped
- B. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify flanged pipe with:
1. Flange manufacturer’s mark, size, and letters “DI” cast or stamped on the flanges.
 2. Fabricator’s mark if other than flange manufacturer.
 3. Length and weight.
- C. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify fittings with:
1. Manufacturer’s identification.
 2. Pressure rating.
 3. Nominal diameters of openings.
 4. Country where cast.
 5. Number of degrees or fraction of the circle on bends.
 6. Letters “DI” or “Ductile” cast on them.

2.3 EXTERIOR SURFACE PREPARATION AND COATINGS

- A. General Coating Requirements:
1. Coating types are specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
- B. Exposed Pipe and Fittings:
1. Surface Preparation:
 - a. Initial Surface Inspection: Pipe and fitting manufacturer and coating applicator shall inspect surface to be coated and mutually determine recommended NAPF 500-03 surface preparation method.
 - b. Surface Preparation: Prepare surface in accordance with recommended NAPF 500-03 method.
 - c. Finished Surface Inspection: Prepared surfaces shall be inspected by coating applicator prior to application to determine acceptability of finished surface. If surface is unacceptable, repeat surface preparation and re-application as necessary.
 2. After recommended surface preparation, prime coat exterior ferrous metal surfaces of pipe and fittings in the shop in accordance with Section 09 91 00, Painting.
 3. Field painting shall comply with Section 09 91 00, Painting.
- C. Buried Pipe and Fittings:
1. Asphaltic Coating: Where specified in piping schedule in Section 33 05 05, Buried Piping Installation, coat pipe and fittings with an asphaltic coating approximately one-mil thick, in accordance with ANSI/AWWA C151,

ANSI/AWWA C115, ANSI/AWWA C110, and ANSI/AWWA C153, as applicable.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Inspect piping to assure that piping is free from defects in material and workmanship. Verify compatibility of pipe, fittings, gaskets, linings, and coatings.

3.2 INSTALLATION AND FIELD QUALITY CONTROL

- A. For buried piping installation and testing, refer to Section 33 05 05, Buried Piping Installation.
- B. For exposed piping installation and testing, refer to Section 40 05 05, Exposed Piping Installation.

+ + END OF SECTION + +

SECTION 40 05 31

THERMOPLASTIC PROCESS PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install thermoplastic piping and fittings.
 - 2. Extent of piping is shown and shall be in accordance with piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before thermoplastic piping Work.
- C. Related Sections:
 - 1. Section 33 05 05, Buried Piping Installation.
 - 2. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. AASHTO, Standard Specifications for Highway Bridges.
 - 2. ASTM D1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 3. ASTM D1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - 4. ASTM D2464, Specification for Threaded Poly (Vinyl Chlorinated) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 5. ASTM D2466, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 6. ASTM D2467, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 7. ASTM D2513, Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
 - 8. ASTM D2564, Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 - 9. ASTM D2665, Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
 - 10. ASTM D683, Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

11. ASTM D3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
12. ASTM D3035, Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
13. ASTM D3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
14. ASTM D3212, Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
15. ASTM D3222, Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
16. ASTM D3261, Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
17. ASTM D3311, Specification for Drain, Waste and Vent (DWV) Plastic Fittings Patterns.
18. ASTM D3350, Specification for Polyethylene Plastic Pipe and Fittings Materials.
19. ASTM D4101, Specification for Polypropylene Injection and Extrusion Materials.
20. ASTM F437, Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
21. ASTM F438, Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
22. ASTM F439, Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
23. ASTM F441/F441M, Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
24. ASTM F442/F442M, Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
25. ASTM F477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
26. ASTM F656, Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
27. ASTM F679, Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
28. ASTM F714, Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
29. ASTM F1055, Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
30. ASTM F1336, Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings.
31. ASTM F1674, Standard Test Method for Joint Restraint Products for Use with PVC Pipe.
32. ASTM F1760, Specification for Coextruded Poly (Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content.
33. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In.-12 In. (100 mm-300 mm), for Water Transmission and Distribution

34. AWWA C901, Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.
35. AWWA C905, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In.-48 In. (350 mm-1,200 mm).
36. AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission.
37. AWWA C907, Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm).
38. NSF 14, Plastic Piping Systems Components and Related Material.
39. ANSI/NSF 61, Drinking Water System Components - Health Effects.
40. Standards of U.S. Food and Drug Administration.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Shall have a minimum of five years experience producing thermoplastic pipe and fittings substantively similar to the materials specified, and shall be able to submit documentation of satisfactory service in at least five completed installations in operation for at least five years each.
2. Installer:
 - a. Engage a single pipe installer who shall be responsible for all thermoplastic pipe Work, and who shall employ only tradesmen with specific skills and experience in the type of Work required.
 - b. Installer shall have a minimum of five years experience installing thermoplastic pipe and fittings substantively similar to the materials specified and substantively similar to or larger than the scope of thermoplastic piping Work on the Project, and shall be able to submit documentation of satisfactory experience in at least five completed installations in operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all materials included in this Section, regardless of component Supplier, from a single thermoplastic pipe Supplier. All pipe of each material type shall be furnished by the same manufacturer.
2. Thermoplastic pipe Supplier shall review and approve to prepare all Shop Drawings and other submittals for all materials furnished under this Section.
3. Materials shall be suitable for specified service conditions and shall be integrated into overall assembly by thermoplastic pipe Supplier.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Submit piping layout Shop Drawings in accordance with Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
2. Product Data:

- a. Submit product data on pipe, fittings, gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Submit manufacturer's certificate of compliance standards referenced in this Section.
 - 2. Source Quality Control Submittals:
 - a. When requested by Engineer, submit results of source quality control tests.
 - 3. Qualifications Statements:
 - a. Submit qualifications of manufacturer when requested by Engineer.
 - b. Submit qualifications of installer when requested by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 SERVICE CONDITIONS

- A. General:
 - 1. Pipe materials shall be suitable for services intended. Refer to piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
 - 2. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, and other defects. Unless otherwise shown or indicated, pipe shall be uniform in color, opacity, density, and other physical properties.
 - 3. Comply with NSF 14.
 - 4. Buried pipe shall be capable of withstanding external live load, including impact, equal to AASHTO H-20 loading, with cover shown or indicated on the Drawings.
 - 5. Pipe, fittings, and appurtenances in contact with potable water or water that will be treated to become potable shall be listed in ANSI/NSF 61 as being suitable for contact with potable water, and shall comply with requirements of the authorities having jurisdiction at the Site.

2.2 POLYVINYL CHLORIDE (PVC) PIPING

- A. PVC Pipe – General Applications: Unless otherwise shown or indicated, PVC pipe shall comply with the following:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Ipex, Inc.
 - b. Spears Manufacturing Company.
 - c. Or equal.

2. Material: Unless otherwise specified, comply with the following:
 - a. Type and Grade: Type 1, Grade 1.
 - b. Wall Thickness: Schedule 80 complying with ASTM D1784 and ASTM D1785, and US Product Service PS 21-70 as having same outside diameter dimension as cast-iron pipe.
 - c. Temperature Rating: Rated for temperature to 140 degrees F.
 - d. Color: Gray
 3. Fittings: Type, grade, schedule, and color of fitting shall match the associated pipe.
 - a. Solvent Weld: Comply with AASTM D2467
 - b. Threaded: Threaded fittings shall comply with ASTM D2464.
 - c. Flanged: Provide flanged fittings with EPDMgaskets.
 4. Joints:
 - a. Solvent Weld: Use primer and solvent cement recommended by PVC pipe manufacturer for the application. Primer shall be in accordance with ASTM F656, and solvent cement shall be in accordance with ASTM D2564.
 - b. Threaded: Use 100 percent virgin polytetrafluoroethylene (Teflon or PTFE) tape for threaded fittings. Pipe shall not be threaded.
 - c. Flanged: Provide with backup flange minimum 1/8-inch thick. Backup flanges and connecting bolts shall be Type 304 stainless steel.
- C. Buried PVC Pressure Pipe:
1. Manufacturers: Provide products of one of the following:
 - a. Ipex, Inc.
 - b. Diamond Plastics Corp.
 - c. Or equal.
 2. Material:
 - a. Pipe shall comply with AWWA C900 or AWWA C905 (as applicable).
 - b. Material shall comply with ASTM D1784.
 - c. Wall Thickness: SDR 14.
 - d. Fabricate pipe with cast-iron pipe equivalent outside diameter.
 3. Fittings:
 - a. Comply with AWWA C900, AWWA C905, or AWWA C907, as applicable.
 4. Joints:
 - a. Provide bell and spigot joints. Bell shall consist of an integral wall section to hold securely in place (and prevent displacement during assembly of joint) elastomeric O-ring gasket.
 - b. Jointing lubricant shall be as recommended by pipe manufacturer.
 - c. Provide elastomeric gaskets complying with ASTM F477 and ASTM D3139.
 - d. Restrained Joints: Provide restrained joints where shown or indicated.
 - 1) Comply with Section 33 05 05, Buried Piping Installation.
 - 2) Proprietary Joint Systems: Comply with ASTM F1674. Provide restrained joint system by one of the following for bell and spigot joint PVC piping:

- a) Ebaa Iron Sales, Inc.: Series 1500 and Series 1600 Restraint Harness for C900 Pipe; Megalug Series 2500, 2800, and 1100HV Restraint Harness for C905 Pipe.
 - b) PV-LOK Series, by Sigma Corp.
 - c) Or equal.
- D. PVC Drain, Waste, and Vent (PVC-DWV) Pipe.
 - 1. Manufacturers: Provide products of one of the following:
 - a. Chemtrol, manufactured by Nibco, Inc.
 - b. Spears Manufacturing Company.
 - c. Or equal.
 - 2. Material: In accordance with ASTM D1784. Unless otherwise shown or indicated, PVC-DWV pipe shall be:
 - a. Type and Grade: Type 1, Grade 1.
 - b. Wall Thickness: Schedule 40.
 - c. Color: White.
 - 3. Fittings: Manufactured in accordance with ASTM D2665 and ASTM D3311.
 - a. Solvent weld.
 - b. Spigot.
 - 4. Joints:
 - a. Solvent weld.
 - b. Threaded.

2.3 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPING

- A. CPVC Pipe – General Applications: Unless otherwise shown or indicated, CPVC pipe shall comply with the following:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Ipex, Inc.
 - b. Spears Manufacturing Company.
 - c. Or equal.
 - 2. Material: Comply with ASTM F441/F441M and US Product Standard PS 21-70 as having same outside diameter as iron pipe. Comply with the following:
 - a. Type and Grade: Type IV, Grade 1.
 - b. Wall Thickness: Schedule 80.
 - c. Temperature Rating: Rated to 210 degrees F.
 - d. Color: Gray, except for hydrogen peroxide tank overflow piping, which shall be clear.
 - e. Manufacture pipe and fittings with minimum of two percent of titanium oxide for ultraviolet protection.
 - 3. Fittings: Type, grade, schedule, and color of fittings shall match the associated pipe.
 - a. Solvent Welded: Fittings shall comply with ASTM F439 for socket type.
 - b. Threaded: Shall comply with ASTM F437.
 - c. Flanged: Provide flanged fittings with gaskets made of material compatible with specific chemical(s) for the given service as specified in Section 43 41 43, Polyethylene Tanks.

4. Joints:
 - a. Solvent Welded: Use primer and solvent cement recommended by CPVC pipe manufacturer. Primer shall be in accordance with ASTM F656, and solvent cement shall be in accordance with ASTM D2564. Joints in hydrogen peroxide service shall be solvent welded unless otherwise indicated.
 - b. Threaded: Use 100 percent virgin polytetrafluoroethylene (Teflon or PTFE) tape for threaded fittings. Pipe shall not be threaded.
 - c. Flanged: Provide with backup flanges minimum 1/8-inch thick. Backup flanges and connecting bolts shall be Type 316 stainless steel.

2.4 FLEXIBLE TUBING

- A. Flexible Tubing: Unless otherwise shown or indicated, flexible tubing shall be as follows:
 1. Manufacturers: Provide products of one of the following:
 - a. Nalgene 980
 - c. Or equal.
 2. Material: Material shall comply with FDA CFR 21 for food packaging . Unless otherwise shown or indicated, PVC tubing shall be:
 - a. Utility (chemical) grade.
 - b. Color: Clear (for visible flow).
 - c. 180° F
 - d. 250 psig at 73° F
 3. Fittings: Fitting shall be as recommended by tubing manufacturer.

2.5 IDENTIFICATION

- A. Pipe material identification requirements are in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

2.6 SOURCE QUALITY CONTROL

- A. Shop Tests:
 1. Pipe manufacturer shall maintain continuous quality control program.
 2. Where applicable and when requested by Engineer, submit results of source quality control tests specified in reference standards.
 3. CPVC plastic molding materials used for manufacturing pipe and fittings under this Section shall be tested for compliance with ASTM D1784.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect pipe materials for defects in material and workmanship. Verify compatibility of pipe and fittings.

3.2 INSTALLATION

- A. For buried piping installation, refer to Section 33 05 05, Buried Piping Installation.
- B. For exposed piping installation, refer to Section 40 05 05, Exposed Piping Installation.

+ + END OF SECTION + +

SECTION 40 05 53

PROCESS VALVES AND APPURTENANCES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install process valves, and appurtenances, complete and operational.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before process valves Work.

C. Related Sections:

1. Section 05 05 33, Anchor Systems.
2. Section 09 91 00, Painting.
3. Section 33 05 05, Buried Piping Installation.
4. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
2. ANSI B16.34, Valves-Flanged, Threaded and Welding end. (ASME B16.34).
3. API STD 594, Check Valves, Flanged Lug, Wafer and Butt-Welding.
4. API STD 598, Valve Inspection and Testing.
5. API STD 609, Butterfly Valves: Double Flanged, Lug-Type and Wafer-Type.
6. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
7. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
8. ASTM A276, Specification for Stainless Steel Bars and Shapes.
9. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
10. ASTM A380, Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.
11. ASTM A536, Specification for Ductile Iron Castings.
12. ASTM A743/A743 M, Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
13. ASTM D429, Test Methods for Rubber Property - Adhesion to Rigid Substrates.

14. AWWA C508, Swing-Check Valves for Waterworks Service, 2-inch through 24-inch NPS.
15. AWWA C550, Protective Interior Coatings for Valves and Hydrants.
16. AWWA Manual M49, Butterfly Valves: Torque, Head Loss, and Cavitation Analysis.
17. FS TT-C-494, Coating Compound, Bituminous, Solvent Type, Acid-Resistant.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have minimum of five years' experience producing substantially similar materials and equipment to that required and be able to provide evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:

1. Obtain each type of equipment and appurtenances included in this Section, regardless of the component manufacturer, from a single Manufacturer of the type of process valve. For each type of valve, do not furnish valves of more than one manufacturer.
2. Manufacturer of each type of equipment specified shall review and approve or prepare all Shop Drawings and other submittals for all components associated with the type of process valve Manufacturer is furnishing.
3. Components shall be suitable for use in the specified service conditions. Components shall be integrated into the overall assembly by the process valve Manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Installation drawings showing orientation of valve in both plan and elevation view. Drawings shall clearly identify valve and its appurtenances, including controls, actuators, valve stems, and other components. Show dimensions of valves and appurtenances in relation to piping and structural and architectural components, where applicable.
 - b. Controls for and control characteristics of modulating valves.
 - c. Power and control wiring diagrams, including terminals numbers for electric-motor actuators.
 - d. Calculations for sizing of electric actuators.
 - e. Calculations for sizing of operating mechanism with extension stems.
 - f. Calculations for sizing of gear actuators.
2. Product Data:
 - a. Product data sheets.
 - b. Complete catalog information, including dimensions, weight, specifications, and identification of materials of construction of all parts.

- c. Corrosion resistance information to confirm suitability of valve materials for the application. Furnish information on chemical resistance of elastomers from elastomer manufacturer.
 - d. CV values and hydraulic headloss curves.
 - e. Certificates of compliance with AWWA Standards, where applicable.
 - f. Special tools list.
- 3. Calculations: Submit the following:
 - a. Sizing of electric actuators.
 - b. Sizing of operating mechanism with extension stems.
 - c. Sizing of gear actuators.
- B. Informational Submittals: Submit the following:
 - 1. Manufacturer Instructions:
 - a. Submit Manufacturer's instructions for handling, storing, and installing valves and appurtenances. Provide templates and setting drawings for valves and appurtenances that require anchor bolts or similar anchorages.
 - b. Certified copies for shop test results and inspection data.
- C. Closeout Submittals: Submit the following:
 - 1. Operations and Maintenance Data:
 - a. Provide Operation and Maintenance manuals for each type of valve furnished and installed.
 - b. Include in Operations and Maintenance manuals complete nameplate data for each valve and electric actuator.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 - 1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delay of the Work.
 - 2. Inspect boxes, crates, and packages upon delivery to Site and notify the Engineer in writing of loss or damage to materials and equipment. Promptly remedy loss and damage to new condition in accordance with Manufacturer's instructions.
 - 3. Conform to Section 01 65 00, Product Delivery Requirements.
- B. Storage and Protection:
 - 1. Keep products off the ground using pallets, platforms, or other supports. Store equipment in covered storage and prevent condensation and damage by extreme temperatures. Store in accordance with Manufacturer's recommendations. Protect steel members and packaged materials from corrosion and deterioration.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage

exists to equipment or components. Replace loss and repair damage to new condition in accordance with Manufacturer's instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Valves, General:

1. Provide each valve with Manufacturer's name and rated pressure cast in raised letters on the valve body.
2. Provide valves to turn clockwise to close, unless otherwise specified.
3. Provide valves with permanent markings for direction to open.
4. Manually operated valves, with or without extension stems, shall require not more than 40-pound pull on manual operator to open or close valve against specified criteria. Gear actuator and valve components shall be able to withstand minimum pull of 200 pounds on manual operator and input torque of 300-foot pounds to actuator nut. Manual operators include handwheel, chainwheel, crank, lever, and T-handle wrench.

B. Valve Materials:

1. Valve materials shall be suitable for the associated valve's service or application, as shown.
2. Protect wetted parts from galvanic corrosion caused by contact of different metals.
3. Wetted components and wetted surfaces of valves used with potable water or water that will be treated to become potable shall conform to ANSI/NSF 61.
4. Clean and descale fabricated stainless steel items in accordance with ASTM A380 and the following:
 - a. Passivate all stainless steel welded fabricated items after manufacture by immersing in pickling solution of six percent nitric acid and three percent hydrofluoric acid. Temperature and detention time shall be sufficient for removing oxidation and ferrous contamination without etching surface. Perform complete neutralizing operation by immersing in trisodium phosphate rinse followed by clean water wash.
 - b. Scrub welds with same pickling solution or pickling paste and clean with stainless steel wire brushes or by grinding with non-metallic abrasive tools to remove weld discoloration, and then neutralize and wash clean.
 - c. For stainless steel bolting, except where Nitronic-60 nuts are required, use anti-seize compound, graphite free, to prevent galling. Strength of the joint shall not be affected by the use of anti-seize compound.

C. Valve Joints:

1. Exposed Valves: Unless otherwise specified, provide with flanged ends conforming to ANSI B16.1. Pressure class of flanges shall be equal to or greater than specified pressure rating of the associated valve.

2. Buried Valves: Unless otherwise specified, provide with mechanical or push-on joints, restrained or unrestrained, as required by piping with which valve is installed.

2.2 BALL VALVES (BV)

A. Type 1 - Thermoplastic True Union Ball Valve:

1. Style: Standard ball with circular port. For sodium hypochlorite service, provide drilled (vented) ball type with clear identification of the valve being a vented ball valve.
2. Construction:
 - a. Material: ASTM D1784, Type 1, Grade 1 polyvinyl chloride full port body, ball, and stem., unless otherwise specified in Valve Schedule.
 - b. Seats: PTFE
3. Seals, O-rings, and elastomers:

Service	Material
Sodium Hypochlorite	FKM
Hydrofluosilicic Acid	FKM
Water	EPDM

4. Pressure Rating: 150 psi at 75 degrees F.
5. End Connections: Socket welded, unless otherwise specified in Valve Schedule.
6. Operator: Lever, unless otherwise specified in Valve Schedule.
7. Manufacturer and Model:
 - a. Asahi/America, Type 21.
 - b. NIBCO Inc. Chemtrol, TU Series Tru-Bloc.
 - c. Georg Fischer Plastic Systems, Type 546.
 - d. Or Engineer approved equal.

B. Type 2 - Thermoplastic True Union Ball Valve (Vented):

1. Style: Standard ball with circular port. For sodium hypochlorite service (applicable to fill lines, overflow lines, and sump pump discharge only), provide PVC drilled (vented) ball type with clear identification of the valve being a vented ball valve. For other chemical systems refer to valve schedule for if ball valves are either vented or non-vented.
2. Construction:
 - a. Ball must contain an adequate vent to the pressure port opposite of the downstream sealing port. Valve must be manufactured with vent at the factory.
 - b. Material: ASTM D1784, Type 1, Grade 1 polyvinyl chloride full port body, ball, and stem., unless otherwise specified in Valve Schedule.
 - c. Seats: PTFE
3. Seals, O-rings, and elastomers:
 - a. Refer to the seals, O-rings, and elastomers under Type 1 Ball Valves.
4. Pressure Rating: 150 psi at 75 degrees F.

5. End Connections: Socket welded, unless otherwise specified in Valve Schedule.
 6. Operator: Lever, unless otherwise specified in Valve Schedule.
 7. Valves shall be lockable where shown.
 8. Manufacturer and Model:
 - a. NIBCO Inc. Chemtrol, TU Series Tru-Bloc.
 - b. Georg Fischer Plastic Systems, Type 546.
 - c. Or Engineer approved equal.
- C. Type 3 - Brass Ball Valves, 2-1/2 inch and Smaller
1. Style: Standard ball with circular port.
 2. Construction:
 - a. Body: Brass.
 - b. Ball: Brass.
 - c. Stem: Brass or Composition Alloy, ASTM B371 steel.
 - d. Seat: TFE.
 3. Pressure Rating: 400 pounds per square inch.
 4. Temperature Rating: 400 degrees F.
 5. End Connections: Threaded.
 6. Operator: Lever, Type 316 stainless steel construction, unless otherwise specified in Valve Schedule.
 7. Manufacturer and Model:
 - a. Jamesbury, Clincher, Series 2000
 - b. Apollo
 - c. Or Engineer approved equal.

2.3 CHECK VALVES

- A. Type 1 - Thermoplastic Ball Check Valve (BC)
1. Style: True union, ball check.
 2. Body and Ball: PVC or CPVC to match material of connecting pipe, unless otherwise specified in the Valve Schedule.
 3. Seat and Seals:

Service	Material
Sodium Hypochlorite	FKM
Hydrofluosilicic Acid	FKM
Water	EPDM

4. Pressure Rating: 150 PSI @ 70 degrees F.
5. End Connections: Socket welded, unless otherwise specified in the Valve Schedule.
6. Manufacturer and Model:
 - a. NIBCO Inc. Chemtrol
 - b. Georg Fischer Plastic Systems
 - c. Approved equal

B. Type 2 - Rubber Duckbill Check Valve

1. Materials of Construction:
 - a. Elastomers: FKM
 - b. Retaining rings: 316 stainless steel
2. The port area shall contour down to a duckbill which shall allow passage of flow in one direction while preventing reverse flow.
3. Valve shall open with as little as 2-inch differential pressure.
4. Company name, plant location, valve size and serial number shall be bonded to the check valve.
5. Manufacturer:
 - a. Series 35-1 Flanged Duckbill Check Valve by Red Valve Company Inc.
 - b. Or approved equal

2.4. GLOBE VALVES

A. Bronze Globe Valves (GL) Class 125

1. Materials of Construction
 - a. Fabricate from dezincification resistant material.
 - b. Copper alloys containing more than 15 percent zinc are not permitted.
2. Class 125:
 - a. WOG Rating: 200 psi.
 - b. WSP Rating: 125 psi, saturated.
3. Comply with MSS SP-80, Type 1.
4. Body:
 - a. ASTM B62, bronze with integral seat and screw-in bonnet.
5. End Connections:
 - a. Threaded
 - b. Solder.
6. Bonnet:
 - a. NRS; Non-rising Stem.
7. Non-Rising Stem:
 - a. Bronze.
8. Disc:
 - a. PTFE.
9. Packing:
 - a. Asbestos free.
10. Handwheel Operator:
 - a. Malleable iron.

2.5 CONTROL VALVES

A. Backpressure Regulating Valve: (BPRV)

1. Applies backpressure to a metering pump to prevent siphoning and eliminates varying dosage rates resulting from fluctuating downstream pressure.
2. Field adjustable via set screw
3. Body: PVC
4. Seals, O-rings, and elastomers compatible with fluid system.

5. Spring: 10 – 150 psig
 6. Bolting: Stainless steel.
 7. Connections: True union socket.
 8. Manufacturer
 - a. George Fischer
 - b. Or approved equal
- B. Thermoplastic Chemical Resistant Spring Operated Pressure Relief Valve (PRVC)
1. Style: Angle pattern design with solid Teflon shaft passing through a series of three seals.
 2. Construction:
 - a. Body: PVC.
 - b. Shaft: Teflon.
 - c. Seals, O-rings, and elastomers compatible with fluid system.
 - d. Adjusting Bolt, Lock Nut, Control Spring and Fasteners: Stainless steel.
 - e. Inlet: 2-Inch NPT unless otherwise specified in the Valve Schedule.
 - f. Outlet: 2-Inch NPT unless otherwise specified in the Valve Schedule.
 3. Pressure Rating: Adjustable from 5 to 150 pounds per square inch. Factory preset as specified in the Valve Schedule.
 4. Manufacturer and Model:
 - a. Plast-O-Matic Valves, Inc., Series RVT.
 - b. Or Engineer approved equal.

2.6 MISCELLANEOUS VALVES

- A. Resilient Seated Gate Valves (GV)
1. Standard: AWWA C509 and AWWA C515
 2. Style: Resilient wedge gate valve.
 3. Construction:
 - a. Body: Cast Iron, ASTM A126 (C509) or Ductile Iron, ASTM A536 (C515).
 - b. Bonnet: Cast Iron, ASTM A126 (C509) or Ductile Iron, ASTM A536 (C515).
 - c. Wedge: Rubber Encapsulated, Cast Iron or Ductile Iron. No exposed iron.
 - d. Packing: "O"- Ring or conventional.
 4. End Connections: Mechanical joint conforming to ANSI B21.11 unless otherwise specified in the Valve Schedule.
 5. Operator: As specified in the Valve Schedule.
 6. Manufacturer and Model:
 - a. Mueller Co., Style A-2360-6.
 - b. Clow, AWWA Gate Valve.
 - c. Or Engineer approved equal.
- B. Curb Stop (CS)
1. Standard: AWWA C800.
 2. Material: Bronze or Brass.
 3. End Connections:
 - a. Inlet: Inside iron pipe thread.

- b. Outlet: Inside iron pipe thread.
- 4. Manufacturer and Model:
 - a. Mueller Co., Model Mark II Oriseal H-10287.
 - b. Or Engineer approved equal.

2.7 VALVE APPURTENANCES

A. Exposed Valves:

- 1. General:
 - a. For valves located less than five feet above operating floor, provide levers on four-inch diameter quarter-turn valves, and provide handwheels on all other valves, unless otherwise shown or specified.
 - b. For valves located five feet or more above operating floor, provide chain operators.
- 2. Handwheels:
 - a. Conform to applicable AWWA standards.
 - b. Material of Construction: Ductile iron, or cast aluminum.
 - c. Arrow indicating direction of opening and word "OPEN" shall be cast on trim of handwheel.
 - d. Maximum Handwheel Diameter: 2.5 feet.
- 3. Chain Operators:
 - a. For valves more than five feet above the operating floor, provide chain operators.
 - b. Chains shall extend to three feet above the operating floor.
 - c. A ½-inch stainless steel hook bolt shall be provided to keep the chain out of the walking area.
 - d. Materials of Construction:
 - 1) Chain: Type 316L stainless steel.
 - 2) Chain wheel: Recessed grooved type made out of Type 316 stainless steel.
 - 3) Guards and Guides: Type 316L stainless steel.
 - e. Chain Construction:
 - 1) Chain shall be welded link type with smooth finish. Chain that is crimped or has links with exposed ends shall not be acceptable.
 - f. Provide geared operators where required to position chain wheels in vertical positions.
 - g. Crank Operator:
 - h. Crank operator shall be removable and fitted with rotating handle.
 - i. Maximum Radius of Crank: 15 inches.
 - j. Materials:
 - 1) Crank: Cast-iron or ductile iron.
 - 2) Handle: Type 304 stainless steel.
 - 3) Hardware: Type 304 stainless steel.

B. Buried Valves:

- 1. Wrench Nuts:

- a. Provide wrench nuts on buried valves of nominal two-inch size, in accordance with AWWA C500.
- b. Arrow indicating direction of opening the valve shall be cast on the nut along with the word "OPEN".
- c. Material: Ductile iron or cast-iron.
- d. Secure nut to stem by mechanical means.
2. Extension Stems for Non-Rising Stem Gate Valves and Quarter-turn Buried Valves:
 - a. Provide extension stems to bring operating nut to six inches below valve box cover.
 - b. Materials of Stems and Stem Couplings: Type 316 stainless steel.
 - c. Maximum Slenderness Ratio (L/R): 100
 - d. Provide top nut and bottom coupling of ductile iron or cast-iron with pins and set screws of Type 316 stainless steel.
3. Valve Boxes:
 - a. Provide valve boxes with covers and properly sized base for all buried valves.
 - b. Type: Three piece valve box.
 - c. Inside Diameter: 4 1/2 inches, minimum.
 - d. Material: Cast-iron or ductile iron.
 - e. Coating: Two coats of asphalt varnish conforming to Federal Specification TT-C-494.
 - f. Valve box bases shall be blocked up on both sides with 4 inch concrete blocks to eliminate settling on valve tops with #57 stone placed between concrete blocks and undisturbed earth.
 - g. Manufacturer and Model:
 - 1) Tyler Pipe, 6860 Series.
 - 2) Or Engineer approved equal.

2.8 QUICK-CONNECT AND STRAINERS

A. Quick Connect:

1. General:
 - a. All coupling assemblies shall have a minimum pressure and temperature rating of 300 pounds per square inch and 225 degrees F.
 - b. Provide finger rings for all sizes 1-1/2 inch and above.
 - c. Size and Location: As shown on the Drawings and as specified.
 - d. Provide increaser or reducer fittings when connection is required for dissimilar size.
2. Polypropylene Glass-Filled Construction – General Requirements:
 - a. All coupling assemblies shall have minimum pressure and temperature ratings as follows:
 - 1) Size 1/4-inch through 1-inch: 125 psi at 70 degrees F.
 - 2) Size 1 1/4-inch through 2-inch: 100 psi at 70 degrees F.
 - 3) Size 3-inch: 75 psi at 70 degrees F.
 - 4) Size 4-inch: 35 psi at 70 degrees F.

- 5) All coupling assemblies shall be suitable for a normal operating temperature range of 0 degrees F to 180 degrees F.
 - b. Size: As shown on the Drawings.
 - c. Gaskets: Provide gaskets compatible with the fluid being handled.
 - d. Finger rings: Provide finger rings for all size 1-1/4 inch and above. Finger rings, handles, and pins shall be of stainless steel construction.
- B. Strainers:
- 1. PVC Strainer Y-Pattern:
 - a. Style: Y-Pattern with removable strainer screen.
 - b. Construction:
 - 1) Body: CPVC
 - 2) Screen: 20 mesh PVC.
 - 3) Seals: FKM
 - c. Pressure Rating: 150 pounds per square inch water service at 150 degrees F.
 - d. End Connections: Socket.
 - e. Manufacturer and Model:
 - 1) Spears Manufacturing
 - 2) Or Engineer approved equal.
 - 2. PVC Strainer Basket:
 - a. Style Basket with removable strainer screen
 - b. Construction
 - 1) Body: PVC
 - 2) Screen: 20 mesh PVC
 - 3) Seals: FKM
 - c. Pressure Rating: 150 pounds per square inch water service at 150 degrees F.
 - d. End Connections: Flanged
 - e. Manufacturer and Model:
 - 1) Spears Manufacturing
 - 2) Or Engineer approved equal.

2.9 ELECTRIC MOTOR ACTUATORS FOR CHEMICAL FEED SYSTEM VALVES

- A. Design
- 1. Quarter turn
 - 2. 75% duty rating
 - 3. NEMA 4X enclosure
 - 4. IP-67
 - 5. Thermal overload protection
 - 6. ASTM A314 303 SS output shaft
- B. Features
- 1. IP-67 rated glass filled polypropylene (GFPP) Housing
 - 2. ISO5211 mounting base
 - 3. 120V

4. Battery fail-safe kit
5. Multi-Voltage Sensing
6. LED Status Light
7. Manual Override
8. External Position Indicator
9. Stainless Steel Fasteners
10. Anti-Condensation Heater
11. 4 SPDT Micro Limit Switches

C. Manufacturer

1. Hayward ECP series
2. Georg Fischer
3. Asahi
4. Bray
5. Or approved equal

2.10 ANCHORAGES AND MOUNTING HARDWARE

A. General:

1. Comply with Section 05 05 33, Anchor Systems, except as modified in this Section.
2. Obtain bolts, nuts, and washers for connection of valve and appurtenances to concrete structure or other structural members from valve Manufacturer.
3. Bolts, nuts, and washers shall be of ample size and strength for purpose intended. Anchorages in concrete shall be at least 5/8-inch diameter.
4. Provide stem guide anchorages of required strength to prevent twisting and sagging of guides under load.
5. Materials: Provide bolts and washers of Type 316 stainless steel and nitrided nuts. Bolts shall have rolled threads. Bolts and nuts shall be electropolished to remove burrs.

2.11 TOOLS, LUBRICANTS, AND SPARE PARTS

A. Provide the following T-Handle Operating Wrenches for Buried Valves:

1. Length of T-Handle Operating Wrench: 36 inches.
2. Quantity: 2.

B. Lubricants: For valves, actuators, and appurtenances requiring lubricants, provide suitable lubricants for initial operation and for first year of use following Substantial Completion. Lubricants for equipment associated with conveying potable water or water that will be treated to become potable shall be food-grade and ANSI/NSF 61-listed.

C. Tools, spare parts, and maintenance materials shall conform with Section 01 78 43, Spare Parts and Extra Materials.

2.12 PAINTING OF EXPOSED VALVES, HYDRANTS, AND APPURTENANCES

- A. Exterior steel, cast-iron, and ductile iron surfaces, except machined surfaces of exposed valves and appurtenances, shall be finish painted in Manufacturer's shop. Surface preparation, priming, finish painting, and field touch-up painting shall conform to Section 09 91 00, Painting.

2.13 PAINTING OF BURIED VALVES

- A. Exterior steel, cast-iron, and ductile iron surfaces, except machined or bearing surfaces of all buried valves, shall be shop-painted with two coats of asphalt varnish conforming to Federal Specification TT-C 494.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 - 1. Install valves and appurtenances in accordance with:
 - a. Manufacturer's instructions and the Contract Documents.
 - b. Requirements of applicable AWWA standards.
 - c. Applicable requirements of Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
 - 2. Install valves plumb and level. Install all valves to be free from distortion and strain caused by misaligned piping, equipment, and other causes.
 - 3. Position butterfly valves so that, when valve is fully open, valve disc does not conflict with piping system elements upstream and downstream of valve.
- B. Exposed Valves:
 - 1. Provide supports for large or heavy valves and appurtenances as shown or required to prevent strain on adjoining piping.
 - 2. Operators:
 - a. Install valves so that operating handwheels or levers can be conveniently turned from operating floor without interfering with access to other valves, piping, structure, and equipment, and as approved by Engineer.
 - b. Avoid placing operators at angles to floors or walls.
 - c. Orient chain operators out of way of walking areas.
 - d. Install valves so that indicator arrows are visible from floor level.
 - e. For motor-operated valves located lower than five feet above operating floor, orient motor actuator to allow convenient access to pushbuttons and handwheel.

3. Floor Stands and Stems:
 - a. Install floor stands as shown and as recommended by Manufacturer.
 - b. Provide lateral restraints for extension bonnets and extension stems as shown and as recommended by Manufacturer.
 - c. Provide sleeves where operating stems pass through floor. Extend sleeves two inches above floor.
- C. Buried Valves:
 1. Install valve boxes plumb and centered, with soil carefully tamped to a lateral distance of four feet on all sides of box, or to undisturbed trench face if less than four feet.
 2. Provide flexible coupling next to each buried valve.
- D. Plug Valves:
 1. Install plug valves that are in horizontal liquid piping with stem horizontal and plugs on top when valve is open. Plug shall be on upstream end when valve is closed.
 2. Install plug valves that are in vertical liquid piping with plug at top when closed or as recommended by valve Supplier.
 3. Supplier shall tag or mark plug valves to indicate proper mounting position.

3.3 FIELD QUALITY CONTROL

- A. Field Tests:
 1. Adjust all parts and components as required to provide correct operation of valves.
 2. Conduct functional field test on each valve in presence of Engineer to demonstrate that each valve operates correctly.
 3. Verify satisfactory operation and controls of motor operated valves.
 4. Demonstrate satisfactory opening and closing of valves at specified criteria requiring not more than 40 pounds effort on manual actuators.
 5. Test ten percent of valves of each type by applying 200 pounds effort on manual operators. There shall be no damage to gear actuator or valve.

3.4 VALVE SCHEDULE

- A. Conform to the type, joint, operator and remarks shown unless otherwise approved by the Owner.
- B. Valves are identified by a type code. Provide and install valves with appropriate operators as scheduled.
- C. All valves shall open counterclockwise (left) unless otherwise noted.
- D. End Type abbreviations are:

1. FL = Flanged Joint.
2. MJ = Mechanical Joint
3. TH = Threaded Joint
4. SW = Socket Welding
5. PE = Plain End
6. LG = Lugged Body

E. Operator abbreviations are:

1. HW = Handwheel
2. GE = Gear
3. EM = Electric Motor

F. Actuator abbreviations are:

1. O/C = Open/Close
2. MOD = Modulating
3. QT = Quarter-turn
4. MT = Multi-turn

- G. Refer to the drawings for each process area's valve schedule. Vendor provided valves are not included in the schedule.

++ END OF SECTION ++

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SECTION 40 05 93

COMMON MOTOR REQUIREMENTS
FOR PROCESS EQUIPMENT

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Electric motors and accessories to be furnished under other equipment Sections shall comply with this Section, unless specified otherwise in the Section for the associated driven equipment.
2. Motor horsepower and voltage ratings, speed, enclosure type, and unusual service conditions (such as ambient temperatures above 40 degrees C, corrosive areas requiring severe duty motors, and variable frequency drive applications requiring inverter duty motors), and requirements for witnessing shop tests shall be as specified in the Sections for the associated driven equipment. Specific accessories and construction features may also be required by the Sections on the associated driven equipment.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM A48/A48M, Specification for Gray Iron Castings.
2. ASTM B117, Practice for Operating Salt Spray (Fog) Apparatus.
3. IEEE 112, Test Procedure for Polyphase Induction Motors and Generators.
4. IEEE 522, Guide for Testing Turn-to-Turn Insulation on Form-Wound Stator Coils for Alternating Current Electric Machines.
5. IEEE 841, Petroleum and Chemical Industry - Premium-Efficiency, Severe-Duty, Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors – Up to and Including 370 KW (500 HP).
6. IEEE 1043, Recommended Practice for Voltage Endurance Testing of Form-Wound Bars and Coils.
7. NEMA MG 1, Motors and Generators. (This Section's references to NEMA MG 1 followed by a hyphen and number, such as “NEMA MG 1-20.14”, indicate the associated NEMA MG 1 paragraph reference.)
8. ANSI/NETA ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems
9. UL 674, Electric Motors and Generators, for Use in Division 1 Hazardous (Classified) Locations.
10. UL 1004, Electric Motors.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer:
 - a. Manufacturer shall have not less than five years experience producing equipment substantially similar to that required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Data sheets indicating nameplate data for fractional-horsepower motors.
 - b. Outline drawing or data sheet indicating complete motor dimensions for motors rated greater than 1/3-hp. Several motors of the same type and rating for the same application may be covered by an appropriate single drawing or data sheet. Drawings and data sheets shall have complete identifying data including frame size, speed, horsepower ratings, and application for each particular motor.
 - c. Details of motor heaters, winding thermal protection, and other accessories.
 - d. Copies of motor characteristic curves and data inputs when required for programming motor protection and management relays.
 - 2. Product Data:
 - a. Submit motor test data sheets for each motor rated one horsepower or greater. Values indicated on test data sheets shall be from tests of a previously manufactured, electrically duplicate motor or calculated data. Mark each test data sheet to indicate the Project motor application location, manufacturer, type, frame size, horsepower, voltage, speed, bearing type, lubrication medium and enclosure type. Test data sheet shall also include:
 - 1) Winding resistances.
 - 2) Torques.
 - 3) Efficiencies.
 - 4) Power factors.
 - 5) Slip.
 - 6) Full load amperes.
 - 7) Locked rotor and no load amperes.
 - 8) Nameplate temperature and results of dielectric tests.
 - 3. Testing Plans and Procedures:
 - a. When witnessed source quality control testing is required in the Section for associated driven equipment, submit description of proposed shop testing methods, procedures, and testing apparatus with calibration dates, together with proposed testing schedule and proposed travel and

logistical plans for testing.

B. Informational Submittals: Submit the following:

1. Manufacturer's Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the motors.
 - b. Installation data for motors, including setting drawings, templates, and directions and tolerances for installing anchorage devices.
2. Source Quality Control Submittals:
 - a. Written reports presenting results of required shop testing. Shop test reports shall be dated and signed by motor manufacturer.
 - b. When witnessed shop tests are required, shop test results shall be signed by and shall bear the seal of registered professional engineer. Name on seal, registration or license number, and jurisdiction or registration of license shall be legible.
3. Field Quality Control Submittals:
 - a. Written reports presenting results of required field testing and inspections. Field testing reports shall be dated and signed by Contractor.
4. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service personnel, including purpose and time of visit, persons contacted, problems encountered and resolved, tasks performed, results obtained, and other pertinent information. Submit within two days of completion of visit to the Site.
5. Qualifications Statements:
 - a. Submit manufacturer's qualifications data when requested by Engineer.

C. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data:
 - a. Furnish operation and maintenance data for motors as part of the operations and maintenance data for the associated driven equipment.
 - b. Comply with Section 01 78 23, Operations and Maintenance Data.

D. Maintenance Material Submittals: Submit the following:

1. Spare Parts and Extra Stock Materials: For each motor size and type, furnish spare parts in accordance with motor manufacturer's recommendations, including the following for three-phase motors:
 - a. One set of fans and guards for each set of three or fewer motors, for each size of totally-enclosed fan-cooled motor.
 - b. One set of bearing liners, or renewable ball or roller bearings, for each set of three or fewer motors, for each type and size of motor.
 - c. One set of oil rings, for each sleeve bearing motor.
 - d. One set of bearing temperature detectors, for each set of three or fewer motors, of each type of motor.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 - 1. Ship motors with openings sealed.
- B. Storage and Protection:
 - 1. Protect materials and equipment from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. Equipment Description:
 - 1. Comply with motor requirements specified in the Sections for the associated driven equipment.
 - 2. Motors shall be suitable for continuous operation at an elevation of up to 3,300 feet above mean sea level, at ambient temperatures ranging from -25 degrees C to 40 degrees C, unless specified otherwise in the Section for the associated driven equipment.

2.2 CONSTRUCTION – GENERAL

- A. Unless specified otherwise in Sections on the associated driven equipment, motors shall have the following features of construction and operation:
 - 1. Successfully operate under power supply variations in accordance with NEMA MG 1-14.30 and NEMA MG 1-20.14.
 - 2. NEMA Design B with torque and starting currents in accordance with NEMA MG 1, except in special high-torque applications, as specified in the Section for the associated driven equipment, which may require NEMA Design C.
 - 3. Motors shall operate within their full load rating without applying the service factor, unless specified otherwise in Section for the associated driven equipment.
 - 4. Speed and horsepower specified or required to properly operate the associated driven equipment and torque characteristics required by the drive load and suitable for direct coupling or V-belt drive, as specified in the Section for the associated driven equipment.
 - 5. Constructed for full-voltage starting.
 - 6. Fabricated steel or cast-iron frames with integrally cast feet or bases, cast-iron end bells, cast iron or steel conduit boxes and covers and bases with precision machined bearing fits, ASTM A48/A48M, Class 25 or better. For each TEFC motor, provide UL-approved automatic stainless steel breather drains in lowest part of front and back brackets to allow drainage of condensation.

7. Stator core assembly shall consist of stacked lamination made from specially selected electrical sheet silicon steel.
8. Rotor cages shall be die-cast or fabricated aluminum or fabricated copper or copper alloy. Shafts shall be carbon steel unless specified otherwise in this Section or in the Section on the associated driven equipment.
9. Rotors on frames 213T and larger shall be keyed shrunk or welded to shaft and rotating assembly, dynamically balanced to NEMA limits. Use rivets to secure balance weights, if required, to rotor resistance ring or fan blades. Machine screws and nuts are unacceptable. Coat entire rotating assembly between bearing inner caps with corrosion-resistant epoxy.
10. Bolt and cap screws shall be high-strength, SAE Grade 5 zinc-plated and chromatic steel. Screwdriver slot fasteners are unacceptable.
11. Motors shall be shop-painted at the motor fabrication facility. Finish coat shall be the same color as the associated driven equipment. Final paint finish shall be corrosive resistant and capable of passing ASTM B117 250-hour salt spray test. Motors that will be located outdoors shall have coating resistant to degradation or chalking in sunlight.

2.3 SINGLE-PHASE AC MOTORS

- A. Motors shall be rated 115-, 200-, or 230-volt, 60 Hertz.
- B. Bearings shall be grease-lubricated ball type with grease fittings or with lubrication for 10 years of normal operation.
- C. Motors shall be totally enclosed except fractional-horsepower motors may be open type if motor is suitably protected from moisture, dripping water, and airborne particulates accumulation. Motor features shall be in accordance with the following:
 1. Open motors shall be split-phase or capacitor start in accordance with torque requirements, with service factor of not less than 1.25, 40 degrees C ambient rating, and Class B insulation.
 2. Enclosed motors shall be capacitor start, with service factor of not less than 1.15, 40 degrees C ambient rating, and Class F insulation. Motors shall be fan-cooled or non-ventilated.
 3. Severe duty type motors shall be designed to withstand chemical corrosion and equipped with cast iron end shields, neoprene gaskets, stainless steel shaft, heavy pressed steel fan cover and provision for threaded conduit connection.
 4. Provide direct drive fan motors with conduit fittings and leads to allow external connection.
 5. Explosion-proof motors shall comply with UL 674.

2.4 THREE-PHASE AC MOTORS

- A. General: Unless specified otherwise in the Sections for the associated driven equipment, provide three-phase motors with the following features:
1. Premium, energy-efficient construction complying with NEMA MG 1.
 2. Motor efficiency determined in accordance with NEMA MG 1-12.58.
 3. Minimum and nominal full-load efficiencies not less than those listed in: NEMA MG 1 Table 12-12 for motors rated 600 volts and smaller, and NEMA MG 1 Table 12-13 for motors rated larger than 600 volts and equal to or less than 5,000 volts.
 4. Motors shall be constructed for operation on three-phase, 60 Hertz, alternating current system. Motor voltage and variable frequency operation, where required, shall be as specified in the Sections for the associated driven equipment. Voltage ratings shall be 200 volts for operation on 208-volt systems, 230 volts for 240-volt systems, 460 volts for 480-volt systems, 2300 volts for 2400-volt systems, and 4000 volts for 4160-volt systems.
 5. Unless otherwise required by the load, motors shall be NEMA Design B, normal starting torque. Locked rotor KVA/HP shall not exceed NEMA Code Letter G for motors 20 hp and larger.
 6. Motor frame shall be a rigid structure, constructed to maintain the lamination in correct alignment, and shall not depend on lamination or bolts for rigidity.
 7. Severe-duty totally-enclosed motors shall comply with IEEE 841.
- B. Bearings:
1. Provide horizontal motors with rolling element (anti-friction) or sliding element (sleeve) type bearings. Use anti-friction type bearings for NEMA frame motors. Use sleeve type bearings when specified in the Section for the associated driven equipment.
 2. Insulate the bearings for motors larger than 200 hp and for inverter-duty motors 100 hp and larger, to prevent shaft currents and related bearing damage.
 3. Bearings for open drip-proof, TEFC, and explosion-proof motors shall be grease lubricated, ball type, unless specified otherwise in the Section for the associated driven equipment. Bearings shall have inlet fittings and outlet plugs. Protect bearings and grease reservoirs from entry of contaminants. Provide suitable fittings to allow convenient positive purging of old grease during re-greasing.
 4. For horizontal motors with ratings up to and including 500 hp, or for motors with speeds up to and including 3600 rpm, and where both conditions apply, anti-friction bearings furnished shall have a minimum L-10 bearing life of 100,000 hours, as defined by the ABMA, for direct-connected motors, and L-10 bearing life of 50,000 hours for belted motors.
 5. Sleeve bearings shall be ring-oiled with adequate, integral self-cooled oil reservoir. Bearing sleeves shall be lined with high tin content babbitt to minimize oil contamination. Close running shaft seals shall prevent oil leakage as well as prevent entrance of foreign material such as water and dirt into the

bearing area. Provide oil level sight gauges with permanently-marked easily-discernible oil level. Provide inspection openings to observe the oil rings.

6. When specified in Section for the associated driven equipment or required by motor speed and bearing size, provision shall be made for forced lubrication. Provide oil rings and an adequate oil reservoir in bearing housings to allow orderly shutdown of motor in the event of failure of forced feed lubrication system.
7. Provide vertical motors with thrust bearings adequate for all thrusts to which motor can be subjected. Rated minimum L-10 life of the thrust bearings shall be at least 15,000 hours when operated at rated speed and full load thrust. Manufacturers of the associated driven equipment shall furnish motor manufacturer with speed and thrust conditions required by the associated driven equipment.

C. Insulation:

1. Insulation systems shall be rated Class F, with a service factor of 1.15 times motor's nameplate horsepower rating when operated on a sine wave power supply, and a service factor of 1.00 on an adjustable frequency power supply. Temperature rise shall be limited to Class B insulation system when motor is operated continuously at rated horsepower with ambient temperature not exceeding 40 degrees C, unless specified otherwise in the Section for the associated driven equipment.
2. Windings shall be epoxy-coated. Treat windings with insulating compound suitable for protecting against moisture, salt air, and slightly acidic and alkaline conditions. Insulation system for enclosed motors shall be upgraded to increase moisture resistance.
3. Motors for outdoor service and all motors larger than 200 hp shall have vacuum/pressure-impregnated epoxy insulation (VPI) for moisture resistance. Motors shall be preheated before VPI and baked in temperature-controlled oven.
4. Stator windings and end turn connections shall be fully brazed to withstand full voltage starting, regardless of the starting method indicated in the Section for the associated driven equipment. Bracing system shall essentially eliminate coil vibration under the high-current conditions of starting as well as during normal operation. When a tied system is used, system shall be such that no tie depends on the integrity of another tie within the system.
5. Motors larger than 200 hp shall be form wound. Form wound coils with micaceous ground wall insulation shall have additional insulation and hot-pressed to provide sealed system. Complete stator shall be vacuum/ pressure-impregnated.

D. Enclosures:

1. Motor enclosure type shall be as specified in the Section for the associated driven equipment. Enclosure types shall comply with the following:

Common Motor Requirements for Process Equipment

- a. Open Drip Proof: Motors shall have a steel or cast-iron frame, cast-iron end brackets, and steel conduit box. Provide vertical motors of the open type with drip hoods. When the drip hood is too heavy to be easily removed, provide access for testing. Provide stainless steel corrosion-resistant screens over air openings in accordance with NEMA requirements for guarded machines.
 - b. Weather Protected Type I and Type II: Weather-protected motor shall be an open drip proof guarded machine with ventilating passages constructed to minimize entrance of rain, snow, and airborne particles to motor's electric parts complying with NEMA MG 1-1.25.8
 - c. Totally enclosed fan cooled and non-ventilated motors shall have cast-iron frame, cast-iron end brackets, and cast-iron conduit box. Provide drain holes on each end of motor.
 - d. Explosion-proof motors shall comply with NEMA MG 1-1.26.10 and UL 674.
2. Motor conduit box shall be split from top to bottom, shall be capable of being rotated to four positions 90 degrees apart, and shall comply with the following:
 - a. Box shall be gasketed with rubber-like gaskets between frame and conduit box and between conduit box and conduit box cover.
 - b. Provide box or opening in motor housing with conduit hub type fitting to allow threaded conduit connections.
 - c. Box sizes shall be in accordance with code requirements and shall accommodate medium-voltage terminations or stress cones, when required.
 - d. Protective and auxiliary devices shall terminate in auxiliary conduit boxes.
 - e. Terminal leads shall be flexible and of sufficient length to extend for distance of not less than ten inches beyond face of terminal box. Terminal leads shall be fitted with solderless lugs suitable for attachment to lugs installed on external wiring. Leads shall be sealed with non-wicking, non-hygroscopic insulating material, or insulating "wrap-cap" as manufactured by Ideal Industries, or equal.
 - f. Provisions for terminal box size, length of leads, size of conduit openings, and type of terminal lugs shall be complied with irrespective of other standards or practice.
 - g. Provide motor frame grounding stud inside conduit box. Stud shall include a drilled and tapped hole.
- E. Motors for Use with Variable Frequency Drives:
1. Motors shall be compatible with characteristics of the intended variable frequency inverters.
 2. Motors shall comply with the performance standards of NEMA MG 1-31.
- F. Vertical Motors:

1. Vertical motors shall have Type P base specifically constructed for vertical installation. Universal position motors are unacceptable.
 2. Vertical motors shall have solid shafts, unless otherwise specified in Section for the associated driven equipment.
- G. Lifting Eyes: Motors weighing more than 50 pounds shall include at least one lifting eye or lifting lug. Construct motor and lifting eyes or lifting lugs to bear motor's full weight.

2.5 ACCESSORIES

A. General:

1. Provide motor accessories in accordance with this Section unless specified otherwise in the Section for the associated driven equipment.
2. Provide space heaters in motors five horsepower and larger installed outdoors, and in enclosed motors five horsepower and larger installed indoors in unheated spaces.
3. Provide thermostat type winding thermal protection for motors in accordance with the following:
 - a. Variable speed motors up to and including 25 hp.
 - b. Constant speed motors when specified in Section for the associated driven equipment.
4. Provide thermistor type winding thermal protection for motors in accordance with the following:
 - a. Constant speed motors 50 hp and larger up to and including 200 hp.
 - b. Variable speed motors 30 hp and larger up to and including 200 hp.
5. Provide resistance temperature detector (RTD) type winding thermal protection for all motors larger than 200 hp.
6. Provide stator and bearing temperature detectors for each motor 250 hp and larger.

B. Space Heaters:

1. Space heaters for condensation prevention shall operate at 120 volts and shall be sized to provide approximately 10 degrees C temperature rise above ambient.
2. Heaters shall be low-density type for low surface temperature and long life.

C. Winding Thermal Protection:

1. Thermostats shall be bi-metal disk or rod type embedded in the stator windings. Thermostat contacts shall be normally-closed, automatic-reset type, rated 120 vac, five amps minimum, opening on excessive temperature. Provide three thermostats, one in each phase, wired to motor junction box.
2. Thermistors embedded in each stator phase winding shall be in direct contact with the winding conductors. Each thermistor circuit shall be factory-wired to

120-volt solid-state control module mounted at the motor in box rated NEMA 4X. Control module contacts shall be automatic-reset type, rated 120 vac, five amps minimum, opening on excessive temperature. Provide normally-closed isolated contact for motor shutdown.

3. Resistance temperature detectors (RTD) shall be 100-ohm platinum three-lead type with calibrated resistance-temperature characteristics. Position detectors, two per phase for non-explosion proof motors and one per phase for explosion proof motors, to detect highest winding temperature and located between coil sides in stator slots. Detector leads shall be wired to a separate terminal box.
- D. Bearing Temperature Protection: When specified in Section for the associated driven equipment, provide motor bearing temperature detectors, RTD type similar to the winding detectors specified in this Article, on each bearing for horizontal motors and on the thrust bearing for vertical motors.
- E. Vibration Protection: When specified in Section for associated driven equipment, provide accommodations for mounting sensors for monitoring bearing or casing vibration.
- F. Medium-Voltage Auxiliary Devices: When specified in Section for the associated driven equipment with medium voltage motors, provide lightning arrestors and surge capacitors, located in motor conduit box.
- G. Single-Phase Motors: Single-phase motors requiring auxiliary starting resistors, capacitors or reactors and switching devices shall be provided as combination units with such auxiliaries either incorporated within motor housings or housed in suitable enclosures mounted on motor frames. Each combination unit shall be mounted on a single base and be provided with a single conduit box.

2.6 IDENTIFICATION

- A. Nameplates:
1. Nameplates shall be Type 316 stainless steel with embossed or pre-printed lettering and fastened to the motor frame with Type 316 stainless steel pins.
 2. Nameplates shall have stamped on them the motor manufacturer's name, voltage, number of Hertz and phases, horsepower rating, amperes and temperature rise at rated load, full load speed, locked rotor amperes or code letter, service factor, NEMA nominal efficiency, model number, insulation class, bearing number, serial number and maintenance manual number.
 3. Name plates for explosion proof motors shall indicate the Division, Class and Group of the hazardous location in which the motor is intended for use.
 4. Dual-voltage motor nameplates shall include connection diagrams.
 5. Nameplate markings shall be in accordance with NEMA MG 1-10.

2.7 SOURCE QUALITY CONTROL

A. Shop Tests:

1. Perform shop testing on the motors at the manufacturer's facility. Shop test shall be in accordance with NEMA MG 1, UL 674, and UL 1004 and shall demonstrate that the motors tested comply with the Contract Documents.
2. Submit shop test reports identifying tests performed and results obtained.
3. Motors shall be given Routine Test in accordance with NEMA MG 1-12.55 and IEEE 112. Test shall include the following:
 - a. Measurement of winding resistance.
 - b. No-load readings of current and speed at normal voltage and frequency.
 - c. Current input at rated frequency with rotor at standstill for squirrel-cage motors (locked rotor amperes).
 - d. High-potential test.
 - e. Bearing inspection.
4. Motors rated 200 hp and larger shall be given a "Complete Test" in accordance with IEEE 112 consisting of a "Routine Test" and a full-load heat run. When "Complete Tests" are required for a group of the same type, rating and horsepower for the same application, each motor of the group shall be given a "Complete Test", unless specified otherwise in the Section for the associated driven equipment. Testing shall document the following:
 - a. Percent slip.
 - b. No-load speed, voltage, current, and losses at rated frequency.
 - c. Full-load current.
 - d. Locked-rotor torque.
 - e. Locked-rotor current.
 - f. Breakdown torque (calculated).
 - g. Starting torque (squirrel-cage).
 - h. Winding resistance.
 - i. Sound pressure level at no-load.
 - j. Vibration levels.
 - k. Efficiency current, and power factor at 100, 75, and 50 percent of full load and at service factor load.
 - l. Stabilized full load temperature rise.
5. Motors with stator windings rated greater than six kV shall have the following additional tests:
 - a. Voltage endurance test of the ground-wall insulation system in accordance with IEEE 1043.
 - b. Partial discharge testing of the stator coils to insure proper impregnation and clearances. Acceptance criteria shall be based on manufacturer's quality assurance data base.
 - c. Voltage surge test on multi-turn stator coils in accordance with IEEE 522.

B. Witnessed Shop Testing:

1. When witnessed motor shop testing, which may also be referred to as witnessed source quality control motor testing, is specified in the Section for associated driven equipment, shop tests shall be witnessed at the motor manufacturer's testing and production facility. The number of attendees shall as indicated in the Sections for the associated driven equipment.
2. Dates of witnessed testing shall be acceptable to Owner and Engineer and shall be agreed upon in writing at least 45 days prior to the actual test. Perform all witnessed tests at motor manufacturer's facility in one day or on consecutive days to minimize the time required to witness the tests.
3. Owner will be responsible for cost of Owner's and Engineer's time for first test on each motor, and for time to travel to and from motor manufacturer's facility once. Responsibility for cost of lodging, meals, and travel expenses shall be as indicated in the Section for the associated driven equipment.
4. If re-testing is required, all labor and expense costs incurred by Owner and Engineer will be deducted from the Contract Price via a Change Order. If tests are not performed on agreed-upon date as a result of Contractor's or motor manufacturer's action or inaction and Owner or Engineer incurs lost time or expense as a result of such action or inaction, the associated costs will be deducted from the Contract Price via a Change Order.
5. Not less than the number of days prior to the scheduled witnessed motor test specified in Paragraph B.2 of this Article, submit to Engineer the proposed witness testing plans and procedures.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:

1. Install motors in accordance with the Contract Documents and manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
2. Install in accordance with Laws and Regulations.
3. Do not modify structures to facilitate installation of motors, unless approved in writing by Engineer.
4. Carefully and properly align motors with the driven equipment.
5. Secure motors to mounting surfaces with anchorage devices complying with manufacturer's recommendations that are of sufficient size and quantity to secure motor to equipment.
6. Until start-up and operation, tightly cover and protect motors from dirt, water, and chemical and mechanical damage.

3.2 FIELD QUALITY CONTROL

A. Site Tests:

1. Inspect motors prior to supplying electricity to (energizing) equipment. Do not energize equipment without Engineer's permission. Inspections shall include the following:
 - a. Inspect motor and equipment for physical damage.
 - b. Inspect motor for proper anchorage, mounting, grounding, connection, and lubrication.
 - c. Check for unusual noise and indications of overheating during initial or test operation.
2. Perform testing at the Site for motors larger than 200 hp, as follows:
 - a. Testing shall be witnessed by Engineer.
 - b. Initial inspections and testing shall include the following:
 - 1) Electrical and grounding connections.
 - 2) Shaft alignment, proper mounting and lubrication.
 - 3) Check ventilating air passageways for blockage.
 - 4) Excessive noise.
 - 5) Overheating.
 - 6) Correct rotation.
 - 7) Protective detectors operation.
 - 8) Excessive vibration.
 - 9) Space heater operation.
 - c. Electrical testing shall include the following:
 - 1) Insulation resistance test.
 - 2) Surge comparison test.
 - 3) Vibration test.
 - 4) Bearing insulation resistance test on insulated bearings.
 - 5) Running current and voltage measurements and evaluations relative to load conditions over full range of operations and nameplate full-load amperes.
 - 6) High-potential test.
 - 7) For wound rotor motors, additional testing at minimum and normal operating load points and at ring short.
 - 8) Motor operation with the driven equipment for not less than 48 continuous hours per motor, with checks for overheating and vibration during operation.
 - d. Tests and values shall be in accordance with motor manufacturer's recommendations and ANSI/NETA ATS.
 - e. Prepare and submit field testing report in accordance with ANSI/NETA ATS.

B. Manufacturer's Services:

1. For motors larger than 200 hp, furnish services of motor manufacturer's qualified service representative to assist with installing motors, checking

Common Motor Requirements for Process Equipment

installed motors before initial operation, assisting in performing field quality control tests and inspections, observing and assisting initial operations, and training operations and maintenance personnel in caring for, operating, and maintaining motors.

2. Preparing and submitting manufacturer's field report for each visit to the Site.

+ + END OF SECTION + +

SECTION 40 23 26

PIPING VALVES AND APPURTENANCES FOR CHEMICAL FEED SYSTEMS

PART 1 — GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall furnish all labor, tools, materials, equipment and incidentals required to supply, install, test and place in satisfactory operation all valves and appurtenances as shown on the Drawings and specified herein.
 - 2. It is the intention of the Drawings and Specifications to provide complete and workable piping systems. Miscellaneous fittings and appurtenances required for proper completion of the Work shall be considered as having been included under this Section.
- B. General:
 - 1. All fittings, valves and appurtenances shall be new, clean and in accordance with material specifications. In no case will used or damaged material be acceptable.
 - 2. Provisions shall be made to permit bleeding air at high points. All piping shall be of the sizes and materials shown on the Drawings or specified herein.
- C. Related Work Specified Elsewhere:
 - 1. Section 09 91 00, Painting.
 - 2. Section 43 41 00, Polyethylene Tanks
 - 3. Section 46 33 44, Peristaltic Metering Pumps

1.02 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Piping and valves shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service. All valves and piping of the same type shall each be the product of one manufacturer.
- B. Source Quality Control: All pipe, specials and valves shall have the working pressure stenciled thereon. Pipe that has been designed for abnormal load conditions or thrust restraint shall have special markings thereon which can be readily identified.
- C. Reference Standards: Comply with applicable provisions and recommendations of the following:
 - 1. Standards of American Water Works Association, AWWA.
 - 2. Standards of American Society for Testing and Materials, ASTM.
 - 3. Standards of American National Standards Institute, ANSI.
 - 4. Standards of American Iron and Steel Institute, AISI.

- D. Manufacturer's Field Services and Reports:
1. Retain factory trained manufacturer's representative with demonstrated ability and experience in the installation and operation of electric actuators, butterfly valves, check valves and surge relief valves to perform the services listed below:
 - a. Supervise the installation.
 - b. Test, calibrate and adjust all components for optimum performance.
 - c. Assist in initial start-up and field testing.
 - d. Inspect the completed installation and prepare an inspection and performance test report.
 - e. Instruct OWNER'S personnel in the operation and user maintenance of all components.
 - f. Supervise the correction of any defective or faulty Work before and after acceptance by OWNER – certify in written report.

1.03 SUBMITTALS

- A. Shop Drawings: Shop Drawing submittals shall include the following:
1. Illustrations, specifications and engineering data including: dimensions, materials, size, and weight for all piping, valves, and appurtenances including pipe supports, pipe restraints, coatings, etc.
 2. Manufacturer's instructions and recommendations for installation of each type of pipe joint, valve and special items.
- A. Delivery, Storage and Handling of Materials: All materials shall be delivered to the site, stored, and handled in accordance with the manufacturer's instructions. CONTRACTOR shall inspect shipments for damage and content well in advance of the date scheduled for incorporation in the Work.
- B. Prior to Shipment:
1. Each piece of pipe and each fitting shall be plainly marked at the manufacturer with schedule number and pressure class. All piping shall be readily identifiable.
- C. To establish minimum criteria for proper installation and handling, measures to be taken by the CONTRACTOR shall include the following:
1. All piping and valves shall be thoroughly cleaned of sand, scale, rust or other foreign substances. Open ends of piping and valves shall be suitably closed to prevent the entrance of foreign matter after cleaning and during shipment and storage.
- D. Handle all pipe, fittings and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks. Do not otherwise drop, roll, or skid pipe. Materials that are cracked, chipped, gouged, dented or otherwise damaged will not be approved for installation.
- E. Store pipe and fittings on heavy wood blocking or platforms. Do not store pipe in contact with ground.

1.04 JOB CONDITIONS

Piping Valves and Appurtenances for Chemical Feed Systems

- A. Protection:
 - 1. Take all measures to ensure that all materials are protected from damage.
- B. Work Affecting Existing Piping
 - 1. Location of Existing Piping:
 - a. Locations of existing piping shown should be considered approximate.
 - b. Determine exact location of existing piping to which connections are required; or which may be disturbed during excavations; or which may be affected by the Work.
 - 2. Work on Existing Piping:
 - a. Cut pipes as shown or required with machines specifically designed for this work.
 - b. Install temporary plugs to keep out all mud, dirt, water and debris.
 - c. Provide all necessary adapters, fittings, taps, outlets, pipe and appurtenances required.
 - d. Verify dimensions of all existing piping to which connections are required and provide all necessary adapters, specials and section pieces required to make the connections.
- C. OWNER does not guarantee watertight closing of isolation valves. CONTRACTOR shall provide, at no additional expense to the OWNER, all temporary caps, plugs, dewatering, pumping and other measures required to ensure proper installation of new piping.

PART 2 — PRODUCTS

2.01 MATERIALS - CHEMICAL FEED SYSTEMS

- A. Valves and Appurtenances:
 - 1. Strainers:
 - a. Service: Liquid.
 - b. Type: Y-Pattern.
 - c. Pressure Class/Rating: 125 psig.
 - d. End Connections: True union.
 - e. Material:
 - 1) Strainers on PVC piping shall be manufactured of PVC.
 - 2) PVC shall be Type 1, Grade 1 in accordance with ASTM D 1784, and shall be dark gray in color.
 - 3) Screens shall be manufactured of PVC with 1/32 perforations with Viton seals.
 - f. Manufacturer:
 - 1) Hayward.
 - 2) Or approved equal.
 - 2. Pressure-Relief Valve:
 - a. Service: Liquid (chemical and water).
 - b. Size Range: ¼-inch to 2 inches.
 - c. Valve Pressure Class/Rating: 150 psig.

Piping Valves and Appurtenances for Chemical Feed Systems

- d. Relief settings: 5-140 psig.
 - e. Valve End Connections: Threaded.
 - f. Material:
 - 1) Valves on PVC piping shall be manufactured of PVC material with Viton or Teflon diaphragm.
 - 2) PVC shall be Type 1, Grade 1 in accordance with ASTM D 1784, and shall be dark gray in color.
 - g. Manufacturer:
 - 1) Griffco Valve, Series PRM or PRG.
 - 2) Or approved equal.
3. Pressure Gages:
- a. Extent: As shown on drawings.
 - b. Range: 0 to 150 psi and as noted on returned shop drawings.
 - c. Dial Size: 4-1/2 inches except where smaller dials are specified.
 - d. Case: Phenolic turret case for surface mounting.
 - e. Bourdon Tube: Stainless steel or bronze.
 - f. Connection: Brass, 2-inch NPT-Bottom.
 - g. Accuracy: +0.5 percent of span.
 - h. Accessories: Provide 2-inch needle valve and diaphragm for pressure snubbing isolation with each gage.
 - i. Product and Manufacturer:
 - 1) Ametek, U.S. Gage Division, Fig. 1980.
 - 2) Or equal.
 - j. Diaphragm seal housing shall be of Type 316 stainless steel, the diaphragm of Telon or Kel-F, and the filling liquid of silicone oil. Seal shall have a 1-inch diameter process connection, cleanout ring, and flush connection. Factory mount a stainless steel cartridge snubber between the gage and diaphragm seal.
4. Backpressure Valves:
- a. Service: Liquid (chemical and water).
 - b. Size Range: 1/4-inch to 2 inches.
 - c. Valve Pressure Class/Rating: 50 psig.
 - d. Range: 0-50 psig.
 - e. Valve End Connections: Threaded.
 - f. Material:
 - 1) Valves on PVC piping shall be manufactured of PVC with Viton or PTFE diaphragm.
 - 2) PVC shall be Type 1, Grade 1 in accordance with ASTM D 1784, and shall be dark gray in color.
 - g. Manufacturer:
 - 1) Griffco Valves, Series BPM or BPG.
 - 2) Or equal.
5. Anti-Siphon Valve
- a. Service: Liquid (chemical and water).
 - b. Size Range: 1/4-inch to 2 inches.
 - c. Maximum inlet pressure: 150 psi at 75° F.

Piping Valves and Appurtenances for Chemical Feed Systems

- d. Relief setting: 5 psi to 125 psi
 - e. Valve End Connections: Threaded.
 - f. Material:
 - 1) Valves on PVC piping shall be manufactured of PVC with Viton or PTFE diaphragm.
 - 2) PVC shall be Type 1, Grade 1 in accordance with ASTM D 1784, and shall be dark gray in color.
 - g. Manufacturer:
 - 1) Plast-O-Matic Valves, Series RVDT/RVDTM.
 - 2) Or equal.
6. Vacuum Breaker Valve
- a. Service: Liquid (chemical and water).
 - b. Size Range: ½ inch to 4 inches.
 - c. Maximum inlet working pressure: 100 psi at 75° F.
 - d. Valve End Connections: Threaded.
 - e. Material:
 - 1) Valves on PVC piping shall be manufactured of PVC with Viton or PTFE diaphragm.
 - 2) PVC shall be Type 1, Grade 1 in accordance with ASTM D 1784, and shall be dark gray in color.
 - f. Manufacturer:
 - 1) Plast-O-Matic Valves, Series VBM/VBS.
 - 2) Or equal.
7. Pressure Sustaining Valve (Pressure Regulator)
- a. Service: Liquid (chemical and water).
 - b. Size Range: ½ inch to 4 inches.
 - c. Maximum inlet working pressure: 150 psi at 75° F.
 - d. Valve End Connections: Threaded.
 - e. Material:
 - 1) Valves on PVC piping shall be manufactured of PVC with FKM seal.
 - 2) PVC shall be Type 1, Grade 1 in accordance with ASTM D 1784, and shall be dark gray in color.
 - f. Manufacturer:
 - 1) Plast-O-Matic Valves, Series PRHM.
 - 2) Or equal.
8. Eductor
- a. Service: Liquid (chemical and water).
 - b. Size Range: 3 inch.
 - c. Maximum inlet working pressure: 100 psi at 75° F.
 - d. End Connections: Threaded.
 - e. Material:
 - 1) Kynar
 - f. Manufacturer:
 - 1) Schutte & Koerting model 264

Piping Valves and Appurtenances for Chemical Feed Systems

- 2) Fox Valve
- 3) Or equal.

- 9. Static Mixer with Side Port
 - a. Service: Liquid (chemical and water).
 - b. Size Range: 1 ½ inch
 - c. Maximum inlet working pressure: 100 psi at 75° F.
 - d. End Connections:
 - 1) Mixer: 150 lb Flanged
 - 2) Side Port: FNPT
 - e. Material:
 - 1) Schedule 80 PVC, NSF 61
 - f. Manufacturer:
 - 1) Koflo
 - 2) Or equal.

B. Miscellaneous Items:

- 1. PVC Pipe Supports:
 - a. Provide fiberglass/plastic supports for chemical pipes as follows:
 - 1. Pipe 2-inch and larger shall be supported at 6 foot maximum spacing. Pipe smaller than 2-inch shall be supported at 4 foot maximum spacing.
 - 2. Pipes adjacent to or on walls shall be supported from molded polypropylene clamp halves complete with cover plate, hex bolts and base weld plate attached to wall with expansion anchors.
 - 3. Manufacturer:
 - a) Unistrut.
 - b) Or equal.
- 2. Flanged Joints:
 - a. Assemble flanged joints using 1/8-inch ring-type gaskets for raised face flanges. Use full face gaskets for flat face flanges unless otherwise approved. Gaskets shall be suitable for the chemical service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.
 - b. Bolts shall be tightened in a sequence that will ensure equal distribution of bolt loads.
 - c. The length of bolts shall be uniform, and they shall not project beyond the nut more than ¼ - inch or fall short of the nut when fully taken up. The ends of bolts shall be machine cut so as to be neatly rounded. Washers shall be used.
 - d. Bolt threads and gasket faces for flanged joints shall be lubricated prior to assembly.
 - e. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.

Piping Valves and Appurtenances for Chemical Feed Systems

- f. All bolts and hardware shall be Type 316 stainless steel.
 - g. Provide graphite-free anti-seize compound for stainless steel nuts and bolts to prevent galling. Strength of bolted joints shall not be affected by use of anti-seize compound.
 - 3. Unions shall be installed for easy disassembly of pipes and where shown on Drawings.
 - 4. Expansion Joints:
 - a. General: Expansion joints shall be three convolutions type.
 - b. Extent: For chemical systems.
 - c. Material: Shall be resistant to chemical.
 - d. Flanges: Shall be ductile iron construction. Flanges shall be full faced with 150 lb. ANSI standard drilling. Retainer rings shall be stainless steel.
 - e. Spring forces to compress, extend and laterally offset shall be low enough to be used with PVC pipe, FRP tanks, and polyethylene tanks.
 - f. Product and Manufacturer: Expansion joints shall be Proco Series 443 or equal.
 - g. Alternative: in lieu of expansion joints at chemical tanks, flexible hose sections approved by the selected tank manufacturer for the tank size, material, and chemical service may be used. If flexible hose sections are used, then connection locations and piping arrangement shall be coordinated to allow installation of hose section in an "S" configuration or a sweep of at least 45 degrees in order to maintain the functionality required for tank expansion/contraction.
 - 5. Pipeline Identification: All exposed piping shall be identified by Brady B-500 vinyl cloth self-sticking arrows and markers. Equivalent products by Seton Name Plate Corporation or equal are acceptable.
 - a. Markers shall be of wording of "Orthophosphate" or as appropriate.
 - b. Install markers and arrows at following locations:
 - 1. At intervals not exceeding 50 feet along continuous runs of pipe.
 - 2. Wherever pipes pass through walls, floor or panels.
 - 3. At each valve or equipment connection.
 - 4. At each branch where it connects to a main line.
 - c. Lettering shall be:
 - 1) 1-1/8 inches high for pipes less than 3 inches diameter.
 - d. Flow arrows shall be:
 - 1) 1-1/8 inches by 3 inches for pipes less than 3 inches diameter.
 - 6. Basket Strainer:
 - a. Provide fiberglass/plastic supports for chemical pipes as follows:
 - 1. Pipe 2-inch and larger shall be supported at 6 foot maximum spacing. Pipe smaller than 2-inch shall be supported at 4 foot maximum spacing.
 - 2. Pipes adjacent to or on walls shall be supported from molded polypropylene clamp halves complete with cover plate, hex

Piping Valves and Appurtenances for Chemical Feed Systems

bolts and base weld plate attached to wall with expansion anchors.

3. Manufacturer:

- a) Unistrut.
- b) Or equal.

2.02 FILL STATION

A. Quick Disconnect Couplings:

- 1. Size and Extent: 2-inch for chemical fill stations.
- 2. Type: Tank fill pipes shall be furnished with male adapter/hose shank type couplings as shown in the drawing for delivery truck connection.
- 3. Materials: Body shall be suitable for chemical application.
- 4. Provide dust cap with security chain.
- 5. Support coupling as needed inside the containment wall to accommodate coupling and chemical fill hose weights. Coupling shall not be installed on top of the wall or outside the wall.
- 6. Manufacturer:
 - a. Banjo Corporation.
 - b. Evertite.
 - c. Murray Equipment Inc.
 - d. Or approved equal.

2.03 CHEMICAL INJECTION NOZZLES

- A. Extent: For application of specified chemicals, as shown on the drawings.
- B. Type and Size: Corporation stop and nozzle assembly type shall be ½-inch or ¾-inch. Retractable injector solution tube shall be ¼-, 3/8-inch, or ½-inch diameter and extend into pipe 1/3 the diameter of the process pipe.
- C. Materials: Entirely suitable for the chemical solution and capable of withstanding maximum pressure conditions.
- D. Mounting: Corporation stop shall be mounted as shown on the Drawings.
- E. Manufacturer: Saf-T-Flo or approved equal.

PART 3 — EXECUTION

3.01 INSPECTION

- A. The CONTRACTOR shall inspect chemical valves and appurtenances to ensure that they are free of defects in material and workmanship. The compatibility of pipe, fittings, and coatings shall be verified.

3.02 INSTALLATION

- A. Chemical valves and appurtenances shall be installed in complete accordance with the manufacturer's instructions and recommendations.

Piping Valves and Appurtenances for Chemical Feed Systems

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SECTION 40 41 13

HEAT TRACE

PART 1 -- GENERAL

1.1 DESCRIPTION

- A. Scope: Provide all labor, material, tools, equipment and incidentals required to furnish, install, and place into satisfactory operation heat tracing systems, complete with appurtenances as shown, specified, and as required.
- B. Related Sections:
 - 1. Section 22 07 19 - Plumbing Piping Insulation.
 - 2. Section 22 11 16 – Domestic Water Piping
 - 3. Section 40 05 05 - Exposed Piping Installation.
 - 4. Section 40 42 00 - Insulation of Process Piping and Equipment

1.2 QUALITY ASSURANCE

- A. All equipment specified in this Section shall be furnished by a single supplier.
- B. Reference Standards:
 - 1. American National Standards Institute, Inc. (ANSI).
 - 2. Institute of Electrical and Electronic Engineers (IEEE).
 - 3. National Electrical Supplier's Association (NEMA).
 - 4. National Electrical Code (NEC).
 - 5. Underwriters Laboratories, Inc. (UL).
 - 6. Factor Mutual Research Corporation (FM).
 - 7. American Society of Heating, Refrigeration, Air Conditioning Association (ASHRAE).

1.3 QULIFICATIONS

- A. The contractor performing the heat trace installation shall have a minimum of three (3) years of experience in the installation, testing, and commissioning of electrical heat tracing systems. Installation personnel shall be trained by, or otherwise qualified in accordance with, the heat trace manufacturer's requirements and shall perform the work in accordance with the contract documents and the manufacturer's written instructions.

1.4 SUBMITTALS

- A. Shop Drawings and Product Data: Comply with the requirements of Section 01 33 00 – Submittal Procedures and provide the following:
 - 1. Supplier's literature, illustrations, specifications and engineering data including dimensions, materials, size, weight, performance data including efficiencies.
 - 2. Electric and control wiring diagrams.
 - 3. Layout drawings showing locations of power taps and thermostats.
 - 4. Sizing calculations for each run of heat trace. Calculations shall show:
 - a. Ambient temperature and wind loss used.
 - b. Temperature maintained in material.
 - c. Running and startup current values.
- B. Reports:
 - 1. Submit all test reports to Engineer within 10 days of testing completion.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Suppliers:
 - 1. Chemelex Auto-Trace Self-Regulating by Raychem Corporation.
 - 2. Approved equivalent.
- B. Service Conditions
 - 1. Process Water Piping
 - a. Pipe heat tracing system shall be provided for the piping as specified or shown on the Drawings and shall be capable of preventing freezing of the pipes or objects protected throughout the ambient temperature range of minus 6F to plus 45F.
 - 2. Design the heat tracing system with the assumption that the carried water in the piping is not moving.
 - 3. Tepid Water Piping for Emergency Shower Eyewash:
 - a. Provide Pipe heat tracing system as specified or shown on the Drawings. The heat tracing system shall be able to maintain 85°F temperature.
 - b. Provide adjustable control Thermostat equal to Thermon E4X-25325.
 - 4. Power supply shall be 120 volts.
- C. Pipe Heat Tracing Materials
 - 1. Type: Self-regulating, designed so that it can be cut to any length without significantly changing the heater output per unit length.
 - 2. The heater output shall vary in response to temperature changes along the pipe.
 - 3. Constant wattage heaters shall not be used.
 - 4. Heater cable shall be rated for 225F, 240 volt AC (for use on 120VAC system). Cable make-up shall include a five component system consisting of stranded

- copper bus wire, self-regulating semi-conductive core, fluoropolymer jacket, tinned copper shield and fluoropolymer outer jacket.
5. The outer jacket of fluoropolymer shall be provided of suitable thickness and corrosion resistant properties to prevent corrosion from the surrounding environment.
 6. The heating system shall also include all necessary components for proper installation of each circuit as required. Components shall include the following:
 - a. Power connection kit with junction box for connecting each heater to the power circuit.
 - b. Fibrous glass tape to fix heater to pipe every 2 feet.
 - c. Cable end seal kit for termination of cable.
 - d. Peel-off self-sticking black on yellow labels "Electric Traced". Labels shall be provided for each ten feet of pipe.
 7. Provide a heat-tracking control panel at each location shown on the Drawings. The control panel shall be a compact, full-featured, microprocessor-based, single-point heat-tracing control system. It shall provide control and monitoring of electrical heat-tracing circuits for both freeze protection and temperature maintenance, and with alarms, ground-fault and voltage protection.
 - a. The panel shall be a NEMA 4X with 480 VAC power feed.
 - b. Temperature measurement shall be via a 3-wire 100-ohm platinum RTD(s) connected directly to the unit.
 - c. Basis of design shall be Raychem 910 series

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Inspect all items immediately upon delivery to site for damage.
- B. Each reel of heater shall be tested prior to installation to determine that the heater has not been damaged in shipment. Provide test results to Engineer.
- C. Heat tracing shall be tested after installation but before insulation is applied. Provide test results to Engineer.
- D. Heat tracing shall be tested after insulation is applied. Provide test results to Engineer.
- E. Install items in complete conformance with the shop drawings and supplier's installation instructions and leave in proper working condition.
- F. Provide all required mounting and control accessories, including all bolts, nuts, ties, junction boxes and adhesives.

- G. Install heating elements directly against metal pipe before insulation is installed. Install in accordance with supplier's instructions.
- H. Packing tape or other similar tapes to affix cable to piping will not be accepted. Contractor shall use manufacturer recommended self-adhesive glass cloth tape such as 3M glass cloth electrical tape 69 or approved equivalent.
- I. Heat trace cable shall be attached to the piping at intervals not exceeding 12 inches.
- J. Valves, flanges, and pipe fittings shall be wrapped to allow future maintenance and removal without damage to the heat trace cable.
- K. Contractor shall use manufacturer supplied cable termination kits for termination of heat trace cable. The use of electrical or other similar tape will not be allowed.

+ + END OF SECTION + +

SECTION 40 42 00

INSULATION OF PROCESS PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, material, equipment and incidentals as shown, specified and required to furnish and install insulation for the process piping systems and equipment indicated below:
 - a. Softened Water
 - b. Sodium Hypochlorite
 - c. Plant Water
 - d. All unions, valves and fittings

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the insulation of process piping and equipment Work.

C. Related Sections:

1. Division 40, Applicable Sections on Pipe Valves
2. Division 22, Applicable Sections on Plumbing Elements
3. Division 23, Applicable Sections on HVAC Elements.

D. General:

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American Society for Testing and Materials, (ASTM).
 - a. ASTM C 449/C 449M, Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - b. ASTM C 547, Specification for Mineral Fiber Pipe Insulation.
 - c. ASTM E 84, Test Method for Surface Burning Characteristics of Building Materials.
2. Federal Specifications, (FS).
 - a. FS HH-1-558B, Insulation Blocks, Boards, Blankets, Felts, Sleeving, Pipe Fitting Covering.
 - b. FS SS-C-160, Cement, Insulation, Thermal.
3. National Fire Protection Association, (NFPA).

- a. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 1. Manufacturer shall have a minimum of five years experience of producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
- B. Component Supply and Compatibility:
 1. Obtain all equipment included in this Section, regardless of the component manufacturer, from a single insulation of process piping and equipment manufacturer.
 2. The insulation of process piping and equipment manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the insulation of process piping and equipment manufacturer.
- C. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 1. National Fire Protection Association, (NFPA).
 2. Underwriters' Laboratories, Inc., (UL). Fire hazard ratings to be verified by Underwriters' Laboratories, Inc. label or listing or a certified test report from an approved independent testing laboratory.
 3. Local and State Building Codes and Ordinances:
 - a. Uniform Building Code
 - b. Uniform Mechanical Code.
 - c. Model Energy Code.
 4. Permits: Contractor shall obtain and pay for all required permits, fees, inspections and approvals by authorities having jurisdiction.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Product Data:
 - a. Manufacturers' catalog literature, specifications, and illustrations with the following information:
 - b. Thermal properties.
 - c. Physical properties.
 - d. Fire hazard ratings.
 - e. Facing information.
 - f. Installation instructions.

- g. Jointing recommendations for butt joints and longitudinal seam.
- B. Informational Submittals: Submit the following:
 - 1. Supplier Instructions:
 - a. Fabrication instructions for pipe fittings and valve insulation and coatings.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
 - 2. Material shall be packed and shipped in corrugated carton.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all materials in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
 - 3. Store material in clean, dry area, out of the weather.
 - 4. Material shall be tightly covered to protect against dirt, water, mechanical injury or chemical damage.
 - 5. Material shall remain in original cartons until time of installation.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

- A. Insulation systems including covering, mastics, adhesives, sealers and facings shall have the following fire hazard classifications:
 - 1. Flame Spread: 25 maximum.
 - 2. Fuel Contributed: 50 maximum.
 - 3. Smoke Developed: 50 maximum.

2.2 MATERIALS

- A. Fiberglass Insulation:
 - 1. Type: Heavy-density sectional pipe insulation with vapor barrier and

- self-sealing lap.
 - 2. Density: Four pounds per cubic foot.
 - 3. R-Value Minimum: 4.0 hr.-ft²-°F/BTU.
 - 4. Fittings: Molded fiberglass.
 - 5. Jointing Materials: Manufacturer's recommended adhesives and tape.
 - 6. Valve Insulation: Miter cut nesting size covering segments of same thickness as pipeline, for insulation of valves.
 - 7. Products and Manufacturers: Provide one of the following:
 - a. Owens Corning Fiberglass Corporation, Fiberglass 25ASJ/SSL.
 - b. Certain-Teed Products Corporation, Certain Teed snap-on ASJ-SSL.
 - c. Or equal.
- C. Mechanical Equipment Insulation:
- 1. Type: Semi-rigid fiberglass board.
 - 2. Minimum Thickness: Three-inches.
 - 3. Insulation Jacket: All service jacket.
 - 4. Density: Three lbs. per cubic foot.
 - 5. Fasteners: 3/4-inch by 0.015-inch stainless steel bands.
 - 6. Wrapping: One-inch wire mesh.
 - 7. Finish: Two, 1/2-inch thick coats of insulating cement with open weave glass cloth.
 - 8. Lagging Adhesive:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Foster Products Division, Sealfast 30-36.
 - 2) Or equal.
 - b. Type: Asbestos free, fire retardant coating.
 - c. References:
 - 1) MIL-A-3361B, Class 1, Grade A.
 - 2) NFPA 90A.
 - 9. Insulating Cement:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Ryder Sales: Thermokote 1.
 - 2) Insulation Industries Inc., Smooth Kote.
 - 3) Or equal.
 - b. Type: Asbestos free, hydraulic setting refractory type insulating cement, non-corrosive to ferrous metals.
 - c. Reference:
 - 1) ASTM C 449/C 449M.
 - 2) Federal Specification SS-C-160 Type III GRF.
 - 10. Products and Manufacturers: Provide one of the following:
 - a. Certain-Teed Products Corporation, Snap Wrap.
 - b. Owens-Corning Fiberglass Corporation, Pipe Wrap.
 - c. Or equal.
- D. Weatherproof Insulation Jacket (for insulated pipes and equipment located outdoor exposed to outside ambient conditions):

1. Type: Smooth embossed aluminum metal jacket.
 2. Thickness: 0.016-inches.
 3. Moisture Barrier: Polycraft.
 4. Fastening: Pre-formed "Z"-lock seam with 2-inch butt strap with sealant.
 5. Bands: 1/2-inch aluminum bands with wing seals.
 6. Fittings:
 - a. Type: Pre-fabricated aluminum fittings.
 - b. Thickness: 0.016-inches.
 7. Manufacturers: Provide products of one of the following:
 - a. Certain-Teed Products Corporation.
 - b. Childers Products Company, Lock-On and Slip-On.
 - c. Or equal.
- E. Flexible-Elastomeric Thermal Insulation (for refrigerant piping):
1. Type: Expanded close cell structure elastomeric thermal insulation.
 2. Thermal Conductivity: 0.25 Btu-inch/hr. - ft²-°F.
 3. Density: Six lbs. per cubic feet.
 4. Products and Manufacturers: Provide one of the following:
 - a. Halstead Industries, Type "Insul-tube".
 - b. Or equal.

2.3 SOURCE QUALITY CONTROL

- A. Source Quality Control: Perform the following tests and inspections at the factory:
1. Flame spread.
 2. Smoke developed.
 3. Fuel contributed.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Ensure that surfaces of all equipment including pipes, valves, and fittings are clean and dry before applying insulation.

3.2 PREPARATION

- A. Ensure that piping and equipment has been tested, inspected and released for application of insulation.

3.3 INSTALLATION

- A. Pipe insulation shall be continuous through walls and floor openings, except where walls or floors are required to be firestopped or required to have a fire resisting rating.

- B. Where hangers are in direct contact with piping the hanger and supporting rod shall be wrapped with foil-faced blanket insulation and vapor sealed. Hanger rod insulation and vapor barrier shall extend up to the rod a minimum distance equal to the diameter of the pipe.
- C. Install insulation so as to make surfaces smooth, even, and substantially flush with adjacent insulation.
- D. Follow manufacturer's application instructions for all materials used.
- E. Provide insulation protection shields for insulated piping supported by pipe hangers.
- F. Install and coat insulation in accordance with the manufacturer's recommendations.
- G. After applying initial equipment insulation, wrap equipment and insulation with wire mesh and apply two separate coats of insulating cement. Apply one coat of insulating finish cement. When dry, apply one coat of fire retardant lagging adhesive. Embed a layer of open weave glass cloth overlapping all seams by 2-inches, and finish with a second coat of fire retardant lagging adhesive.
- H. Weatherproofing for Outdoor Pipe and Equipment Insulation:
 - 1. Piping: Apply field applied jacket with moisture barrier around pipe or equipment and slip edge into preformed Z lock position to shed water. Butt next jacket section leaving approximately 3/8-inch gap. Place preformed 2-inch butt strap with sealant over the seam and secure with 1/2-inch aluminum band and wing seal.
 - 2. Fittings: Apply prefabricated metal fittings identical in composition to pipe jacketing.

3.4 FIELD QUALITY CONTROL

- A. Ensure that insulation is dry when installed, and before and during application of any finish.
- B. Protection:
 - 1. All material applied in one day shall have the vapor barrier applied the same day and any exposed ends shall be temporarily protected with a moisture barrier and sealed to the pipe.

3.5 SCHEDULE

- A. Refer to Schedule below for minimum thickness of pipe insulation:

<u>Pipe Size (inches)</u>	<u>Minimum Insulation Thickness (inches)</u>
1/2 thru 1:	1

Insulation of Process Piping and Equipment

1-1/4 thru 4:
5 and up:

1-1/2
2

Exterior Piping:

1-1/2 thick w/weatherproof jacket.

Exterior Equipment:

3 thick w/cement and weatherproof jacket.

- B. Where part of existing piping is removed, the remaining piping shall be capped watertight and covered with insulation. Any existing piping insulation damaged shall be patched.

+ + END OF SECTION + +

SECTION 40 60 05

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, install, calibrate, test, start-up, and place in satisfactory operation a complete and operating instrumentation and control system.
2. The Work includes, but is not limited to, the following:
 - a. Furnishing all components required for all Control Panels including the enclosure, PLC processor, modem, relays, and associated equipment as required.
 - b. Field mounted instruments.
 - c. Modifications to existing Control System and SCADA.
 - d. Uninterruptible power supply.

B. Coordination:

1. Instrumentation and Controls:
 - a. Instrumentation and Controls equipment as shown and specified herein shall be furnished, installed, and placed into satisfactory operation by an Instrumentation and Controls subcontractor. Programming of PLC and configuration of OIT software is part of the work and shall be programmed and configured by the owner approved programmer.
 - b. Some panels or equipment are furnished under other Specification Sections under this Contract, and computer system hardware and software are provided by computer system contractor retained by Owner. Contractor shall coordinate with Suppliers of panels and equipment to provide fully functional system complying with the Contract Documents and that interfaces with the central computer system.
 - c. Computer system input/output list identifies inputs and outputs required, and is part of this Section. Use input/output list for coordinating signals between equipment provided under this and other contracts. Include Work for Contractor-furnished control options not on the input/output list at no additional cost to Owner.

C. Related Sections:

1. Division 00, Bidding and Contracting Requirements
2. Division 01, General Requirements
3. Division+ 26, Electrical

4. Section 40 05 53, Process Valves and Appurtenances

1.2 REFERENCES

- A. The following organizations have generated standards that are to be used as guides in assuring quality and reliability of components and systems: govern nomenclature, define parameters of configuration and construction, in addition to specific details in this specification and the Contract Drawings:
1. ISA, Instrument Society of America.
 2. UL, Underwriters' Laboratories, Inc.
 3. AWWA, American Water Works Association.
 4. NEMA, National Electrical Manufacturers Association.
 5. OSHA, Occupational Safety and Health Administration.
 6. ANSI, American National Standards Institute.
 7. NFPA, National Fire Protection Association.
 8. SAMA, Scientific Apparatus Manufacturers Association.
 9. JIC, Joint Industrial Council.
 10. IEEE, Institute of Electrical and Electronic Engineers.
 11. NEC, National Electrical Code.
 12. FM, Factory Mutual.

1.3 QUALITY ASSURANCE

- A. Qualifications:
1. Supplier:
 - a. Shall be financially sound with at least five years continuous experience in designing, implementing, supplying, and supporting instrumentation and control systems for Fayette County Water Treatment Plant comparable to the instrumentation and control systems required for the Project, relative to hardware, software, cost, and complexity.
 - b. Shall have record of successful instrumentation and control system equipment installations. Upon Engineer's request, submit record of experience listing for each project: project name, owner name and contact information, name and contact information for contractor, name and contact information for engineer or architect, approximate contract value of instrumentation and controls Work for which Supplier was responsible,
 - c. Shall have at time of Bid experienced engineering and technical staff capable of designing, supplying, implementing, and supporting the instrument and control system and complying with submittal and training requirements of the Contract Documents.
 - d. Shall be capable of training operations and maintenance personnel in instrumentation and control applications, and in operating, programming, and maintaining the control system and equipment.
 - e. Shall have UL-approved panel shop.

2. Manufacturer: Manufacturers of instrumentation and control equipment furnished under this Section shall be experienced producing similar equipment and shall have the following qualifications:
 - a. Shall manufacture instrumentation and control system components that are fully-developed, field-proven, and of standardized designs.
 - b. Shall have system of traceability of manufactured unit through production and testing in accordance with ANSI/ASQ Z1.4.
 - c. Shall have guaranteed availability clause (99.99 percent, minimum for one year) for microprocessor-based components and appurtenances.
 - d. Shall have documented product safety policy relevant to products proposed for the Work.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Field Instruments:

- 1) Manufacturer's product name and complete model number of devices proposed for use, including manufacturer's name and address.
- 2) Instrument tag number in accordance with the Contract Documents.
- 3) Data sheets and manufacturer's catalog literature. Provide data sheets in accordance with ISA 20 and annotated for features proposed for use. For instruments not included in ISA 20, submit data sheets using a format similar to ISA 20.
- 4) Description of construction features.
- 5) Performance and operation data.
- 6) Installation, mounting, and calibration details; instructions and recommendations.
- 7) Service requirements.
- 8) Dimensions of instruments and details of mating flanges and locations of closed tanks, pipe sizes for insertion instruments, and upstream/downstream straight run pipe lengths required.
- 9) Range of each device and calibration information.
- 10) Descriptions of materials of construction and listing of NEMA ratings for equipment

b. Panels and Cabinets:

1) Layout drawings that include:

- a) Front, rear, and internal panel views to scale.
- b) Tag number and functional name of components mounted in and on panel, console, or cabinet, as applicable.
- c) Product information on panel components.
- d) Nameplate location and legend including text, letter size and colors to be used.
- e) Location of anchorage connections.
- f) Location of external wiring and piping connections.

- g) Mounting and installation details, coordinated with actual application.
 - h) Proposed layouts and sizes of operator interface graphic display panels and alarm annunciator panels.
 - i) Calculations for heating and cooling of panels
 - j) Subpanel layouts and mounting details for items located inside control panels.
- 2) Product information on panel components including:
 - a) Manufacturer's product name and complete model number of devices being provided, including manufacturer's name and address.
 - b) Instrument tag number in accordance with the Contract Documents.
 - c) Data sheets and catalog literature. Submit data sheets as shown in ISA 20 and annotated for features proposed for use. For instruments not included in ISA 20, submit data sheets with format similar to ISA 20.
 - d) Description of construction features.
 - e) Performance and operation data.
 - f) Installation, mounting, and calibration details; instructions and recommendations.
 - g) Service requirements
- 3) Wiring and piping diagrams, including the following:
 - a) Name of each panel, console, or cabinet.
 - b) Wire sizes and types.
 - c) Pipe sizes and types.
 - d) Terminal strip and terminal numbers.
 - e) Wire color coding.
 - f) Functional name and manufacturer's designation for components to which wiring and piping are connected.
 - g) Lightning and surge protection grounding.
- 4) Electrical control schematics in accordance with NFPA 79. Drawings shall be in accordance with convention indicated in Annex D of the NFPA 79. Typical wiring diagrams that do not accurately reflect actual wiring to be furnished are unacceptable. Tables or charts for describing wire numbers are unacceptable.
- 5) Stock list or bill of materials for each panel including tag number, functional name, manufacturer's name, model number and quantity for components mounted in or on the panel or enclosure.
- 6) Detail showing anchorage plan of wire bundles between subpanels and front panel mounted devices.
- c. Field wiring and piping diagrams, include the following:
 - 1) Wire and pipe sizes and types.
 - 2) Terminal numbers at field devices and in panels.
 - 3) Fiber optic termination designations in the field and in panels.
 - 4) Color coding.

- 5) Conduit numbers in which wiring will be located.
- 6) Locations, functional names, and manufacturer's designations of items to which wiring or piping are connected.
- d. Proposed operator interface graphics layouts. Each graphic display and process report layout will be subject to modification from Contractor's submitted format within limits of software package used for development. Implement such modifications in accordance with Engineer's comments.
- e. Instrumentation and Controls Equipment:
 - 1) Submit the following general information:
 - a) Detailed block diagram showing system hardware configuration and identifying model numbers of system components.
 - b) Software listings for operating system, applications, and HMI.
 - c) Software language and organization.
 - d) Format, protocol and procedures for data transmission and communications with input/output modules and peripheral devices, including wide area network (WAN) or local area network (LAN).
 - e) HMI interfacing details, licensing structure, and included functions.
 - f) Control and failure modes.
 - g) Online and offline capabilities for programming, system utilities, and diagnostics.
 - h) Input/Output Information:
 - i. Input/output (I/O) point listing with I/O module cross-reference identification.
 - ii. I/O module cross-reference identification based on I/O address list developed by I&C Subcontractor .
 - i) Database listing, including all I/O points.
 - 2) Hardware:
 - a) Layout drawings showing front, rear, end and plan views to scale of equipment, I/O components, power supplies, and peripheral devices.
 - b) Equipment ventilation requirements.
 - c) Interconnection diagrams, including termination details, cable identification list, and cable length.
 - d) Drawings showing equipment layout.
 - e) Installation requirements, instructions, and recommendations.
 - 3) Software:
 - a) Licensing agreement with name of licensee, renewal requirements, release and versions, expiration dates (if any) and upcoming releases scheduled before Project completion. When upcoming releases are expected, provide descriptions, when available, of features that differ from the proposed release.
 - b) Standard technical and instructional documentation covering software for utility, system support, system documentation,

- display, communications, data logging and storage and diagnostic functions. Submit this information on electronic media.
- c) Standard technical documentation covering all aspects of the computer system software functions and capabilities, including instruction set description and programming procedures related to monitoring, display, logging, reporting and alarming functions.
 - d) Detailed functional descriptions of application programs explaining control, display, logging and alarming features to be provided and functions to be performed.
- 4) Documentation describing memory type, size and structure and listing size of system memory, I/O and Data Table memory and size of memory available for control programs.
- 5) System I/O Loop Wiring Diagrams: (a) Prepare Shop Drawings on module-by-module basis and include the following information:
- a) Rack numbers, module type and slot number, and module terminal point numbers. Include location and identification of intermediate panel and field terminal blocks and terminal numbers to which I/O wiring and power supply wiring is connected. Identify power supply circuits with designation numbers and ratings.
 - b) Wiring types, wire numbers, and color coding.
 - c) Designation of conduits in which field I/O wiring will be installed.
 - d) Location, functional name, tag numbers and manufacturer's module numbers of panel and field devices and instruments to which I/O wiring will be connected.
 - e) Prepare loop wiring diagrams in accordance with ISA 5.4.
- f. Complete point-to-point interconnection wiring diagrams of field wiring associated with the system. Diagrams shall include the following:
- 1) Field wiring between each equipment item, panel, instruments, and other devices, and wiring to control stations, panelboards, and motor starters. Some of this equipment may be specified in other Divisions, Contractor is responsible for providing complete point-to-point interconnection wiring diagrams for control and monitoring of that equipment.
 - 2) Numbered terminal block and terminal identification for each wire termination.
 - 3) Identification of assigned wire numbers for interconnections. Assign each wire a unique number.
 - 4) Schedule showing the wiring numbers and the conduit number in which the numbered wire is installed.
 - 5) Junction and pull boxes through which wiring will be routed.
 - 6) Identification of equipment in accordance with the Contract Documents.

2. Product Data:
 - a. Product data for field instruments in accordance with requirements for Shop Drawings in this Section.
 - b. Product data for panels, consoles, and cabinets in accordance with requirements for Shop Drawings in this Section.
 - c. Product data for field wiring and piping provided for instrumentation and control service and not included under other Sections or contracts.
 - d. Product data for I&C equipment, including software and hardware. Requirements for software product data are included in requirements for Shop Drawings under this Section.
 3. Factory Acceptance Test Procedure: Submit factory testing procedures that will be performed to fulfill requirements of the Contract Documents. Test procedure shall include the following:
 - a. Visual inspection of components and assembly.
 - b. Description of hardware operational testing.
 - c. Description of software demonstration.
 - d. Description of testing equipment to be used.
 - e. Sign-off sheets to be used at time of testing.
- B. Informational Submittals: Submit the following:
1. Documents to be submitted prior to pre-submittal conference, in accordance with Article 1.3 of this specification.
 2. System Software Documentation: Submit preliminary software documentation not later than four weeks prior to scheduled start of factory testing. Software documentation shall include the following:
 - a. Complete printed copies of all programming.
 - b. Complete listing of external and internal I/O address assignments, register assignments and preset constant values with function point descriptions. List unused/undefined I/O and data table registers available.
 - c. Copies of all configured HMI screens.
 3. Manufacturer's Instructions:
 - a. Shipping, handling, storage, installation, and start-up instructions.
 4. Source Quality Control Submittals:
 - a. Factory test reports and results.
 5. Special Procedure Submittals:
 - a. Submit notification to Owner and Engineer at least 14 days before readiness to begin system checkout. Schedule system checkout on dates agreed to by Owner and Engineer.
 - b. Submit written procedure for system checkout to Engineer three months prior to starting system checkout. Three months prior to starting system checkout submit written procedure for start-up to Engineer.
 6. Field Quality Control Submittals:
 - a. Submit the following prior to commencing system checkout and start-up.

- 1) Completed calibration sheets for each installed instrument showing five-point calibration (0, 25, 50, 75, 100 percent of span), signed by factory-authorized serviceman.
 - b. Field calibration reports
 - c. Field testing reports.
 7. Supplier's Reports:
 - a. Installation inspection and check-out report.
 - b. Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
 8. Qualifications Statements:
 - a. Supplier.
 - b. Manufacturer, when required by Engineer.
- C. Closeout Submittals: Submit the following:
 1. Operations and Maintenance Data:
 - a. Submit in accordance with Section 01 78 23, Operation and Maintenance Data.
 - b. Include complete up-to-date system software documentation. Provide hardcopy and electronic copies.
 - c. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.
 2. Record Documentation:
 - a. Prepare and submit record documents in accordance with Section 01 78 39, Project Record Documents.
 - b. Revise all system Shop Drawing submittals to reflect as-built conditions in accordance with the following.
 - 1) Two copies of each revised Shop Drawings and documentation to replace out-dated drawings and documentation contained in operation and maintenance manuals. Submit half-size black line drawings for each drawing larger than 11 inches by 17 inches. Include specific instructions for out-dated drawing removal and replacement with record documents submittal.
 - 2) Half-size black line prints of wiring diagrams applicable to each control panel shall be placed in clear plastic envelopes and stored in a suitable print pocket or container inside each control panel.
 - 3) Submit CADD drawings of the point-to-point interconnection wiring diagrams updated to reflect final as-built equipment information and as-installed field installation information.

1.5 STORAGE AND HANDLING

- A. Prior to packaging, each manufacturer or Supplier shall securely attach tag number and instructions for proper field handling and installation to each instrument.
- B. Comply with Section 01 65 00, Product Delivery Requirements, and Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. Power Supplies:
 - 1. Electrically powered equipment and devices shall be suitable for operation on 115-volt plus-or-minus 10 percent, single-phase, 60 Hertz plus-or-minus two Hertz, power supply. If different voltage or closer regulation is required, provide suitable regulator or transformer at no additional cost to Owner.
 - 2. Provide appropriate power supplies for field instruments requiring power source less than 115 volts. Power supplies shall be mounted in control panels or enclosures installed near associated instrument or in field panels.
 - 3. Power supplies shall be capable of minimum of 130 percent of maximum simultaneous current draw.
 - 4. Provide power on-off switch or air circuit breaker for each item provided under this Section that requires electric power.
- B. Signal Requirements:
 - 1. Control system shall use four to 20 mA DC analog signals, unless otherwise shown or indicated.
 - 2. Provide signal converters and repeaters where required. Adequately size power supplies for signal converters and repeater loads.
 - 3. Isolate signals from ground.
 - 4. Signals transient DC voltage shall not exceed 300 volts over one millisecond, and shall not have a DC component over 300 volts.
 - 5. Discrete signals shall use 24 VDC.
- C. Surge Protection Requirements:
 - 1. Provide surge protection to protect electronic instrumentation and control systems from surges propagating along signal and power supply cabling. Protection systems shall be such that the protection level shall not interfere with normal operation, but shall be lower than instrument surge withstand level, and be maintenance-free and self-restoring.
 - 2. Provide instruments in suitable metallic cases, properly grounded. Ground wires for surge protectors shall be connected to good earth ground and, where practical, run each ground wire individually and insulated from other wires. Mount protectors within instrument enclosure or in separate junction box compatible with the area designation coupled to the enclosure.

D. Miscellaneous:

1. General:
 - a. Instrumentation components shall be heavy-duty types, constructed for continuous service.
 - b. System shall consist of equipment models currently in production.
 - c. Materials and equipment, including cabling and interconnections, shall be in accordance with Division 16, Electrical, and manufacturer's recommendations, unless indicated otherwise in the Contract Documents.
 - d. Materials and equipment shall, where applicable, be in accordance with UL standards and be so marked and labeled.
2. Provide surge protection for instruments and other control system components that could be damaged by electrical surges.
3. Field-mounted instruments and system components shall be constructed for use in humid and corrosive service conditions. Field-mounted instrument enclosures, junction boxes and appurtenances shall have NEMA rating appropriate for hazardous rating requirements shown or indicated on Electrical Drawings, instrument data sheets, and elsewhere in the Contract Documents.
4. Miscellaneous hardware such as fittings, fasteners, and screws, be Type 316 stainless steel or other appropriate material to prevent galvanic reactions, and shall be suitable for service intended. Piping stands shall be provided for fastening instruments as required. Provide threaded pipe stands with flange bolted to slab. Use carbon steel piping and flanges painted in accordance with Section 09 91 00, Painting.
5. Data processing equipment and relays with interconnections to field devices shall be wired through field wiring terminal blocks in the panel. Terminals as part of relay base are unacceptable.
6. Arrange panel-mounted instruments, switches, and other devices ergonomically for functional use and ease of maintenance. Similar types of panel-mounted devices shall be by one same manufacturer and of the same model line.
7. Equipment furnished shall be of modular construction and be capable of field expansion through installation of plug-in circuit cards and additional cabinets as necessary.
8. Field- and panel-mounted instruments shall be tagged with equipment number and nomenclature indicated in the Contract Documents; if not so indicated, tag in accordance with approved Shop Drawings.
9. Coordinate ranges and scales specified in the Contract Documents with manufacturer of the equipment actually furnished for operability over the intended range. Complete the coordination prior to submitting Shop Drawings to Engineer.
10. Treat field-mounted devices with anti-fungus spray.
11. Protect field-mounted devices from exposure to high and freezing temperatures to provide complete operability under the environmental conditions indicated in the Contract Documents.

E. Environmental Conditions:

1. Provide control system suitable for continuous operation under the following conditions:
 - a. Indoor Instruments:
 - 1) Ambient Temperature: Zero degrees F to 120 degrees F.
 - 2) Relative Humidity: 100 percent, maximum.
 - b. Outdoor Instruments
 - 1) Ambient Temperature: -15 degrees F to 120 degrees F.
 - 2) Relative Humidity: 100 percent, maximum.
2. Protect outdoor-mounted field instruments from direct sunlight by providing sunshade for instruments. Construct sunshade out of non-corrosive material. Sunshade shall withstand wind velocity of 70 miles per hour.

2.2 PANELS

A. General Provisions:

1. Provide electrical components and devices, support hardware, fasteners, and interconnecting wiring and piping required to provide control panels complete and operational.
2. Locate and provide hardware so that connections can be easily made and there is ample room for servicing each item.
3. Prevent movement by adequately supporting and restraining devices and components mounted on or within panel.
4. Provide panels with sub-panels for installation of all internally mounted hardware.
5. Provide numbered terminal strips for terminating field wiring and wiring from other panels, unless otherwise shown or indicated.
6. Provide copper grounding studs for hardware requiring grounding.
7. Provide the following convenience accessories inside each panel:
 - a. One 120 vac, 20-amp duplex, grounding type receptacle.
 - b. One 120 vac fluorescent service light fixture with 20-watt lamp and protective plastic shield or appropriate wattage incandescent bulb for panels two feet by two feet and smaller.
 - c. One 120 vac snap switch, to turn on service light, mounted in outlet box with cover and located so that switch is easily accessible from access door.
 - d. Service light with switch and duplex receptacle shall have a dedicated circuit breaker.
8. Panels to be located in non-hazardous (non-classified) environments shall comply with UL 50 and UL 508A.
9. Panels to be located in hazardous (classified) environments shall comply with UL 698A and UL 2062.
10. Provide panels under this Section with 10% percent additional space requirements for future use. Install nothing in space reserved for future use.

11. Contractor is responsible for detailed layout and design of panels, in accordance with the Contract Documents. Base cutouts and design on instrument manufacturers' requirements.
12. Lower 12 inches of free standing panels shall be free of devices, including panduits and terminal strips, for ease of installation and maintenance.
13. For front-opening panels, install no device less than three feet above operating floor level, unless otherwise shown or indicated. For rear-opening panels, install no devices on the door.
14. Wire bundles between subpanels and front panel-mounted devices shall be anchored and protected from damage by opening and closing of panel door.
15. Do not locate front panel-mounted devices requiring manipulation by operating personnel, such as pushbuttons, hand switches, controllers, and similar devices, higher than 5.5 feet above finished floor.
16. Panduits located on either side of terminal strips shall have minimum clearance of 1.5 inches between panduit and terminal strip.
17. Provide three-inch high channel base assembly, drilled to mate panel to floor pad.
18. Provide easily-accessible pocket built into panel door to enclose "as built" panel wiring diagrams.
19. Panels shall be UL-listed.

B. Identification:

1. Provide laminated plastic nameplate for identification of panels. Use self-tapping stainless steel screws for fastening nameplates to panels. When self-tapping screws may degrade panel's NEMA rating, retain NEMA rating intact by using gaskets on each side of panel surface and use retaining plate on the panel back that is same size as nameplate. When gaskets and retaining plate are used, use full-penetration screws with nuts.
2. Panel identification nameplates shall have 1/2-inch high engraved letters.
3. Identify front panel-mounted devices with nameplates engraved with functional description of the device. Nameplate engraving shall be in accordance with the identification provided in the Drawings.
4. Tag electric components and devices mounted within panels with high adhesive labels.
5. Identify terminal strips with nameplate engraved as "TB-XX" where "XX" is the numerical identification of terminal strip.
6. Identify terminals within each terminal strip with sequential numbers and wire numbers.
7. Internal panel wiring shall be color-coded and numerically identified with unique wire numbers affixed at each end of each wire. Color coding shall be in accordance with panel wiring color code table, below:

Panel Wiring Color Code Table

Description	Color
110 vac panel power before fuses or breakers	Black

Instrumentation and Control for Process Systems

Controlled 110 vac power (e.g., after relay contacts, selector switch contacts, and similar equipment.)	Red
110 vac power source from devices external to panel	Yellow
110 vac neutral	White
24 vdc positive power from power supplies	Brown
24 vdc negative power from power supplies	
Controlled 24 vdc power (e.g., after PLC output contacts, relay contacts, and similar)	Blue
24 vdc positive power from devices external to panel	Orange
24 vdc negative power from devices external to panel	
24 vdc four to 20 mA DC signal cable	Grey with red positive, clear negative
Grounding wire	Green

C. Panel Construction Features:

1. Panels located inside control or electric room areas shall be rated NEMA 12 with the following features:
 - a. Fabricate enclosures using minimum 14-gage steel for wall- or frame-mounted enclosures and minimum 12-gage for free standing enclosures. Steel shall be free of pitting and surface blemishes.
 - b. Continuously weld exterior seams and grind smooth. Surface grind panel to completely remove corrosion, burrs, sharp edges, and mill scale.
 - c. Reinforce sheet steel with steel angles where required to adequately support devices and equipment and ensure rigidity and to preclude resonant vibrations.
 - d. Panel shall be flat within tolerance of 1/16-inch over two-foot by two-foot area, or flat within tolerance of 1/8-inch for larger surface area. Acceptable out-of-flatness shall be gradual, in one direction only, and shall not consist of obvious depressions or a series of wavy sections.
 - e. Use pan type construction for doors. Door widths shall not exceed three feet.
 - f. Mount doors with full-length heavy-duty piano hinge with stainless steel hinge pins.
 - g. Provide oil resistant gasket completely around each door or opening.
 - h. Provide handle-operated, oil-tight, key-lockable three-point stainless steel latching system with rollers on latch-rods for easy door closing.
 - i. Use stainless steel fasteners throughout.
 - j. Provide interior mounting panels and shelves constructed of minimum 12-gage steel with white enamel finish.
 - k. For prints, provide steel pocket with white enamel finish.
 - l. Provide enclosure mounting supports as required for floor, frame, or wall mounting as required.
 - m. Completely clean interior and exterior surfaces so surfaces are free of corrosive residue, oil, grease, and dirt. Zinc phosphatize for corrosion protection.
2. Control panels located in non-environmentally controlled areas and outdoor areas shall be rated NEMA 4X and with the following features:

- a. Panels shall be Type 316L stainless steel construction with minimum thickness of 12-gage for all surfaces, except areas requiring reinforcing, with a smooth-brushed finish.
 - b. Stainless steel screw clamp assemblies on three sides of each door.
 - c. Rolled lip around three sides of door and along top of enclosure opening.
 - d. Hasp and staple for padlocking.
 - e. Provide clear-plastic, gasketed lockable hinged door to encompass non-NEMA 4X front-of-panel devices.
3. Control Panels Located in Hazardous Rated Areas (NEMA 7):
- a. General: Provide explosion-proof enclosures, suitable for use in NEC Class 1, Groups C and D or Class II, Groups E, F and G applications and comply with UL 2062 .
 - b. Required Features:
 - 1) Lightweight and corrosion-resistant copper-free aluminum.
 - 2) Integral, cast-on mounting lugs.
 - 3) Left side door hinges.
 - 4) Viewing windows sized to suit internally-mounted components.
 - 5) Stainless steel cover bolts.
 - 6) Cadmium-plated steel mounting pans.
 - 7) Enclosed heat-generating devices shall not cause external surfaces to reach temperatures capable of igniting explosive gas-air mixtures in surrounding atmosphere.
 - 8) Mark panels with appropriate class and group(s) for which panel is qualified. Panels shall comply with features and test criteria of NEMA 250.
4. Wall-Mounted Panels:
- a. General: Wall-mounted panels shall comply with applicable features and standards specified in this Section for the associated NEMA-rated panel.
 - b. Unless otherwise indicated or approved by Engineer, depth of wall-mounted panels shall not exceed 18 inches.
 - c. Panels may be all stainless steel, fiberglass, polycarbonate, or acrylonitrile butadiene and styrene (ABS).
 - c. Provide appropriate size and number of external mounting feet.
 - d. Drilled holes or knockouts in back of wall-mounted panels are not allowed.
 - d. Provide corrosion-resistant polyester quick release latches (for non-stainless steel panels) or stainless steel screw clamp assemblies (for stainless steel panels).

D. Electrical Systems:

1. Power Source and Internal Power Distribution:
 - a. Provide in the panel, near where incoming power is terminated, nameplate with panel power supply source, type, voltage, and circuit number.
 - b. Protect incoming 120 vac power feeds to power the panel by providing lightning and surge arrestors, properly connected to grounds.

- c. Provide panels with internal 120 vac power distribution system with properly-sized and -rated circuit breakers to distribute power. Power not more than six devices from a single breaker. When power supplies are included in the panel, not more than two power supplies shall be powered from a single breaker. Convenience receptacles and interior panel lights shall have their own breakers. When one or more field instruments require 120 vac power from the panel for instrument power, power not more than three instruments from a given breaker.
 - d. Provide space for a minimum of two spare breakers in each panel.
- 2. Provide complete wiring diagram of “as-built” circuitry enclosed in transparent plastic.
- 3. Electrical Systems:
 - a. Internal wiring shall be Type MTW and THW stranded copper wire with thermoplastic insulation rated for 600 volts at 85 degrees C for single conductors, color-coded and labeled with wire identification.
 - b. For DC signal wiring, use shielded cable with 18-gage conductors. DC field signal wiring terminal strips shall be capable of handling wires up and including No. 12 size.
 - c. For AC power wiring, use No. 12 minimum AWG. For AC signal and control wiring, use No. 16 minimum AWG. For wiring carrying more than 15 amps, use sizes required by the NEC (NFPA 70) .
 - d. Inside of panels, route DC signal wiring separately from power wiring with minimum separation distance of six inches.
 - e. Use covered panduits to route internal panel cables and wiring. Panduits in each section of panel shall be appropriately sized to accommodate the quantity of wires to be routed with a spare capacity of 40 percent.
 - f. Install wire troughs inside panels along horizontal or vertical routes to present a neat appearance. Angled runs are unacceptable.
 - g. Wiring that is routed without panduits shall be adequately supported and restrained to prevent sagging or other movement. Use of adhesive anchors to support or restrain wiring is unacceptable.
 - h. Terminate internal panel wiring using forked, insulated, crimp-on connectors; soldered connectors are unacceptable. Provide panels with 600-volt rated barrier type terminal strips mounted on Din rails. Identify terminal strips as indicated in this Section. Identification devices shall be self-stick, plastic tape strips with permanent, machine-printed numbers. .
 - i. Wiring in panels shall be installed such that, if wires are removed from any one device, power will not be disrupted to other devices.
 - j. Provide spare terminals equal in number to 20 percent of terminals used for each type of wiring (e.g., DC signal and AC power).
 - k. Provide ground terminals to terminate the shield wire of shielded cables. Termination of more than two shielded wires on a single ground terminal is unacceptable.

- l. Provide a single copper bus bar with 5/16-inch diameter copper grounding stud to connect the panel to external ground. Panel's internal grounds shall be terminated to the bus bar.
- m. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.
- n. When DC power or low voltage AC power is required, furnish and install in the panel required power supplies and transformers.
- o. Provide complete wiring diagram of "as-built" circuitry enclosed in transparent plastic.
- p. Terminal blocks for 4-20 mA DC signals shall be fused and knife disconnect type. Fused terminal blocks shall have LED blown fuse indication.

2.3 PANEL INSTRUMENTS AND PRIMARY SENSORS AND FIELD INSTRUMENTS

A. General:

1. Panel-mounted devices and instruments and primary sensors and field instruments shall be in accordance with instrument list
2. Do not fabricate, ship, or assemble instruments and devices in panels until require Shop Drawings and other submittals required for fabrication are approved or accepted as required.

B. Diaphragm Seal:

1. General:
 - a. Furnish diaphragm seals for pressure gauges and switches at locations shown and as specified.
 - b. The complete diaphragm seal assembly, including gage, switch or transmitter, shall be factory assembled, filled and calibrated to the ranges and switch setpoints specified prior to shipment.
 - c. System Supplier Manufacturer shall be responsible for assuring that fill volumes and sensitivities of the supplied seals and diaphragms are suitable to provide the required gage, switch or transmitter accuracy over the specified measurement range or at switch setpoints.
 - d. Location and orientation of the gauges, switches and seal assemblies shall be coordinated with the actual piping and equipment installations so that gages and indicators shall be easily read and accessed for maintenance by plant personnel.
 - e. Where field mounting and orientation conflicts arise due to incomplete coordination with field changes in the process piping and equipment installation, assemblies shall be relocated, re-oriented, re-assembled and re-calibrated as directed by the ENGINEER.
2. Construction Features:
 - a. Instrument Connection: 1/2-inch NPT.
 - b. Process Connection: 1/2-inch NPT.
 - c. Flushing Connection: 1/4-inch NPT.

- d. Top Housing Materials: Type 316 stainless steel.
- e. Process Side Housing Materials:
Type 316L stainless steel for metallic piping.
PVC or CPVC to match non-metallic piping.
- f. Bolting Materials: Type 316 stainless steel.
- g. Diaphragm, O-Rings, and Gasket Materials:

<u>Process Fluid</u>	<u>Diaphragm</u>	<u>O-Ring</u>	<u>Gasket</u>
Wastewater/Sludge	316 SS	Buna-N	Buna-S
Potassium Permanganate	Carpenter 20	Viton	Viton
Sodium Hypochlorite	Teflon	Teflon	Teflon
Polymer	316 SS	Buna-N	Buna-S
Alum	316 SS	Teflon	Teflon
Lime	316 SS	Teflon	Teflon
Sodium Hydroxide	Teflon	Teflon	Teflon
Hydrofluosilicic Acid	Hastelloy C	Viton	Viton

- h. Filling Liquid: See Article 1.8.
 - i. Working Pressure Rating: Equal to or greater than the attached gage or switch operating pressure specified in Exposed Piping Schedule in Section 40 05 05, Exposed Piping Installation, whichever is greater.
3. Accessories:
 - a. Provide fill/bleed screw to permit filling of instrument and diaphragm seal.
 - b. Provide a clean-out ring which holds the diaphragm captive in the upper housing to allow the upper housing assembly to be removed for recalibration or cleaning of the process side housing without the loss of filling liquid or change in calibration.
 4. Manufacturer and Model:
 - a. Ashcroft Type 1009/DG25
 - b. Wika 232.50
 - c. US Gauge M&G Type 1981
 - d. Or equal
- C. Flow Switch (Swinging Vane Type):
1. The flow indicating switch shall be swinging vane, field trimmable for installation into a suitable tee.
 2. Required Features
 - a. Material of Construction: Match surrounding piping for instrument body, with stainless steel vane.
 - b. Setpoint: As specified in the instrument schedule.
 - c. Operating Temperature: -4 degrees F to 220 degrees F.
 - d. Pressure Limits: 2000 psig
 - e. Enclosure Rating: Weatherproof and explosion proof, UL listed.
 - f. Switch Type: SPDT rated for 5A at 120VAC.

- g. Electrical Connection: 18" leads, 18 AWG.
- h. Conduit Connection: ¾" male NPT.
- i. Process Connection: ½" male NPT.
- 3. Manufacturers: Provide products of one of the following:
 - a. Johnson Controls F61 Series
 - b. WE Anderson Dwyer V6 FLOTECT
 - c. Or equal
- D. Magnetic Flow Tube and Transmitter
 - 1. Type: Flowtube with pulsed DC magnetic flow transmitter.
 - 2. Function:
 - a. Monitor and measure conductive liquid flows as specified.
 - b. Transmitter shall display flow and provide a 4-20 mA DC output proportional to flow.
 - 3. Performance Requirements:
 - a. Range: As specified in the instrument schedule.
 - b. Display: Large backlit LCD with configurable engineering units.
 - c. Accuracy: ±0.25% of rate (±0.15% optional), unaffected by fluid properties above minimum conductivity.
 - d. Repeatability: ±0.15% of rate or better.
 - e. Zero Stability: Automatic zero function.
 - f. Minimum Conductivity: 5 µS/cm or less.
 - g. Power: 100–240 VAC or 10–36 VDC.
 - h. Outputs: Isolated 4–20 mA and scalable pulse; optional digital (HART, Modbus, Profibus, Fieldbus).
 - i. Operating Temperature: 0 to 140°F (–20 to 60°C), depending on liner.
 - j. Pressure Rating: Up to ANSI Class 150/300, per piping.
 - 4. Construction Features:
 - a. Flowtube:
 - Lined stainless steel, 304L or 316L.
 - PTFE, polyurethane, Neoprene, or hard rubber lining.
 - Electrodes: 316L SS, Hastelloy C, Platinum, or Tantalum.
 - b. Enclosure:
 - Powder-coated aluminum alloy.
 - NEMA 4X/6, IP67/IP68.
 - ANSI Class 150/300 flanged or wafer ends.
 - c. Transmitter:
 - Die-cast aluminum, NEMA 4X/6, IP67/IP68.
 - Large LCD, totalizer, and isolated outputs.
 - 5. Accessories:
 - a. 316 SS mounting hardware, grounding rings/straps.
 - b. Shielded cable assemblies.
 - c. Remote or integral transmitter mounting.
 - d. Calibrator for all provided tubes.
 - 6. Manufacturers:
 - a. Siemens MAG 5100/5000

- b. KROHNE OPTIFLUX Series
 - c. Endress+Hauser Promag Series
 - d. ABB ProcessMaster
 - e. Yokogawa ADMAG Series
 - f. Or equal
- E. Rotameter
- 1. Type: High Flow Variable-area Flow meter:
 - a. Accuracy: $\pm$ Two percent of maximum flow.
 - b. Range: Ten to one.
 - c. Float: Conventional stainless steel.
 - d. Frame: Type 302 stainless steel.
 - e. Tube: Borosilicate glass.
 - f. End Fittings: PVC or Type 316 stainless steel.
 - g. Location: As shown.
 - h. Flow Range and Scale Size: As listed in the Instrument Index.
 - i. Service: Liquid or Gas Flows as listed in the Instrument Index.
 - 2. Manufacturers: Provide products of one of the following:
 - a. Wallace and Tiernan Varea meter.
 - b. Or equal.
- F. Level Transmitter – Radar Type
- 1. Type:
 - a. Microprocessor based, non-contacting, continuous liquid level measuring system consisting of radar sensor (transducer), remote transmitter, and interconnecting cable, producing an output signal linear with liquid level.
 - b. Radar Principle: FMCW (Frequency Modulated Continuous Wave) or pulse radar technology, as specified.
 - 2. Performance Requirements:
 - a. Accuracy: $\pm 0.1\%$ of measured range, with automatic temperature compensation.
 - b. Resolution: 0.1 percent of range or 1 mm, whichever is greater.
 - c. Range: As specified in the Instrument Schedule.
 - d. Damping: Adjustable damping rate through transmitter configuration.
 - e. Ambient Temperature:
 - Electronics: -4 degrees F to 140 degrees F.
 - Transducer: -40 degrees F to 176 degrees F.
 - f. Output: Two isolated 4 to 20 mADC into 0 to 750 ohms.
 - g. Relay Output: Three SPDT level alarm contacts rated 5A at 250 VAC, with LED indication of relay status.
 - h. Power: 120 VAC, 60 Hz.
 - i. Signal Filter: Electronic filter to smooth the small variations in the level signal due to surface waves or minor disturbance.
 - 3. Construction Features:
 - a. Transmitter:

Microprocessor based circuitry control.

Keypad for system programming and configuration. Programming and configuration values shall be stored in EEPROM memory that does not require battery back-up.

NEMA 4X (IP66) polycarbonate or aluminum enclosure. Provide Type 316 stainless steel mounting hardware as required.

Display: Multi-field backlit LCD, minimum 100 mm x 40 mm, showing level, signal strength, diagnostics, and relay status.

Units of Measure: Feet, or as specified in the Instrument Schedule.

Front panel indication of loss of echo.

Adjustable blanking distance to ignore false reflections from tank internals.

b. Radar Sensor (Transducer):

PVDF, stainless steel, or PEEK housing, as required for chemical compatibility.

Integral temperature sensor for temperature compensation.

Beam angle suitable for application: Narrow beam ($\leq 4^\circ$) for tall tanks, wider beam for open sumps

Provide flange or threaded mounting as shown in the Electrical Drawings.

Provide flange mounting or threaded pipe mounting as shown.

Provide coaxial communication cable from transducer to the remote transmitter; length as required.

4. Accessories:

a. NEMA 4X rated 120 VAC power on-off selector switch

5. Manufacturer and Model:

a. VEGA, Model C22

b. Or equal

G. Level Switch – Float Type

1. Type: Direct acting, pear shaped, eccentric weighted, displacement type liquid level sensor.

2. Construction Features:

a. Float Body: Hollow hermetically sealed, rigidly molded of polypropylene containing mechanical switch and eccentric metal weight.

b. Mechanical Switch: SPDT switch rated 16 amps resistive at 120 VAC and five amps resistive at 30 VDC.

c. Weight: Weight to cause sensor to hang straight down from cable when not immersed and only allow float to pivot when immersed in liquid.

d. Electrical Cable:

Heavy duty, three conductor, flexible and submersible cable, sheathed in PVC and connected to float and switch with watertight seal.

Length furnished to be sufficient to extend to junction box.

3. Manufacturer

a. Flygt, Model ENM-10

- b. Or equal

H. Pressure Gauge – Bourdon Tube

1. Type : Bourdon Tube Pressure Element Type, Liquid Filled Gauge (for pressure ranges of 15 psi and greater and vacuum ranges to 30-inches Hg)
2. Performance Requirements:
 - a. Range: As specified in the Instrument Schedule.
 - b. Accuracy: ± 0.5 percent of span (ANSI B40.1 Grade 2A).
3. Construction Features:
 - a. Case:
Solid front design constructed of glass filled polyester
Color: Black
 - b. Size: 4 ½"
 - c. Ring: Threaded, glass filled polyester
 - d. Window: Glass
 - e. Dial: White with black markings
 - f. Filling Liquid
 - g. Overpressure protection: Full blowout back
 - h. Bourdon Tube and Socket:
Type 316 stainless steel
Heliarc welded, unless otherwise specified.
 - i. Movement:
Type 300 series stainless steel.
Rotary geared with Teflon S coating, or cam and roller type
Built-in overload and underload movement stops
 - j. Connection: ½" male NPT, bottom
 - k. Mounting: Stem Mount
 - l. Calibration:
Adjustable pointer
Externally accessible zero adjustment
4. Accessories:
 - a. Pressure Snubber: Sintered stainless steel snubber threaded into gauge socket or in external stainless steel housing with 1/2-inch NPT male and female connections.
 - b. Process Isolation: Provide ball valves for process isolation.
5. Manufacturer:
 - a. Ashcroft, Duragage 1279 Series
 - b. US Gauge Solfrunt Model 1981 Advantage
 - c. Wika XSEL Process Gauge
 - d. Or equal

I. Weight Scale

1. Type: Platform or tank-mounted weight scale designed for continuous monitoring of chemical day tank contents by weight.
2. Function:

- a. Accurately monitor and display the weight of chemicals in day tanks at the water treatment plant (WTP).
 - b. Provide a local digital indicator and remote analog/digital output proportional to tank contents for integration with plant control systems.
3. Performance Requirements:
 - a. Capacity: As specified in the instrument schedule (typically 500 – 10,000 lbs).
 - b. Accuracy: $\pm 0.1\%$ of full scale or better.
 - c. Repeatability: $\pm 0.05\%$ of full scale.
 - d. Display: Local LCD or LED digital indicator, readable in both lb and kg.
 - e. Output: 4–20 mA analog output, field scalable; optional digital output (Modbus, Ethernet, etc.).
 - f. Power: 120 VAC, 60 Hz or 24 VDC as specified.
 - g. Environmental: NEMA 4X or IP65 enclosure, suitable for corrosive chemical environments.
 - h. Operating Temperature: 0° to 120°F (-18° to 49°C).
4. Construction Features
 - a. Platform/Frame:
Corrosion-resistant stainless steel, powder-coated steel, or fiberglass as appropriate to chemical.
 - b. Load Cells:
Hermetically sealed, stainless steel; minimum IP67 rating.
 - c. Cable:
Shielded, chemical-resistant cable assemblies; factory provided.
 - d. Mounting Hardware:
Type 316 stainless steel or equivalent corrosion-resistant materials.
 - e. Indicator:
Wall or panel mount with easy-to-read display.
Calibration and zeroing via keypad or digital interface.
 - f. Accessories:
All necessary grounding straps, mounting brackets, and hardware.
Junction box, if required, NEMA 4X.
5. Manufacturers:
 - a. Force Flow CHEM-SCALE or Indicator Series
 - b. Scaletron Model 4042, 4020, or 1020
 - c. Or equal

2.4 IDENTIFICATION

A. Input/Output List Identification

1. I/O point list contains information required to configure PLC I/O interface hardware, and to indicate range conversion or signal functions.
2. “POINT NUMBER” is an alphanumeric character string. For example, for the point “MP-FI-806-0123” the following apply:

- a. The first two characters (MP) refer to the specific plant area (MP = Main Pump, for example).
 - b. The third character is the functional identifier and conforms with ANSI/ISA S5.1. In the example, “F” represents flow.
 - c. The fourth (and sometimes fourth and fifth) alphabetical character (I) is the function identifier. In the example, the “I” represent indication input.
 - d. The first three-digit number (806) identifies the P&ID number.
 - e. The next four-digit number (0123) identifies the loop or field device.
 - f. Suffix, where required, is used for distinguishing between similar variables.
3. “DESCRIPTION” is an alphanumeric character string up to 40 characters in length. Points described as “SPARE” indicate pre-wired I/O.
 4. “SIGNAL TYPE” is one of the following:
 - a. AI indicates analog input.
 - b. DI indicates discrete input.
 - d. AO indicates analog output.
 - e. DO indicates momentary, maintained or latched discrete output.

C. ISA Identification

1. A = Miscellaneous Analytical.
2. B = Burner, Combustion.
3. C = Chlorine Residual/Gas.
4. D = Density.
5. E = Voltage.
6. F = Flow.
7. G = Intrusion.
8. H = Hand.
9. I = Current.
10. J = Power.
11. K = Time.
12. L = Level.
13. M = Motor.
14. N = pH.
15. O = Oxygen.
16. P = Pressure.
17. Q = Quantity.
18. R = Radioactivity.
19. S = Speed, Frequency.
20. T = Temperature.

21. U = Common.
22. V = Vibration.
23. W = Torque (Weight or Force).
24. X = Hazardous Gas.
25. Y = Event, State or Presence (Switch Position).
26. Z = Position, Dimension.

D. Function Identifier:

1. A = Available / In Auto (input)
2. B = Backward Rotation (input)
3. C = Full Closed (input)
4. D = Full Open (input)
5. E = Close/Energize (output)
6. H = High (input)
7. I = Input (Analog)
8. L = Low (input)
9. N = Open (output) or Control Mode (input)
10. O = Output (Analog)
11. R = Running (input)
12. S = Start (output)
13. T = Stop (output)
14. U = Malfunction or Alarm (input)
15. V = Slow (output)
16. W = Slow (input)
17. X = Selector Switch (input)

2.5 PROCESS CONTROL DESCRIPTIONS

A. Control System Description:

1. The control system shall consist of HMIs, OITs, and PLCs. The Controllers shall be configured and programmed to control all systems either manually or automatically, based on monitored data, commands and set points entered by operators at the HMIs. For maintenance mode only, control of equipment shall be possible from local control stations or control panels located at or near the equipment.
2. The control strategies are written descriptions of process control for the unit processes and mechanical or electrical equipment controls required for safe operation. Control strategies shall reside in the memory of the designated processor.

B. Local Control Mode:

1. All equipment shall have local manual control capabilities at or near the equipment. Equipment that can also be controlled remotely by the PLC shall have a HAND/OFF/AUTO selector switch at that piece of equipment to select control location. If the selector switch is in the HAND position, the local manual control shall be enabled, and the remote control and PLC control will be disabled.

C. Remote Control Mode:

1. When the HAND/OFF/AUTO selector switch for the equipment that can be controlled remotely is in the AUTO position, the remote control and PLC control shall be enabled, and the local manual control shall be disabled.
2. In some cases, there are multiple levels of control. In the case of a VFD driven pump, for example, local control is provided by a Local Control Station (LCS) or Local Control Panel (LCP) at or near the piece of equipment. However, the VFD is also capable of operating the equipment. The OITs and HMIs, together, form the remote control.
 - a. When the HAND/OFF/AUTO switch on the LCS is in HAND, the equipment shall be controlled via START and STOP pushbuttons on the LCS. A VFD can also take over control by flipping the LOCAL/REMOTE switch on it to LOCAL.
 - b. . When the HAND/OFF/AUTO switch on the LCS is in the AUTO mode, the PLC shall be allowed to control the equipment based on control values entered by the operator. The PLC shall control the equipment in either an HMI Manual or a PLC Auto mode of operation, as selected by the operator at the HMI.
 - 1) HMI Manual Control: The HMI Manual mode of control requires operator action at the HMI to change the operating status of the piece of equipment.
 - 2) PLC Auto Control: PLC Auto control allows the PLC to control the equipment based on operator-entered set points and measured values.
 - 3) Out of Service: In this mode, selected at the HMI, the equipment is considered unavailable by the control system. Indicate at the HMI equipment that is out of service and manage alarms accordingly.
3. Control Modes:
 - c. Remote Manual control: It shall be possible for the Operator to interrupt any sequence, loop, or automatic operation and operate the same manually through the HMI or OIT
 - d. Output Verification: This control function shall verify that the equipment has responded to the digital commands before proceeding to the next step during automatic operation. If any discrepancy is detected, an alarm shall be annunciated.

- e. System Initialization Routine: Each processor shall have an initialization routine to initialize all system variables.

D. Protective Interlocks:

- 1. Equipment protective, hardwired interlocks shall remain in effect in all control modes.

E. Control System Configuration:

- 1. The PLC and HMIs shall be located as shown on the and building layout drawings.
- 2. 2. At each HMI, graphic displays shall provide detailed, user-friendly information on all equipment, and shall allow the operator to initiate process changes or respond to alarm conditions as shown on the drawings with this description.
- 3. 3. The information contained within each PLC connected to the network shall be fully available on the control system network for viewing on the HMIs within the control rooms. The monitoring and control functions shown on the drawings represent the minimum required information to be programmed into the HMI screens.
- 4. 4. Each PLC shall be programmed to be a standalone unit that will control the equipment connected to it, even if the communication between the PLC and the HMI is severed. In this case, the PLC shall use the previously entered set points to control the equipment. The specified requirements within this section are for the modifications to the program for the new requirements.
- 5. 5. All set points, tuning parameters and engineering scales shall be documented for each control point and each control strategy on configuration sheets or similar documentation. These configuration sheets with initial data shall be submitted for review, shall be updated before the factory test and available at the factory test, and shall be updated during startup and commissioning. The record documents shall be submitted showing the final version of the configuration sheets.

F. Process Control Functions:

- 1. Process control function shall be structured to permit the realization of all control strategy requirements. In addition, each control function shall be designed so that non-disruptive (bumpless and balance free) transfers are obtained during operating mode changeover and initialization. Where applicable, user changeable parameters shall be automatically defaulted to a preset value if a specific value is not given during system operation.
- 2. The P&IDs represent the required process monitoring and control. The required control for the system is a combination of the representation on the P&IDs and the requirements specified herein. The P&IDs do not show all the required internal diagnostic indications for the systems. In addition to the

indications shown on the P&IDs, the following, at a minimum shall be provided, including internal diagnostic functions, indications, analog signal conversions and discrete signal verifications:

- a. Indication of bad quality on any hard-wired input/output point (such as zero milliamps on a 4 to 20 mA DC circuit). Bad quality points shall be excluded from average calculations.
- b. Individual PLC fault indications. (Controller Fault)
- c. Indication of a communications failure. With the high quantity of Ethernet-connected devices, provide heartbeats and watchdog timers to detect loss of communications to MCCs, VFDs, and other devices.
- d. Cumulative runtime indicators shall be provided for all equipment.
- e. Adjustable startup and shutdown delay timers shall be provided to allow normal startup and shutdown of equipment without alarms or bypassing of hardware safety interlocks.
- f. Controller fault- individual controller fault indication.
- g. Network communication failure- Indication of communication failure at each process network node or processor.
- h. Track and hold- for analog control loops, when control of field equipment is not in "remote mode" the associated PID controller output shall track the position feedback.
- i. Analog alarms: for all analog signals, provide the following alarm indications. These settings shall be adjustable based on security login.
 - 1) High-high
 - 2) High
 - 3) Low
 - 4) Low-low
 - 5) High rate of change, low rate of change.
- j. Follow the ISA 18.2 standard for the definition of and basis for alarms.
3. If any equipment faults or shuts down through an interlock, the cause of the alarm/shutdown must be corrected and the alarm must be acknowledged in the HMI prior to restart.
4. All equipment shall be controlled independently of each other when operated in manual unless otherwise indicated.
5. When equipment is operated in HMI Manual Mode, the HMI shall prompt the operator for their input and provide warning to the operator with messages displayed on the screen. These messages shall be to assist in the proper sequencing of equipment startup.
6. Each control function shall be implemented using the programmable hardware in the designated processor. No functions shall be developed using hardwired relay logic.
7. The following shall be provided in addition to the indications above.
 - a. ANALOG DATA SCALING: This control function shall scale all analog inputs to a common span and shall normalize the digital representation of each analog input to a percent of the operating span. The processed value shall be expressed as a binary number that specifies the analog

input's position on a straight line lying between zero and full scale as defined for a given input by the zero and span values in the data base.

- b. **AMPLITUDE LIMIT CHECK:** This control function shall perform dual level, high/low amplitude limit checking and shall identify a limit violation every time a measured or virtual variable goes out-of-limits and returns back into limits. The control function shall determine the time at which each limit excursion occurred. A dead band shall be provided on each limit and shall be expressed as a percentage of span or in engineering units. Low and high limiting default values shall be set-up for each measured or calculated variables used in the process control loops.
- c. **ENGINEERING UNIT CONVERSION:** This control function shall convert scaled analog data to engineering units by means of the following equation:

$$Y = (H - L) (D/DH) + L$$

where:

Y = value in engineering units

H = high value of span, expressed in engineering units

L = low value of span, expressed in engineering units

D = digitized scaled input value in counts

DH = full scale digitized value in counts

- 8. All equipment shall be controlled independently of each other when operated in manual unless otherwise indicated.
- G. **Hardware:** CONTRACTOR shall provide all the hardware, as shown, specified, or required to implement the control strategies as described.
- H. **Configuration:** All set points, tuning parameters, and engineering scales shall be documented for each control point and each control strategy on configuration sheets or similar documents. These documents shall be updated during Factory Testing and finally during start-up.
- I. **Control Strategy Displays:** Control strategy displays shall be submitted for review. Displays shall clearly show initial conditions, start, and progression of the control strategies. Each control strategy shall be displayed in a minimum number of displays for ease of monitoring by the Operator.
- J. **Plant Power Failure:** Plant equipment controlled by the control system shall be programmed to automatically reset upon failure. The reset and restart sequence shall be enabled through the PCS. When power is restored select process equipment as approved by the ENGINEER shall be permitted to restart.

- K. Restart: Equipment and motors that can safely be restarted shall be automatically restarted after power failure by the control system in an orderly time delayed sequence approved by the ENGINEER. Equipment that requires Operator intervention shall be prompted for restart following power restoration.
- L. All relays, tuning parameters, scales, configuration values, mathematical constants, equations, and set points given in the control strategies are adjustable over a wide range. The values given are initial and may change during Shop Drawing review and may have to be readjusted during start-up.

2.6 HYDROFLUOROSILICIC ACID SYSTEM (I-05)

A. General:

1. The hydrofluorosilicic acid (fluoride) system includes 2 tanks, a bulk tank and a day tank, two transfer pumps, and two metering pumps.
2. The fluoride feeds the filter effluent.
3. The day tank is equipped with a scale with a weigh transmitter, for local and remote monitoring of the tank.
4. Metering pumps shall have integral drives with keypads to controls.

B. Local Controls:

1. The storage tank shall be filled manually by the operator manually opening the fill station valve of the tank. The level shall be monitored at the local fill panel and verified by a level gauge on the storage tank. High Level alarm shall be indicated by an indicating light on the Fill Panel and by an audible alarm; the alarm shall be silenced by depressing the Acknowledge pushbutton. High-High level alarm shall be indicated by a High-High Level indicating light, audible alarm, and strobe. The audible alarm shall be silenced by the Acknowledge push button, but the strobe shall remain active until tank level is below the High-High level setting.
2. The transfer pump shall be operated from START and STOP pushbuttons on the transfer pump local control panel or the remote pushbuttons to fill the day tank. There shall be no remote control of the transfer pump. Permissive interlocks in the transfer pump local control panel shall stop the transfer pump on High level (High Weight) in the day tank.
3. The metering pumps shall be started and stopped via controls on the metering pump. The metering pump feed rates shall be controlled from the metering pump when the metering pump HAND/OFF/AUTO selector switch is in the HAND position.

C. Remote Control:

1. The fluoride storage tanks and feed system shall be monitored from SCADA
2. When the metering pumps HAND/OFF/AUTO selector switch is in the AUTO position, the metering pumps shall be controlled from SCADA via the HMI. HMI Manual or PLC Auto Modes shall be selectable at the HMI.
3. SCADA shall adjust the feed rate in either HMI Manual mode or PLC

Automatic mode. The SCADA output signal to the metering pump (feed rate in gallons per hour) shall be scaled from zero to the maximum capacity setpoint entered by the operator from the HMI.

4. In HMI Manual mode, the operator shall enter the desired feed rate in gallons per hour (adjustable range 0 to maximum capacity setpoint) and SCADA shall control the metering pumps accordingly.
5. In PLC Auto mode, SCADA shall calculate the feed rate based on an operator entered dosage setpoint, concentration setpoint, and the combined filter effluent flow (based on filters in service), according to the following formula:

$$FR = (FWF \times DOS \times K) / (CONC \times SG \times 24)$$

where:

FR = feed rate (gal/hr)

FWF = filtered water flow (MGD)

DOS = dosage setpoint (mg/L F-)

CONC = concentration setpoint (%)

SG = specific gravity

K = ratio of molecular weight of Hydrofluosilicic acid (H_2SiF_6) and fluoride (6F) = 144/114

D. Monitoring:

1. See I-05 and I/O list for Hydrofluosilicic Acid Storage and Feed System I/O points that shall appear on SCADA

2.7 SODIUM HYPOCHLORITE STORAGE AND FEED SYSTEM (I-06 & I-07)

A. General:

1. The Sodium Hypochlorite system includes 3 tanks, two bulk storage tanks and a day tank, two transfer pump, and three metering pumps.
2. The Sodium Hypochlorite system feeds the pre-filter and post treatment disinfection.
3. The day tank is equipped with a scale with a weigh transmitter, for local and remote monitoring of the tank.
4. Metering pumps shall have integral drives with keypad to controls.

A. Local Control:

1. The storage tanks shall be filled and diluted simultaneously, including opening and closing of valves at the fill station control panel with assistance from SCADA.
2. The fill station control panel shall be provided to monitor storage tanks levels and temperature, control the fill and dilution process, and operate the transfer pumps.
3. The dilution process shall be automated with no manual dilution sequence available. Only specified processes shall be available on the fill station control panel to assist with automation of the process.

4. Local controls for manual operations of the transfer pumps will be available utilizing the designated HAND/OFF/AUTO selector switch.
5. Softened water shall be used to dilute sodium hypochlorite. The dilution process shall be manually activated at the fill station control panel as follows:
 - a. At the OIT located on the control panel, the operator shall have the capability to make predetermined selections.
 - b. To facilitate the filling and dilution process, the operator shall select which tank will be the active tank by selecting either TANK 1 or TANK 2.
 - c. Operator shall input the volume within a range of 2000 to 5000 gallons into the OIT via an onscreen keyboard. Entry should remain visible on screen throughout the process.
6. Following the entry of the delivery volume SCADA shall utilize the volume and tank level to determine the softened water quantity as follows:
 - a. SCADA shall utilize the level sensor to determine the maximum tank level and the current tank level in conjunction with the operator input volume to determine the available capacity of the selected tank to calculate the required volume of softened water. Based upon this calculation, SCADA shall display a Fill Availability status message:

“Tank Not Ready to Fill”

Or

“Tank Ready to Fill”

- b. SCADA shall determine the storage tank fill availability based upon the following equation:

$$V = X \times SG \times ((A-B)/B)$$

where:

V = Volume of softened water to be added (gal)

X = Volume of delivered sodium hypochlorite (gal)

SG = Specific Gravity of delivered sodium hypochlorite, operator enterable (1.1 to 1.2)

A = Weight % of delivered sodium hypochlorite, operator enterable (11% to 13%)

B = Weight % of diluted sodium hypochlorite, (8%)

- c. A status message of “Tank Not Ready to Fill” is referenced when the existing tank capacity is not adequate for the expected delivery. The operator shall manually operate the valves required to transfer chemicals between tanks.
- d. A status message of “Tank Ready to Fill” is referenced when there is available tank capacity in the selected tank.
- e. Upon the status message being received, the Operator will select “Start Mixing”
- f. Before the filling and mixing process begins, the non-selected tank fill valve will CLOSE, and the fill line, softened water line, and the selected

tank valves will all OPEN with all four valve position status being received at SCADA to begin the process.

- g. Upon completion of the delivery, all valves shall CLOSE
- 7. The transfer pump shall be operated from START and STOP pushbuttons on the transfer pump local control panel or the remote pushbuttons to fill the day tank. There shall be no remote control of the transfer pump. Permissive interlocks in the transfer pump local control panel shall stop the transfer pump on High level (High Weight) in the day tank.
- 8. The metering pumps shall be started and stopped via controls on the metering pump. The metering pump feed rates shall be controlled from the metering pump when the metering pump HAND/OFF/AUTO selector switch is in the HAND position.

C. Remote Control:

- 1. The metering pumps shall be monitored from SCADA. The metering pumps shall be started and stopped via controls on the HMI when the metering pump HAND/OFF/AUTO selector switch(s) is in the AUTO position. The SCADA system shall adjust the feed rate in either HMI Manual mode or PLC Automatic mode, as selected from the HMI. The SCADA system output signal to the metering pump (feed rate in gallons per hour) shall be scaled from zero to the maximum capacity setpoint entered by the operator from the HMI. Separate manual and automatic control functions shall be provided for each metering pump feeding a different application point.
- 2. In HMI Manual mode, the operator shall enter the desired feed rate in gallons per hour (adjustable range 0 to maximum capacity setpoint) and SCADA shall control the metering pumps accordingly.
- 3. In PLC Auto mode, SCADA shall calculate the feed rate based on an operator entered dosage setpoint, concentration setpoint, and the filtered effluent flow (based on filters in service), according to the following formula:

$$FR = (F \times DOS \times 8.34 \text{ lb L/mg MG}) / (C \times 24 \text{ hr/day})$$

where:

FR = feed rate (gal/hr)

F = flow to injection point (MGD)

DOS = dosage setpoint (mg/L as Cl₂)

C = 0.52 lb Cl₂/gal NaOCl for 6% Sodium Hypochlorite

For Filter Influent Injection, F = RWF (Raw Water Flow)

For Filter Effluent Injection, F = FWF (Filtered Water Flow)

D. Monitoring:

- 1. See I-06 and I-07 for Sodium Hypochlorite Storage and Feed System I/O points that shall appear on SCADA.

2.6 SOURCE QUALITY CONTROL

A. Factory Inspection:

1. Inspect each panel, console, device, and cabinet before testing and before shipping. Inspection shall include, but not be limited to the following:
 - a. Verify all “Approved as Corrected” comments on Shop Drawings were implemented.
 - b. Verify presence of and accuracy of nameplates and tags.
 - c. Verify that wire sizes and color-coding comply with the Contract Documents.
 - d. Verify presence of terminal blocks, terminal block numbers, and required quantity of spares.
 - e. Verify annunciator window engravings and quantity of spare windows comply with the Contract Documents.
 - f. Verify proper wiring practices and grounding.
 - g. Verify enclosure flatness, finish, and color.
 - h. Verify anchoring of wire bundles between subpanels and front panel-mounted devices.
 - i. Verify presence of applicable items specified in this Section.
 - j. Check and verify software licenses for latest release and license types.

B. Panel Operational Testing:

1. Test all input/output components to verify that internal panel wiring is properly terminated at correct locations. Verify initial ranges and settings.
2. Test all system hardware and software to verify proper operation as stand-alone units. Test shall include, but not be limited to, the following:
 - a. Power distribution and breaker ratings to match approved Shop Drawings.
 - b. Power fail/restart tests.
 - c. Diagnostics checks.
 - d. Demonstrate that all specified equipment functional capabilities are working properly.
 - e. Check and verify process displays are in accordance with approved Shop Drawings.
3. Test components and devices requiring data transmission to verify that communication between such components is working properly. Verify communication by using the same media required for the completed system at the Site as indicated in the Contract Documents.
4. Perform integrated system test with all system equipment and simulated inputs/outputs connected to verify that equipment is performing properly as an integrated system.

5. Simulation devices shall be of suitable quality to not mask control panel defects.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Environmental Requirements:
 1. Do not install instruments in areas where construction may cause instrument to be damaged, without providing adequate protection for said instrument.
- B. Installation of Instrumentation:
 1. Secure field-mounted instruments to stands or brackets in accordance with manufacturer's recommendations, approved or accepted (as applicable) submittals, and the Contract Documents.
 2. Locate sensors where shown on the Drawings. Confirm exact locations in the field with Engineer.
 3. Install all devices so that devices are readily accessible for service and do not cause potential hazards.
- C. Installation of Fiber Optic Cable
 1. Provide continuous inter- and intra-building installation, closet to closet, suitable for passing through inside conduit locations directly from outside conduit. Exempt from NFPS 70 (NEC) Article 770-50 (50-foot rule).
 2. Fiber optic cable installation shall include the following:
 - a. Do not exceed cable minimum bend radius. Tight loops, kinks, knots, and tight bends during and after installation are unacceptable.
 - b. Pull cables using an indirect attachment method such as Kellems Grip to distribute the pulling forces over cable's outer portion. Pulls directly on fiber core are not allowed.
 - c. Provide handholds and pull boxes as required by cable manufacturer. At minimum, provide handholds or pull boxes minimum of every two hundred feet, and at every third 90-degree conduit bend.
 - d. Upon receipt of the fiber optic cable reels, test each fiber separately with optical time domain reflectometer (OTDR) to verify fiber length, attenuation and continuity. Maximum total loss including connectors and cable attenuation for each fiber optic link shall not exceed 7.5 dB.

- D. Services and Operator Instructions:

1. Provide repairs or replacement of defective materials, equipment or workmanship, including with respect to equipment, the services of factory-trained servicemen.
2. In addition to the calibration required for check-out, provide two additional calibrations on all instruments. The first re-calibration shall be approximately six months after acceptance of the system, and the second shall be approximately eleven months after acceptance. As part of each calibration, provide two copies of the calibration sheets, a detailed list of deficiencies (should any be found), and a statement that the entire system is in proper operation and condition (except for the deficiencies noted) and shall be turned over to the Owner.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. System Check-Out and Start-Up Responsibilities:
 - a. CONTRACTOR shall perform check-out and start-up of all system components.
 - b. Check and approve the installation of all instrumentation and control system components and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation.
 - c. CONTRACTOR shall provide all test equipment necessary to perform the testing during system checkout and start-up.
 - d. CONTRACTOR shall furnish ENGINEER an Installation Inspection Report certifying that all equipment has been installed correctly and is operating properly. The report shall be signed by an authorized representative of the CONTRACTOR.

B. Loop Status Reports: Each loop shall have a Loop Status Report to organize and track its inspection, adjustment, and calibration. These reports shall include the following information and check-off items with spaces for sign-off by the CONTRACTOR and OWNER:

1. Project Name, Test Date, name of the person whom the CONTRACTOR authorized to conduct the test and CONTRACTORs Name.
2. Loop Number.
3. Tag Number for each component.
4. Check-offs/sign-offs for each component: Tag/identification; installation; termination (wiring and tubing); scale, range, and setpoint as applicable; and calibration/adjustment (four-point for analog, set point for switches) rising and falling.

5. Check-offs/sign-offs for the loop: Panel interface terminations; I/O interface terminations; I/O signal operation; inputs/outputs operational (received/sent, processed, adjusted); total loop operation; process controller scaling and adjustment; and space for comments.
- C. Loop Checks:
1. CONTRACTOR shall test all I/O from the field device to the PLC terminals and verify that the PLC has received the signal.
 2. Loop checks shall be documented using OWNER-approved Input/Output Status Sign-Off forms.
- D. Functional Test:
1. CONTRACTOR shall demonstrate operation of each device and the connection to the PLC and SCADA System. Test operation of pumps, valves, and instruments locally, at RTU, and remotely using FCWS SCADA system.
- 3.4 SUPPLEMENTS
- A. The supplements listed below, following the “End of Section” designation, are part of this Specification section.
- D. Instrument Index
- E. Input/Output List

END OF SECTION

NO.	I/O TAG	DESCRIPTION	SIGNAL TYPE	INPUT FROM	OUTPUT TO	CONTROL PANEL	DRAWING REFERENCE
1	LAH-6201	SUMP HIGH LEVEL	DI	SUMP LEVEL SWITCH	CBSP	CBSP	I-06
2	LIT-6201	FLOURIDE BULK TANK LEVEL	AI	FLOURIDE LEVEL SENSOR	CBSP	CBSP	I-06
3	ZIL-6201	62-TP-01 PUMP IN REMOTE	DI	CP-HPA	CBSP	CBSP	I-06
4	HS-6201	62-TP-01 PUMP START/STOP	DO	CBSP	CP-HPA	CBSP	I-06
5	YIL-6201	62-TP-01 PUMP RUNNING	DI	CP-HPA	CBSP	CBSP	I-06
6	UA-6201	62-TP-01 PUMP FAULT	DI	CP-HPA	CBSP	CBSP	I-06
7	YA-6201	62-TP-01 PUMP E-STOP	DI	CP-HPA	CBSP	CBSP	I-06
8	ZIL-6202	62-TP-02 PUMP IN REMOTE	DI	CP-HPA	CBSP	CBSP	I-06
9	HS-6202	62-TP-02 PUMP START/STOP	DO	CBSP	CP-HPA	CBSP	I-06
10	YIL-6202	62-TP-02 PUMP RUNNING	DI	CP-HPA	CBSP	CBSP	I-06
11	UA-6202	62-TP-02 PUMP FAULT	DI	CP-HPA	CBSP	CBSP	I-06
12	YA-6202	62-TP-02 PUMP E-STOP	DI	CP-HPA	CBSP	CBSP	I-06
13	SC-6201	62-MP-01 PUMP SPEED CONTROL	AO	CBSP	METERING PUMP NO.1	CBSP	I-06
14	SI-6201	62-MP-01 SPEED FEEDBACK	AI	METERING PUMP NO.1	CBSP	CBSP	I-06
15	HS-6201	62-MP-01 START/STOP	DO	CBSP	METERING PUMP NO.1	CBSP	I-06
16	YIB-6201	62-MP-01 IN AUTO	DI	METERING PUMP NO.1	CBSP	CBSP	I-06
17	YIR-6201	62-MP-01 RUNNING	DI	METERING PUMP NO.1	CBSP	CBSP	I-06
18	UA-6201	62-MP-01 FAULT	DI	METERING PUMP NO.1	CBSP	CBSP	I-06
19	SC-6202	62-MP-02 PUMP SPEED CONTROL	AO	CBSP	METERING PUMP NO.2	CBSP	I-06
20	SI-6202	62-MP-02 SPEED FEEDBACK	AI	METERING PUMP NO.2	CBSP	CBSP	I-06
21	HS-6202	62-MP-02 START/STOP	DO	CBSP	METERING PUMP NO.2	CBSP	I-06
22	YIB-6202	62-MP-02 IN AUTO	DI	METERING PUMP NO.2	CBSP	CBSP	I-06
23	YIR-6202	62-MP-02 RUNNING	DI	METERING PUMP NO.2	CBSP	CBSP	I-06
24	UA-6202	62-MP-02 FAULT	DI	METERING PUMP NO.2	CBSP	CBSP	I-06
25	ZIO-6201	SOLENOID VALVE GV-6201 OPEN	DI	GV-6201	CBSP	CBSP	I-06
26	ZIC-6201	SOLENOID VALVE GV-6201 CLOSE	DI	GV-6201	CBSP	CBSP	I-06
27	HS-6201	SOLENOID VALVE GV-6201 OPEN/CLOSE	DO	CBSP	GV-6201	CBSP	I-06
28	FIT-6301	SOFTENED WATER SYSTEM FLOW	AI	FIT-6301	CBSP	CBSP	I-06
29	ZIL-6201	SOLENOID VALVE GV-6201 IN REMOTE	DI	GV-6201	CBSP	CBSP	I-06
30	ZIO-6301	SOFTENED WATER VALVE BV-6301 OPENED	DI	BV-6301	CBSP	CBSP	I-07
31	ZIC-6301	SOFTENED WATER VALVE BV-6301 CLOSED	DI	BV-6301	CBSP	CBSP	I-07
32	HS-6301A	SOFTENED WATER VALVE BV-6301 OPEN	DO	CBSP	BV-6301	CBSP	I-07
33	HS-6301B	SOFTENED WATER VALVE BV-6301 CLOSE	DO	CBSP	BV-6301	CBSP	I-07
34	ZIO-6302	FILL STATION VALVE BV-6302 OPENED	DI	BV-6302	CBSP	CBSP	I-07
35	ZIC-6302	FILL STATION VALVE BV-6302 CLOSED	DI	BV-6302	CBSP	CBSP	I-07
36	HS-6302A	FILL STATION VALVE BV-6302 OPEN	DO	CBSP	BV-6302	CBSP	I-07
37	HS-6302B	FILL STATION VALVE BV-6302 CLOSE	DO	CBSP	BV-6302	CBSP	I-07
38	ZIO-6303	BULK TANK NO. 1 VALVE BV-6303 OPENED	DI	BV-6303	CBSP	CBSP	I-07
39	ZIC-6303	BULK TANK NO. 1 VALVE BV-6303 CLOSED	DI	BV-6303	CBSP	CBSP	I-07
40	HS-6303A	BULK TANK NO. 1 VALVE BV-6303 OPEN	DO	CBSP	BV-6303	CBSP	I-07
41	HS-6303B	BULK TANK NO. 1 VALVE BV-6303 CLOSE	DO	CBSP	BV-6303	CBSP	I-07
42	ZIO-6304	BULK TANK NO. 2 VALVE BV-6304 OPENED	DI	BV-6304	CBSP	CBSP	I-07
43	ZIC-6304	BULK TANK NO. 2 VALVE BV-6304 CLOSED	DI	BV-6304	CBSP	CBSP	I-07
44	HS-6304A	BULK TANK NO. 2 VALVE BV-6304 OPEN	DO	CBSP	BV-6304	CBSP	I-07
45	HS-6304B	BULK TANK NO. 2 VALVE BV-6304 CLOSE	DO	CBSP	BV-6304	CBSP	I-07
46	LIT-6301	SODIUM HYPOCHLORITE BULK TANK NO.1 LEVEL	AI	SODIUM HYPOCHLORITE LEVEL SENSOR	CP-SHC	CBSP	I-07
47	TIT-6301	SODIUM HYPOCHLORITE BULK TANK NO.1 TEMPE	AI	SODIUM HYPOCHLORITE TEMPERATURE SENS	CP-SHC	CBSP	I-07
48	ZIL-6301	63-TP-01 PUMP IN REMOTE	DI	CP-SHC	CP-SHC	CBSP	I-07
49	HS-6301	63-TP-01 PUMP START/STOP	DO	CBSP	CP-SHC	CBSP	I-07
50	YIL-6301	63-TP-01 PUMP RUNNING	DI	CP-SHC	CBSP	CBSP	I-07
51	UA-6301	63-TP-01 PUMP FAULT	DI	CP-SHC	CP-SHC	CBSP	I-07
52	YA-6301	63-TP-01 PUMP E-STOP	DI	CP-SHC	CP-SHC	CBSP	I-07
53	LIT-6302	SODIUM HYPOCHLORITE BULK TANK NO.2 LEVEL	AI	SODIUM HYPOCHLORITE LEVEL SENSOR	CP-SHC	CBSP	I-07
54	TIT-6302	SODIUM HYPOCHLORITE BULK TANK NO.2 TEMPE	AI	SODIUM HYPOCHLORITE TEMPERATURE SENS	CP-SHC	CBSP	I-07
55	ZIL-6302	63-TP-02 PUMP IN REMOTE	DI	CP-SHC	CP-SHC	CBSP	I-07
56	HS-6302	63-TP-02 PUMP START/STOP	DO	CBSP	CP-SHC	CBSP	I-07
57	YIL-6302	63-TP-02 PUMP RUNNING	DI	CP-SHC	CBSP	CBSP	I-07
58	UA-6302	63-TP-02 PUMP FAULT	DI	CP-SHC	CP-SHC	CBSP	I-07
59	YA-6302	63-TP-02 PUMP E-STOP	DI	CP-SHC	CP-SHC	CBSP	I-07
60	SC-6301	63-MP-01 PUMP SPEED CONTROL	AO	CBSP	METERING PUMP NO.1	CBSP	I-08
61	SI-6301	63-MP-01 SPEED FEEDBACK	AI	METERING PUMP NO.1	CBSP	CBSP	I-08
62	HS-6301	63-MP-01 START/STOP	DO	CBSP	METERING PUMP NO.1	CBSP	I-08
63	YIB-6301	63-MP-01 IN AUTO	DI	METERING PUMP NO.1	CBSP	CBSP	I-08
64	YIR-6301	63-MP-01 RUNNING	DI	METERING PUMP NO.1	CBSP	CBSP	I-08
65	UA-6301	63-MP-01 FAULT	DI	METERING PUMP NO.1	CBSP	CBSP	I-08
66	SC-6302	63-MP-02 PUMP SPEED CONTROL	AO	CBSP	METERING PUMP NO.2	CBSP	I-08
67	SI-6302	63-MP-02 SPEED FEEDBACK	AI	METERING PUMP NO.2	CBSP	CBSP	I-08
68	HS-6302	63-MP-02 START/STOP	DO	CBSP	METERING PUMP NO.2	CBSP	I-08
69	YIB-6302	63-MP-02 IN AUTO	DI	METERING PUMP NO.2	CBSP	CBSP	I-08
70	YIR-6302	63-MP-02 RUNNING	DI	METERING PUMP NO.2	CBSP	CBSP	I-08
71	UA-6302	63-MP-02 FAULT	DI	METERING PUMP NO.2	CBSP	CBSP	I-08
72	SC-6303	63-MP-03 PUMP SPEED CONTROL	AO	CBSP	METERING PUMP NO.3	CBSP	I-08
73	SI-6303	63-MP-03 SPEED FEEDBACK	AI	METERING PUMP NO.3	CBSP	CBSP	I-08
74	HS-6303	63-MP-03 START/STOP	DO	CBSP	METERING PUMP NO.3	CBSP	I-08
75	YIB-6303	63-MP-03 IN AUTO	DI	METERING PUMP NO.3	CBSP	CBSP	I-08
76	YIR-6303	63-MP-03 RUNNING	DI	METERING PUMP NO.3	CBSP	CBSP	I-08
77	UA-6303	63-MP-03 FAULT	DI	METERING PUMP NO.3	CBSP	CBSP	I-08
78	WI-6301	SODIUM HYPCHLORITE DAY TANK WEIGHT	AI	WIT-6301	CBSP	CBSP	I-08

SECTION 43 21 13.16

CENTRIFUGAL MAGNETIC DRIVE SEALLESS END SUCTION PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, services, equipment and incidentals required to furnish and install centrifugal magnetic drive sealless end suction pumps, complete and operational, with motors and accessories as shown and specified. This Section includes, but is not limited to the following:
 - a. Sodium Hypochlorite (8 percent solution) and Hydrofluosilicic Acid (25 percent solution), transfer pumps.
 - b. Pump appurtenances.
 - c. Anchor bolts.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the centrifugal magnetic drive sealless end suction pumps Work.
- C. Related Sections:
 - 1. Section 03 00 05 Concrete.
 - 2. Section 05 05 33, Anchor Systems.
 - 3. Section 40 05 93, Common Motor Requirements for Process Equipment.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American Bearing Manufacturers Association (ABMA).
 - 2. American Gear Manufacturer's Association (AGMA).
 - 3. American National Standards Institute, (ANSI).
 - 4. American Society for Testing and Materials, (ASTM).
 - a. ANSI B73.1, Horizontal End Suction Centrifugal Pumps for Chemicals.
 - 5. American Water Works Association (AWWA).
 - 6. Institute of Electrical and Electronics Engineers, (IEEE).
 - 7. National Electrical Code, (NEC).
 - 8. National Electrical Manufacturers' Association, (NEMA).
 - 9. National Sanitary Foundation (NSF).

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:

Centrifugal Magnetic Drive Sealless End Suction Pumps

1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment, and shall be able to show evidence of at least five installations, each in satisfactory operation for at least five years.
 2. Pumps and appurtenances shall be supplied by a single pump manufacturer who shall be responsible for proper applications, engineering, testing and operation and start-up of the equipment as specified herein.
- B. Component Supply and Compatibility:
1. Obtain all equipment included in this Section regardless of the component manufacturer from a single centrifugal magnetic drive sealless end suction pumps manufacturer.
 2. The centrifugal magnetic drive sealless end suction pumps equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the centrifugal magnetic drive sealless end suction pumps equipment manufacturer.

1.4 SUBMITTALS

- A. Product Data:
1. Manufacturer's literature, illustrations, specifications and engineering data including:
 - a. Dimensions, materials, size, weight, pump and motor performance data and curves showing overall pump efficiencies, required net positive suction head, allowable suction lift, flow rate, head, brake horsepower, motor horsepower, speed and shut-off head. Indicate the specified rated conditions and operating range on the head capacity curve. Pump curves with information noted above shall be supplied full size on 8-1/2 x 11 paper.
 - b. Motor nameplate data for the electric motor driven pumps. Provide motor data sheet.
 2. Shop Drawings:
 - a. Fabrication, assembly, installation and wiring diagrams.
- B. Informational Submittals: Submit the following:
1. Source Quality Control:
 - a. Certified pump tests.
- C. Closeout Submittals: Submit the following:
1. Operation and Maintenance Data:
 - a. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare and protect equipment for shipment in accordance with manufacturer's printed operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

- A. General:
1. All wetted surfaces of the pumps and appurtenances and all sealing gaskets shall be suitable for continuous exposure to the chemical service and concentration shown on the Centrifugal Magnetic Drive Sealless End Suction Pumps Schedule, below.
 2. All wetted surfaces shall be of materials suitable for contact with chemicals in service and shall not leach out any organic or inorganic constituent which is not permitted by local or federal regulations.
- B. Pumps shall be of close coupled, end suction, top discharge, back pullout, centrifugal magnetic drive sealless design with separate motor. Pumps shall be specially designed, constructed and installed for the service intended and shall comply with the conditions as shown on the following schedule:

CENTRIFUGAL MAGNETIC DRIVE SEALLESS END SUCTION PUMPS SCHEDULE

Chemical Service	Sodium Hypochlorite	Hydrofluorosilicic Acid
Chemical Concentration:	8.0%	25%
Specific Gravity, (68°F):	1.21	1.13
Liquid Temperature Range, (°F):	50-90	50-90
Quantity of Pumps:	2	2
Pump Designation:	63-TP-01 63-TP-02	62-TP-01 62-TP-02
Location:	Outdoor - Sodium Hypochlorite bulk storage.	Outdoor - Hydrofluorosilicic Acid Metering Room
Design Flow, (gpm):	62	12
Design Discharge Head, (feet): *	48	25

Centrifugal Magnetic Drive Sealless End Suction Pumps

Chemical Service	Sodium Hypochlorite	Hydrofluorosilicic Acid
Flow at Second Design Point, (gpm, minimum):	75	18
Head at Second Design Point, (feet, minimum):*	45	24
Shutoff Head, (feet): *	50	30
Pump Speed, (RPM, maximum):	3500	3300
Efficiency at Design, (%):	60	60
Motor, (Hp):	2	1/4
Motor, (Volts/Phase)	480/ 3 phase	120/ 1 phase

* Ft. of Chemical in service.

2.2 MANUFACTURERS

A. Products and Manufacturers: Provide one of the following:

1. Sundyne
 - a. Sodium Hypochlorite: Model KM2156, 4.267" impeller.
 - b. Hydrofluorosilicic Acid: Model KM1515, 5" impeller.
2. Iwaki
 - a. Sodium Hypochlorite: Model MX-F402, 4.13" Impeller
 - b. Hydrofluorosilicic Acid: Model MX-F400, 2.76" Impeller.
3. Finish Thompson
 - a. Sodium Hypochlorite: Model DB 22, 7.25" impeller
 - b. Hydrofluorosilicic Acid : Model DB 22, 5.25" impeller.

2.3 DETAILS OF CONSTRUCTION

A. Dimension Interchangeableness:

1. Sealless magnetically driven pumps shall conform to all dimension standards of ANSI B73.1. The sealless pumps shall be dimensionally interchangeable with the standard sealed ANSI pump of the same size designation.

B. Pump Materials of Construction:

1. The outer bearing system for frame-mounted pumps shall consist of two interchangeable ball bearings, oil lubricated by a constant level oilier. The outer bearing housing shall be sealed from the elements by spring loaded lip seals on both the outboard and inboard ends to keep oil spray out of the magnet drive area of the pumps. The outer bearing housing shall be capable of oil mist lubrication, as required. The bearings shall have a minimum B-10 life of 100,000 hours.

Centrifugal Magnetic Drive Sealless End Suction Pumps

2. The outer bearing housing for frame-mounted pumps shall be constructed of ductile iron material free from blowholes and leaks. The outer shaft shall be one piece and the outer magnet carrier shall be attached by threading against rotation into the outer shaft or keyed.
3. The magnetic drive system shall consist of an outer and inner permanent magnet drive system, separated by a containment shell and air and liquid gaps. Magnets shall be rare earth and made of Neodymium Iron Boron and shall be designed for zero slippage for full range of operation.
4. Outer Magnet Carrier: The outer magnet carrier shall be made of carbon steel and shall be spin balanced after the magnets are installed. The magnet shall be attached to the outer magnet carrier by high temperature epoxy for pump temperatures anticipated. Magnets shall be covered by a stainless steel cup and not exposed to the atmosphere.
5. Magnets: The magnets shall be of suitable materials for operating fluid temperatures less than 250°F, and shall be entirely suitable for the load at any point on the pump operating curve when pumping the chemical indicated on the Magnetic Drive Sealless End Suction Pump Schedule.
 - a. The containment shell shall be furnished in a non-metallic material selected for the service. Containment shell shall be made to have a maximum operating pressure of 150 psi and a design pressure of 225 psi. Containment shell shall be designed to eliminate any energy loss in the magnet coupling. Rear casing shall be rated to a minimum 900-psi burst pressure.
 - b. The liquid gap between the containment shell and the inner magnet encapsulation shall be no less than 0.045-inch on a side or 0.090-inch diametral clearance.
 - c. The containment shell shall be attached to the rear casing cover with socket head stainless steel cap screws. Provide O-ring seal between the containment shell and the casing cover that is compatible with the pumped fluid. Welding of the containment shell to the casing cover is unacceptable.
6. Inner Bearings:
 - a. The inner bearing system shall be product lubricated as standard. The lubrication path shall minimize pressure drop and shall always remain under a pressure greater than suction pressure to prevent flashing in the bearing system under low NPSHA operating conditions.
7. Impeller:
 - a. Type: The impeller shall be of enclosed design.
 - b. Construction: Shaft shall be non-rotating and supported on both ends to prevent overhung loads. Material shall be suitable for the service and no smaller than 1-1/4-inch in diameter. A groove, minimum 1/16-inch along length of shaft, shall be provided for passage of occasional solids.
 - c. Materials: The impeller material shall be suitable for the service and shall be non-metallic.
 - d. A silicon carbon fiber reinforced mouth ring shall be provided with the impeller. The mouth ring shall be removable and replaceable.

8. Casing:
 - a. Construction: Pump casing shall be furnished with 150-pound ANSI flanges. Casing material and lining shall be suitable for the service intended.
 - b. Assembly: The casing shall provide for back pullout maintainability without disconnecting the suction or discharge flanges.
 - c. Casing shall be provided with a drain.
 - d. Provide a removable silicon carbide thrust ring and press fit into the casing.
 9. Bedplate:
 - a. Fiberglass reinforced vinylester composite or Type 316 stainless steel bedplate shall be provided. Bedplate shall be provided with molded-in stainless steel hardware complete with devices to prevent those devices from spinning when the bolting is tightened. Provide Type 316 stainless steel anchor bolts and hardware.
 10. Manufacturer to provide chemical compatibility data sheets to verify suitability of material for each chemical.
- C. Motors:
1. Motors shall conform to requirements of Section 40 05 93, Common Motor Requirements for Process.
 2. Lifting Lugs: Provide for equipment weighing over 100 pounds

2.4 CONTROLS

- A. Provide pump controls as shown and specified in the applicable Sections of Division 40, Process Interconnections.

2.5 TOOLS, SPARE PARTS AND MAINTENANCE MATERIALS

- A. Each pump shall be furnished with the following spare parts.
1. Recommended spare parts kit.
 2. One set of special tools required for maintenance and operations.
 3. One quart of touch-up paint
- B. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the OWNER at the completion of the project.

2.6 SURFACE PREPARATION AND SHOP PAINTING

- A. Pumps, motors, drives, frames, baseplates, appurtenances, etc., shall receive shop primer and finish coating conforming to the requirements of Section 09 91 00, Painting. If any damage to the paint system occurs, the equipment shall be repainted as directed by the Engineer.

- B. Surface preparation and painting shall conform to the requirements of Section 09 91 00, Painting.
- C. All gears, bearing surfaces, machined surfaces and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. This coating shall be maintained during storage and until the equipment is placed into operation.
- D. Contractor shall certify, in writing, that the shop primer and finish paint system conforms to the requirements of Section 09 91 00, Painting.

2.7 SOURCE QUALITY CONTROL

- A. Shop Tests:
 - 1. Each pump casing shall be hydrostatically tested to twice the discharge head or 1-1/2 times the shutoff head, whichever is greater.
 - 2. Running Test: Each pump assembly shall be operated from zero to maximum capacity as shown on the approved pump curve. Results of the test shall be shown in a plot of test curves showing head, flow, horsepower, efficiency, current and NPSH. Readings shall be taken at a minimum of five evenly spaced capacity points including shut-off, design point and minimum head for which pump is designed to operate.
 - 3. Each test shall be witnessed by a Registered Professional Engineer who may be an employee of the manufacturer. The Registered Professional Engineer shall sign and seal all copies of curves and shall certify that hydrostatic tests were performed. Tests shall be conducted in conformance with the Standards of the Hydraulics Institute.
 - 4. Pumps shall not be shipped until the Engineer has approved the test reports.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect all equipment immediately upon delivery to Site. All surfaces shall be smooth, free of voids and porosity, without dry spots, crazes or unreinforced areas. Any damaged equipment shall be replaced.

3.2 INSTALLATION

- A. Installation shall be in complete accordance with manufacturer's instructions and recommendations and the approved Shop Drawings.
- B. Pump shall be installed on concrete base, secured with anchor bolts, and grouted with non-shrink grout conforming to Section 03 00 05, Concrete.

- C. Installation shall include furnishing and applying an initial supply of grease and oil, recommended by the manufacturer.
- D. Support piping independent of pump.
- E. Check and align all pump motors and shafting.

3.3 START-UP AND TEST

- A. CONTRACTOR shall verify that structures, pipes and equipment are compatible.
- B. Make adjustments required to place system in proper operating condition.
- C. Initial testing shall be performed using potable water to ensure the system operates as specified, prior to testing with Sodium Hypochlorite (8%), or Hydrofluosilicic Acid (25%), according to the requirements of Section 01 75 11, Checkout and Startup Procedures. Test pumps across range of conditions from full storage tank to storage tank at minimum level to ensure pumps operate properly and without cavitation.

3.4 MANUFACTURER'S SERVICES

- A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of two visits for a minimum of 8 hours on-Site each time. The visits shall be for assistance in the installation of equipment and for checking the completed installation, start-up and training of the system. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to the requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.
- B. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

++ END OF SECTION ++

SECTION 43 41 43

POLYETHYLENE TANKS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all professional services, labor, materials, equipment, and incidentals required to furnish and install polyethylene tanks and appurtenances complete and operational.
2. OWNER shall provide initial fill of all chemical storage tanks and totes as noted on the Contract Drawings. CONTRACTOR shall perform testing with water as specified in Section 01 45 53, Cleaning, Testing, and Disinfection Hydraulics Structures. CONTRACTOR shall provide 14 days' notice to OWNER when initial fill of chemicals is needed.

B. Coordination:

1. Review installation procedures under this and other Sections, as well as the manufacturers guidelines for installation, operation and maintenance and coordinate the installation of items that must be installed with, or before the polyethylene tanks.
2. Size and location of manways, pipe connections, etc. shall be coordinated with the requirements of applicable chemical feed systems per the schedule and details shown on the Drawings.
3. Size, location, and reinforcing for required openings for level instruments shall be coordinated with Contractor provided instruments. Reference manufacturer installation documents and openings shall be fully shown in Shop Drawings.
4. Electrical conduit supports to top of tank. Coordinate with the Contractor on conduit sizes, quantity, and termination locations. Conduit supports shall be shown on Shop Drawings.

C. Related Sections:

1. Section 05 05 33, Anchor Systems.
2. Section 26 05 33.13, Rigid Conduits.
3. Section 46 33 44, Skid Mounted Peristaltic Metering Pumps
4. Section 46 33 66, Liquid Chemical Transfer Pumps.
5. Division 26, Electrical.
6. Division 40, Applicable Sections on Instrumentation and Control Systems.
7. Division 40, Applicable Sections on Piping, Valves, and Appurtenances.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI B-16.5, Pipe Flanges and Flanged Fittings

2. ARM Low Temperature and Impact Resistance (Falling Dart Test Procedure).
3. ASTM D618, Conditioning Plastics and Electrical Insulating Materials for Testing.
4. ASTM D638, Tensile Properties of Plastics.
5. ASTM D790, Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
6. ASTM D883, Definitions of Terms Relating to Plastics.
7. ASTM D1505, Density of Plastics by the Density-Gradient Technique.
8. ASTM D1525, Test Method for Vicat Softening Temperature of Plastics.
9. ASTM D1693, Test Method for Environmental Stress-Cracking of Ethylene Plastics.
10. ASTM D1998, Standard Specification for Polyethylene Upright Storage Tanks.
11. ASTM D2765, Degree of Crosslinking in Crosslinked Ethylene Plastics as Determined by Solvent Extraction.
12. ASTM D2837, Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
13. ASTM D3892, Practice for Packaging/Packing of Plastics.
14. ASTM F412, Definitions of Terms Relating to Plastic Piping Systems.
15. American Water Works Association, (AWWA).

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer shall have a minimum of five years of experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of the component manufacturer from a single polyethylene tank Manufacturer.
2. The polyethylene tank Manufacturer shall review and prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the polyethylene tank Manufacturer.

C. Source Quality Control:

1. All dimensions will be taken with the tank in the vertical position, unfilled. Tank dimensions will represent the exterior measurements.
 - a. The tolerance for the outside diameter, including out of roundness, shall be per ASTM D1998-15.
 - b. The tolerance for fitting placements shall be +/- 0.5 inch in elevation and 2 degrees radial at ambient temperature.
2. Test specimens shall be taken from fitting location areas or piggy-back test molds.
3. Low Temperature Impact Test - ARM Standard:

- a. Test specimens shall be conditioned at -40 degrees Fahrenheit for a minimum of 2 hours.
- b. The test specimens shall be impacted in accordance with the standard test methods as found in ASTM D1998. Test specimens less than 1/2-inch thickness shall be tested at 100 ft.-lb. Test specimens greater than or equal to 1/2-inch thickness shall be tested at 200 ft.-lb.
- 4. All tanks 2,000 gallons or larger shall be measured for tank wall thickness at 6 inches, 1 foot, 2 feet and 3 feet on the tank sidewall height at 0 degrees and 180 degrees around the tank circumference with 0 degrees being the tank manway and going counter-clockwise per ANSI standard drafting specifications. All tanks shall meet design thickness requirements and tolerances.
- D. Each tank shall be inspected for defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delaminations that will impair the serviceability of the vessel. All cut edges where openings are cut into the tanks shall be trimmed smooth.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

- 1. Shop Drawings:
 - a. Complete layout and all critical dimensions, including thickness of tank wall.
 - b. Materials of construction.
 - c. Fitting locations and details.
 - d. Accessories.
 - e. Anchor and hold-down details. Anchor Systems submittals shall comply with the requirements of Section 05 05 33, Anchor Systems.
 - f. Manufacturer's literature, illustrations, chemical compatibility data, calibration charts, specifications, engineering data and installation instructions.
 - g. Signed and sealed structural design calculations that demonstrate compliance with all required regulations. Calculations shall be sealed and signed by a licensed professional engineer with an active registration in the State of Georgia.
 - h. Openings and sizes for level instruments.
 - i. Electrical conduit supports.
- 2. Testing Plans:
 - a. Source quality control testing plan.
 - b. Field quality control testing plan.

B. Informational Submittals: Submit the following:

- 1. Manufacturer's Instructions:
 - a. Instructions for handling, storing, and installing equipment.
 - b. Installation instructions for installing tank on a concrete slab.
- 2. Site Quality Control Submittals:
 - a. Results of field quality control tests.

- b. Manufacturer's Reports: Submit a written report of results of each visit to Site by Manufacturer's service technician, including purpose and time of visit, tasks performed, and results obtained.
- 3. Qualifications Statements:
 - a. When requested by ENGINEER, submit qualifications data for Manufacturer.
- C. Closeout Submittals:
 - 1. Instructions of Operation and Maintenance Personnel:
 - a. Comply with the requirements of Section 01 79 23, Instruction of Operations and Maintenance Personnel.
 - 2. Source Quality Control Submittals:
 - a. Results of quality control tests and inspections.
 - 3. Operation and Maintenance Data:
 - a. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver any anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
 - 2. Handle all polyethylene tanks and appurtenances as recommended by the manufacturer to avoid damage. Polyethylene tanks that are damaged will not be acceptable. Protect all polyethylene tank appendages from damage and contamination.
 - a. The tanks shall be held in place with nylon strapping.
 - b. Flange faces shall be protected from damage by covering with suitable plywood or hardboard, securely fastened. The tanks shall be positively vented at all times. Fittings and accessories that could be damaged during shipment may be removed.
 - c. Pipe and tubing, fittings, and miscellaneous small parts shall be crated or boxed. Additional protection, such as end wrapping, cross bearing, or other interior fastening may be required to assure such individual equipment pieces are not damaged in transit.
 - d. The equipment shall be inspected by CONTRACTOR and ENGINEER before unloading at the installation site and any resulting damage shall be the carrier and/or fabricator's responsibility to repair at no cost to OWNER.
 - e. The tanks and appurtenances shall be unloaded and stored in accordance with the manufacturer's written instructions.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Tanks should be:

- a. Chocked and tied down to prevent being blown by wind.
- b. Vented to allow for temperature changes that may affect their integrity.
- c. Provided with opening protection to exclude foreign matter.
- d. Protected from sunlight (UV) degradation.
- e. Stored on site in cradles if storage is required prior to installation.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. Equipment Description:

1. Design Temperature: Ambient, indoor installation, 50 to 96 degrees F. Ambient, outdoor installation, Chemicals may be delivered at higher or lower temperatures, depending on season.
2. Normal Internal Loads: Hydrostatic.
3. External Loads:
 - a. Appurtenances as shown and specified herein.
 - b. Tanks shall also be designed to accommodate for access to the manway.
 - 1) Minimum uniform dome live load shall be 60 psf.
 - 2) Minimum concentrated dome load: 300 pounds distributed over a 4-inch by 4-inch area at the top of the tank.
 - c. Design loads shall include the controlling effects of the following loads acting separately or in combinations as required in the 2018 International Building Code with Georgia State Amendments (2022), except where other applicable codes and the Contract Documents are more restrictive.
 - d. Transportation, handling, and erection loads.
4. Anchor bolt pullout force shall be based on the critical effects of loads/load combinations causing overturning of the tank.
 - a. All controlling reactions to foundation shall be provided to ENGINEER as part of Shop Drawing Submittal.
5. Configuration:
 - a. Flat-bottom, vertical, cylindrical with dished tops.

B. Design Criteria:

1. Table 2-2: Indoor Chemical Storage

Location	Fluoride Feed Room	Sodium Hypochlorite Feed Room
Number Required	1	1
Equipment Name	Hydrofluorosilicic Acid Day Storage Tank	Sodium Hypochlorite Day Tank
Equipment Tag	62-DT-01	63-DT-01
Service (Chemical and % Solution)	Hydrofluorosilicic Acid, 25%	Sodium Hypochlorite, 8%
Chemical Specific Gravity at 60 degrees F	1.25	1.21
Basis of Design Manufacturer (Model)	Poly Processing (VERT-00060)	Poly Processing (VERT-00285)
Volumetric Capacity per Tank, gal	60	285
External Diameter, ft.	1'-11"	2'-10"
Straight Shell, Height, ft.	2'-11"	6'-2"
Total Overall Height, ft.	3'-6 1/4"	7'-0"
Bottom Style (Flat/Cone)	Flat	Flat
Inlet Connection	1" Bulkhead fitting (PVC/EPDM)	2" Bulkhead fitting (PVC/EPDM)
Outlet Connection	1" Socket x thread (PVC/EPDM)	2" Socket x thread (PVC/EPDM)
Vent Connection	1" Bolted Double Flanged (PVC/EPDM)	3" Bolted Double Flanged (PVC/EPDM)
Overflow/Drain Connection	1.5" Socket x thread (PVC/EPDM)	2.5" Socket x thread (PVC/EPDM)
Reverse Float Level Gauge	No	No
Manway	No	No
Seals/Gaskets/O-rings	EPDM	EPDM
Fitting Material	SCH 80 PVC	SCH 80 PVC
Bolt Material	Hastelloy C276	Hastelloy C276
Resin	XLPE	XLPE

2. Table 2-3: Outdoor Chemical Storage

Location	Fluoride Bulk Storage	Sodium Hypochlorite Bulk Storage
Number Required	1	2
Equipment Name	Hydrofluorosilicic Acid Bulk Storage Tank	Sodium Hypochlorite Bulk Storage Tank No. 1 & 2
Equipment Tag	62-TX-01	63-TX-01 & 63-TX-02

Location	Fluoride Bulk Storage	Sodium Hypochlorite Bulk Storage
Service (Chemical and % Solution)	Hydrofluorosilicic Acid, 25%	Sodium Hypochlorite, 8%
Chemical Specific Gravity at 60 degrees F	1.25	1.21
Basis of Design Manufacturer (Model) (Note 1)	Poly Processing (IMFO-F-06150)	Poly Processing (IMFO-F-10150)
Volumetric Capacity per Tank, gallons	6,150	10150
Internal Diameter, ft.		
External Diameter, ft.	10'-2"	11'-11"
Straight Shell, Height, ft.	10'-5"	12'-6"
Total Overall Height, ft.	12'-4 ¾"	14'-4 ¾"
Bottom Style (Flat/Cone)	Flat	Flat
Outlet ¹	2" IMFO Style	2" IMFO Style
Vent Connection	4" Bolted Double Flanged (PVC)	6" Bolted Double Flanged (CPVC)
Overflow/Drain Connection	4" Bulkhead fitting (PVC/ EPDM)	4" Bulkhead fitting (PVC/ EPDM)
Top Level Element Connection	4" Bolted Double Flanged (PVC)	4" Bolted Double Flanged (PVC)
Top Fill Connection	2" Bulkhead fitting (PVC/ EPDM)	3" Bulkhead fitting (PVC/ EPDM)
Reverse Float Level Gage	Yes	Yes
Manway	Yes	Yes
Platform Ladder	Yes	Yes
Seals/Gaskets/O-rings	EPDM	EPDM
Fitting Material	SCH 80 PVC	SCH 80 CPVC
Bolt Material	Hastelloy C-276	Hastelloy C-276
Resin	XLPE	XLPE
1) Selected items above are specific to Basis of Design Manufacturer shown.		

- C. Size: Each tank shall have a volumetric and working capacity as listed above and shall be sized as listed herein or as shown on the Drawings.

2.2 MANUFACTURERS

- A. Manufacturers: Provide equipment of one of the following:
1. Poly-Processing, Inc.
 2. Assmann, Inc.
 3. Snyder Industries, Inc.
- B. CONTRACTOR shall note that the named Manufacturers listed are acceptable sources for equipment specified in this Section, however, the design, where noted herein as to basis of design manufacturer, is largely based on one of the named Manufacturers. If the CONTRACTOR chooses to proceed with other than the specified basis of design Manufacturer, it will be the responsibility of the

CONTRACTOR to coordinate with the equipment Manufacturer to modify the equipment, layout and overall design as required to meet the intent and requirements of these Contract Documents. Alternative approaches to achieve the functional performance including accessibility/clearances per the design requirements may be acceptable pending review and acceptance by the Owner in accordance with substitution procedures outlined in the General Conditions and Section 01 25 00 – Substitution Procedures. Acceptance of the alternative approach will be based on meeting the same functional performance as that specified for the basis of design named Manufacturer in no more space than allocated for equipment per space allocated in the drawings. All changes required that result from providing other than the equipment of the first named Manufacturer including changes to structures, piping, ancillary building support items, upstream and downstream circuiting and all associated controls and controls interfaces to other equipment and revisions to the Contract Documents shall be provided by the CONTRACTOR at no additional cost to the Owner.

2.3 DETAILS OF CONSTRUCTION

A. Polyethylene:

1. The resin used shall be XLPE (High density cross link polyethylene) as recommended by the chemical tank manufacturer.
2. All polyethylene resin material shall contain a U.V. 8 stabilizer as compounded by the resin manufacturer. For outdoor tanks, pigments may be added but shall not exceed 0.25 percent (dry blended) of the total weight.
3. Mechanical Properties of Tank Material:

<u>Property</u>	<u>ASTM Value</u>	
Density (Resin)	ASTM D1505	0.941-0.950 g/cm ³
Tensile (Yield Stress 2-inch min)	ASTM D638	2,800-3,500 psi
Elongation at Break (2-inch/min)	ASTM D638	>1,000 percent
ESCR (100% Igepal, Cond. A, F50)	ASTM D1693	>500 hours
ESCR (10% Igepal, Cond. A, F50)	ASTM D1693	40-48 hours
Flexural Modulus 1% Secant	ASTM D790	130,000-145,000 psi

4. Surface portions of tanks, inside and outside, shall be suitable for the specified environment.

B. Design:

1. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation but shall not be less than 0.187 inches thick.

$$T = \frac{p \times OD}{2 \times SD} = \frac{0.433 \times SG \times H \times OD}{2 \times SD}$$

T = wall thickness, in.

SD = hydrostatic design stress, PSI

p = pressure ($0.433 \times SG \times H$), PSI

H = fluid head, ft.

SG = specific gravity.

OD = outside diameter of tank, in.

- a. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress should be < 660 psi at 73 degrees Fahrenheit for Type I and Type II materials based on resin density. In accordance with the equation in Paragraph 1.08.A, the tank shall have a stratiform (tapered wall thickness) wall. In no case shall the wall thickness be less than the minimum allowed per calculation of ASTM D1998.
- b. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.
- c. The design specific gravity shall be 1.9 for all tanks.
2. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support. Flat areas shall be provided to allow locating large fittings on the cylinder straight shell.
3. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The top head of tanks with 2,000 or more gallons of capacity shall be designed to provide a minimum of 1,300 square inches of flat area for fitting locations.
4. Tanks with 2,000 or more gallons of capacity shall have a minimum of 3 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of an empty tank.
5. The tank shall be designed to maintain tank retention in wind and seismic loading situations without tank damage. Provide tie-down lugs integrally molded into the top head to resist loading conditions.

C. Construction:

1. Tanks shall be upright, cylindrical, flat bottomed, one-piece seamless construction by rotational molded.
2. The tanks shall be designed for above-ground, vertical installation and shall be capable of containing chemicals at atmospheric pressure.

3. Tanks shall be of the types and sizes shown on the Drawings and specified herein.
4. Lifting Lugs: As required for installation. Capable of withstanding weight of an empty tank with a safety factor of 3 to 1.
5. All gaskets and accessories shall be compatible with the chemical in storage.
6. The tanks shall be natural in color.
7. Integral tank openings with required reinforcing for level instruments.

D. Fittings:

1. All connections to the system piping (including vent lines that don't terminate in a gooseneck at the tanks), except the overflow lines, shall have a flexible connection as specified herein to allow the tanks to expand/contract freely without imposing forces on the piping or from piping onto the tank.
2. Bolted 150 lb. Flange Fitting
 - a. The (single) bolted flange fitting shall be constructed with one 150 lb. flange and the correct number and size of all-thread bolts for the flange specified by the flange manufacturer. The flange shall be constructed of PVC Type 1, Grade 1 or CPVC Type IV, Grade 1 as scheduled above. Connection to the flange shall be threaded or socketed as scheduled. Gaskets shall be a minimum of 1/4-inch thickness and constructed of the specified material in Paragraph 2.1B. There shall be a minimum of 4 ea. all-thread bolts. The bolts may have gasketed flanged metal heads or bolt heads encapsulated in polyethylene material. The encapsulated bolt shall be designed to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation. The polyethylene encapsulation shall fully cover the bolt head and a minimum of 1/4-inch of the threads closest to the bolt head. Each encapsulated bolt shall have a chemically compatible gasket to provide a bolt sealing surface against the inner flange.
3. Bolted Double 150 lb. Flange (Bolted Spool) Fittings:
 - a. The bolted double flange fitting shall be constructed with 2 ea/ 150 lb. flanges, 2 ea. 150 lb. flange gaskets, and the correct number and size of all-thread bolts for the flange specified by the flange manufacturer. The flanges shall be constructed of PVC Type 1, Grade 1 or CPVC Type IV, Grade 1 as scheduled above. Gaskets shall be a minimum of 1/4-inch thickness and constructed of the specified material in Paragraph 2.1B. There shall be a minimum of 4 ea. all-thread bolts. The bolts may have gasketed flanged metal heads or bolt heads encapsulated in polyethylene material. The encapsulated bolt shall be designed to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation. The polyethylene encapsulation shall fully cover the bolt head and a minimum of 1/4-inch of the threads closest to the bolt head. Each encapsulated bolt shall have a chemically compatible gasket to provide a bolt sealing surface against the inner flange.
 - b. Provide fitting with a flexible hose connection or PTFE (polytetrafluoroethylene) expansion joint for the chemical being stored.

- Flexible hose connections/expansion joints shall compensate for expansion and contraction of the storage tank during filling and draining of the tank.
- c. The bolted double flange fittings shall be used where scheduled above.
4. Molded Flanged Outlet Fitting:
 - a. The 150 lb. flanged outlet shall be integrally molded into the tank during the rotational molding process. The flanged outlet shall be seamless and manufactured from the same material as the tank.
 - b. The flanged outlet shall provide complete drainage of liquid through the sidewall of a flat bottom container without the use of a special support structure or concrete pad.
 5. Threaded Bulkhead:
 - a. The bulkhead fittings shall be constructed of PVC or CPVC as scheduled. Gaskets shall be a minimum of 1/4-inch thickness and constructed of the specified material in Paragraph 2.1B
 - b. The threaded bulkhead fitting shall be used where scheduled above.
 6. Self-Aligning Threaded Bulkhead:
 - a. Self-aligning fittings shall be installed on the spherical dome section of the tank. The self-aligning fittings shall be constructed of PVC, CPVC, or PE as scheduled. Gaskets shall be a minimum of 1/4-inch thickness and constructed of the specified material in Paragraph 2.1B
 - b. The self-aligning threaded bulkhead fitting shall be used where scheduled or for the miscellaneous lines located on the curved dome of the top of the tank.
 7. Provide flanged nozzles on top of tank as shown on the Drawings for mounting of radar level transmitter. Coordinate tank mounting with instrument supplier.

2.4 ACCESSORIES

- A. Manways:
 1. Bolted Sealed Top Manway:
 - a. Provide the size and location as shown on the Drawings.
 - b. The sealed manway shall be constructed of polyethylene material. The bolts shall be polypropylene. The gaskets shall be in accordance with the tables listed under 2.1 B Design Criteria.
 2. Provide standard manways for the day tanks as recommended by the tank manufacturer.
- B. Vents:
 1. Provide the size and location as shown on the Drawings.
 2. Bulk tanks vents shall be a minimum of 4 inches. Refer to the Drawings for schedule.
 3. Each tank vent line shall be equipped with an FRP (or other material as scheduled) insect screen that is compatible with the chemical stored.
- C. Chemical Feed Flexible Connection:
 1. Other Services:

- a. Provide flexible PVC or CPVC hose on all tank piping connections that are as detailed on Drawings.
 - b. Inside diameter of hose shall match outer diameter of rigid PVC/CPVC pipe.
 - c. Hose shall be capable of being cemented over PVC/CPVC pipe.
- D. Pipe Supports:
1. Pipe supports shall be furnished in accordance with Section 40 05 07, Pipe Hangers and Supports, and the additional requirements listed below.
 2. Provide support braces from tank's outside wall for support of the tank's overflow lines.
 3. Maximum spacing between pipe supports shall be 5-feet.
- E. Anchorage System:
1. Anchorage systems shall meet design requirements of 2018 international building code with Georgia amendments, and Section 05 05 33, Anchor Systems.
 2. The anchorage system shall be Hastelloy C-276 as defined in the scheduled above.
- F. Tie Down Systems for Outdoor Tanks:
1. The tie down system shall be designed to withstand windloads per IBC code, using wind exposure C.
 2. The tie down system shall be resistant to chemicals stored.
- G. Conduit Supports:
1. Conduit supports shall be furnished in accordance with Section 26 05 33.13, Rigid Conduits, and the additional requirements listed below.
 2. Maximum spacing between conduit supports in accordance with Section 26 05 33.13, Rigid Conduits.
- H. Tank Insulation and Heat Tracing:
1. Tank insulation and heat tracing shall be provided for the sodium hypochlorite bulk storage tanks.
 2. Insulation shall consist of polyurethane foam and shall be 2-inches thick.
 3. Insulation shall be of uniform density and thickness in order to avoid areas of incalculable heat loss.
 4. Insulation as specified above shall be furnished for the exterior tank sides and domed top. For the tank bottom, the tank manufacturer shall furnish sufficient quantities of roofing felt.
 5. Insulated tanks shall be furnished with two coats of weather resistant, white mastic coating.
 6. Two temperature controllers shall be supplied.
 7. Tanks are supplied with heating panels and a controller installed by the tank manufacturer. The only field connection required is the 110 VAC supply power to the heating system.

8. All heating system components shall be NEMA 4 rated and factory pre-wired for 110 VAC.
9. In the control enclosure, provide a set of SPDT dry contacts rated for at least 1A at 120 VAC for both the Temperature Over-Limit alarm and the Temperature Low-Limit alarm.

I. Level indication

1. The (reverse float) level indicator shall be assembled to the tank and shall consist of PVC float, indicator, polypropylene rope, perforated interior pipe, PVC roller guides, clear UV resistant PVC sight tube EnviroKing® by C.F. Harvel, and necessary pipe supports. The level indicator shall act inversely to the tank contents and shall not allow entrance of tank contents into the sight tube at any time. Indicator shall be neon orange color for visual ease for onsite operators. Provide calibration markings for tank capacity.

J. Platform Ladder

1. Fabricated in accordance with OSHA Requirements #1910.27
2. Side Rails are to be 2" X 1/4" FRP Square Tubing.
3. Rungs are to be 1 1/4" dia. X 1/4" Round Fluted Tube
4. Rungs are to be attached to square tubing with dowel and glue method, preventing rung rotation
5. Stank-off clips are spaced @ 6'-0" maximum and to be FRP.
6. Resin systems to be vinylester.
7. Stand-off Clips to be field located and installed.
8. Stand-off & base clips to be vinylester beige.
9. FRP materials to meet ASTM E-84, Class 1, flame spread rating less than 25 and self-extinguishing requirements of ASTM D-635

2.5 IDENTIFICATION

A. Label: Permanently attach label to each tank with the following minimum information:

1. Chemical to be stored including:
 - a. Concentration.
 - b. Specific gravity.
 - c. Maximum temperature.
2. Tank manufacturer.
3. Date of manufacture.
4. Tank serial number.
5. Tank material.
6. Tank capacity.
7. Tank working capacity.

B. Tanks shall be furnished with OSHA approved 20-inch by 24-inch Chemical Warning signs with NFPA 704 hazard numbers for the chemical services intended. Chemical signs shall include, as a minimum, the name of the product stored in the tank, precautionary measures, signal word (danger, warning, caution), statement of

hazard, precautionary measures, instructions in case of contact, exposure, etc. and NFPA 704 hazard numbers.

- C. Tanks shall be provided with gallonage markers.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.
- B. Inspect tanks prior to installation. If damaged, notify ENGINEER and manufacturer at once.
- C. Do not install damaged tanks until repairs are made in accordance with manufacturers written instructions and approval by ENGINEER.
- D. Inspect concrete pads for proper elevation, dimensions, evenness, and anchor bolt locations. Correct if required.

3.2 INSTALLATION

- A. Install tanks in complete conformance with manufacturer's instructions.

3.3 START-UP AND TEST

- A. All equipment shall be tested by CONTRACTOR at the job Site following installation of the equipment. Should the tests indicate any malfunction, CONTRACTOR shall make any necessary repairs and adjustments. Such tests and adjustments shall be repeated until, in the opinion of ENGINEER, the installation is complete, and the equipment is functioning properly and accurately, and is ready for permanent operation.
- B. Field Testing:
 - 1. Comply with the requirements of Section 01 75 11, Checkout and Startup Procedures.
 - 2. After installation is complete but before piping connections are made, block all outlets, and fill each tank with water to the overflow elevation. Hold water in the tank for 24 hours to identify any leaks.
 - 3. Repair all leaks in accordance with manufacturer's instructions.
- C. Cleaning and Repairing
 - 1. After installation is complete and connections made, clean tank and nozzles with detergent and rinse with 130 degree F water.

2. Tank shall be dried completely prior to putting tank in service.

3.4 FIELD QUALITY CONTROL

- A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of two visits. The first visit shall be for assistance in the installation of equipment. Subsequent visits shall be for checking the completed installation, start-up, and training of operations and maintenance personnel in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel. Manufacturer's representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.
- B. Submit report by manufacturer of each visit to the site that provides complete information on time, schedule, tasks performed, persons contracted, problems corrected, test results, training, instruction, and all other pertinent information.
- C. All costs, including expenses for travel, lodging, meals and incidentals, and costs for travel time, for visits to the Site shall be included in the Contract Price. All costs for additional visits shall be at no additional costs to the OWNER.

+ + END OF SECTION + +

SECTION 46 33 44

SKID MOUNTED PERISTALTIC METERING PUMPS AND APPURTENANCES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals required to furnish and install Sodium Hypochlorite and Hydrofluorosilicic Acid skid mounted peristaltic metering pumps complete and operational with pumps, motors, control equipment and appurtenances both on the skids and separate as shown and indicated in the Contract Documents. In addition to the skid mounted pumps, this work includes fill lines and valves, and system piping and valves separate from the skids.
2. Pump Manufacturer shall supply pumps, skids, and all appurtenances on the skids, with Contractor supplying components outside the skid boundaries – see P&IDs for additional information including definition of skid boundaries.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before peristaltic metering pumps and appurtenances work.

C. The following sections are related to the skid mounted peristaltic metering pumps and appurtenances. Additional related sections may apply that are not specifically listed below.

1. Section 03 00 05, Concrete
2. Section 40 05 05, Exposed Piping Installation
3. Section 40 05 53, Process Valves and Appurtenances.

1.2 REFERENCES

A. The skid mounted peristaltic metering pumps and associated work shall conform to the latest editions or revisions (in effect at the time of contract award) of the following applicable codes and standards, and regulations generally available from the association, society, governing body, or regulatory agency named in the title:

1. American Bearing Manufacturers Association, (ABMA).
2. American Gear Manufacturers' Association (AGMA).
3. American National Standards Institute (ANSI).
4. API 675, Positive Displacement Pumps Controlled Volume.
5. American Society for Testing and Materials (ASTM).
6. Institute of Electrical and Electronics Engineers (IEEE).
7. National Electrical Code (NEC).

8. National Sanitation Foundation (NSF).

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Shall have minimum of five years of experience producing substantially similar equipment to that required and shall be able to document of at least five installations, each in satisfactory operation for at least five years.

B. Component Supply and Compatibility:

1. Skid mounted pump manufacturer shall obtain all materials and equipment included in this Section under their scope of supply regardless of component manufacturer.
2. Skid mounted pump manufacturer shall prepare all Shop Drawings and other submittals for components under their scope of supply furnished under this Section.
3. Materials and equipment shall be fully compatible with specified service conditions, and shall be integrated into overall assembly by skid mounted pump manufacturer.
4. Contractor shall provide appurtenances and ancillary equipment outside the boundaries of the skid as specified herein and submit accordingly.

C. Certifications

1. Certificate of Compliance:

- a. Provide notarized certificate of compliance with the Contract Documents from the skid-mounted peristaltic metering pump manufacturer on manufacturer letterhead and signed by an authorized official; certification by manufacturer's representatives is not acceptable.
- b. Certificate shall be worded as follows:

“[Insert manufacturer's name] proposes to supply equipment included in Section 46 33 44 for Fayette County Water System, Crosstown WTP Chemical Upgrades construction. We have examined the Contract Documents and understand the Project requirements insofar as they affect the proposed products. Except as may be specifically exempted in Section 46 33 44, we accept unit responsibility for the products specified in this Section in our scope of supply, and certify that the products are compatible, meet the requirements of the Contract Documents, and comprise a functional unit that will operate satisfactorily under the conditions described in the Contract Documents:

[List exceptions, deviations or changes necessary or recommended to accommodate the proposed products.]

We further certify that the products to be furnished shall conform to the standards listed in Section 46 33 44, Skid Mounted Peristaltic Metering

Pumps and Appurtenances, of the Contract Documents.

[List exceptions, deviations or changes necessary to accommodate the proposed products.]

	Authorized Signature & Title	Date
c.	Provide written justification for exceptions, variations, deviations, or changes. Engineer will determine whether exceptions, deviations, and changes are acceptable. Exceptions, variations, deviations, and changes may result in rejection of products.	
d.	Provide certificate of compliance before submitting Shop Drawings. Shop Drawings will not be reviewed prior to receipt of the certificate of compliance.	
e.	Acceptance of certification of compliance shall not relieve the Contractor of responsibility for adequacy of all products.	
f.	Submittal of certificate of compliance shall not relieve the Contractor, equipment manufacturer, and Supplier of requirement to comply with Submittal procedures in the Contract Documents.	

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Complete layout and installation drawings for each skid showing mounting details, dimensions, fitting locations, and materials of construction.
 - b. Wiring diagrams.
 - c. Shop drawings showing ancillary piping and equipment layouts and pipe routing (beyond the skid boundaries).
2. Product Data:
 - a. Complete product data for each size and type of pump, motor, and all accessories, including manufacturer's brochure, specifications, weight, performance data, turndown, and capacity. This shall include valves, instrumentation, piping, and other components on the skids. Contractor supplied appurtenances may be submitted separately from skid-mounted pump products.
 - b. Chemical compatibility documentation showing wetted materials submitted for pumps and ancillary equipment provide optimal compatibility for each chemical service.
 - c. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant

drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

d. Recommended anchor sizing.

3. Testing Plans:

a. Source quality control testing plan.

b. Field quality control testing plan.

B. Informational Submittals: Submit the following:

1. Certificates:

a. Provide certificate of compliance prior to shop drawing submission, as specified in this Section.

b. Once installation is complete, skid mounted peristaltic metering pump manufacturer representative shall inspect the installation and provide certification on manufacturer's letterhead that the skid mounted peristaltic metering pumps and appurtenances have been properly installed in accordance with the Drawings, Specifications, and Manufacturer's Shop Drawings and recommendations, and that the system is ready to be tested and placed into operation.

2. Manufacturer's Instructions:

a. Setting drawings, templates, and directions for installing anchor bolts and other anchorage devices.

b. Instructions for handling, storing, and installing equipment.

3. Source Quality Control Submittals:

a. Results of source quality control tests and inspections.

4. Site Quality Control Submittals:

a. Results of field quality control tests.

b. Manufacturer's Reports: Submit a written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained.

5. Qualifications Statements:

a. When requested by the Engineer, submit qualifications data for manufacturer.

C. Closeout Submittals:

1. Operation and Maintenance Data: Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

2. Spare Parts, Extra Stock Materials, and Tools:

a. Two spare pump head assemblies.

b. Two complete sets of special tools required for normal maintenance and operation.

c. Provide one spare calibration column.

d. One per five of gauges, indicators and/or switches used in field complete with diaphragm seals, filled and ready for use

- e. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the Owner at the completion of the project.
- f. Manufacturer shall furnish a list of additional recommended spare parts for an operating period of one year. The list shall describe each part, the quantity recommended, and the unit price of the part.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 - 1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work.
 - 2. Inspect all boxes, crates, and packages upon delivery to the Site and notify Engineer in writing of loss or damage to products. Promptly remedy loss and damage to new condition in accordance with manufacturer's instructions.
 - 3. Conform to Section 01 65 00, Product Delivery Requirements.
- B. Storage and Protection:
 - 1. Keep materials and equipment off ground using pallets, platforms, or other supports. Protect steel, packaged materials, and electronics from corrosion and deterioration.
 - 2. Conform to Section 01 66 00, Product Storage and Handling Requirements.

1.6 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive Owner of other rights or remedies Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under the Contract Documents. Obligations of the Contractor under the Contracts Documents shall not be limited in any way by provisions of the specified special warranty.
- B. Special Warranty: Provide skid mounted pump manufacturer's written warranty, running to the benefit of Owner, agreeing to correct, or at option of Owner, remove and replace materials and equipment specified in this Section found to be defective during a period of 3 years after date of Substantial Completion of the Work under this Section.

PART 2 – PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. System Description:
 - 1. Provide skid-mounted peristaltic metering pumps, complete with skid assembly containing chemical metering pumps, all necessary piping, valves, fittings, supports, electrical/instrumentation controls and accessories as specified

Skid Mounted Peristaltic Metering Pumps and Appurtenances

herein. Components of each of the skid systems shall be as indicated on the Drawings and shall include the following items:

- a. Unenclosed skid
 - b. Metering pumps with integral motors
 - c. Calibration column
 - d. Pressure gauges
 - e. Ball valves
 - f. Ball check valves
 - f. Pulsation dampeners
 - g. Pressure relief valves
 - h. Instrumentation and controls
 - i. All piping, valves, gaskets, supports, hardware, wiring, junction boxes, and accessories necessary for a fully functioning skid. Piping shall be terminated within 2 inches from the edge of skid. Electrical cables shall terminate in the NEMA 4X junction box. If pumps are not hardwired, then outlet shall be weather protected and GFCI type.
2. The skid shall be constructed of chemical resistant materials such as PVC, polypropylene, polyethylene or approved equal. The skid shall include measures to allow it to be anchored to the concrete pad on which it is installed.
 3. Chemical and corrosion resistant pipe supports and clips shall be used to secure the piping to the skid.
 4. Unions, flanges, or Swagelok fittings shall be used to allow easy maintenance of the system.
 5. All piping shall be Schedule 80 PVC and assembly shall be performed by the skid manufacturer.
 6. Each skid shall be completely assembled and tested by the manufacturer prior to delivery to the job site.
 7. Maximum pump operating speed at design maximum flow rate shall be no higher than 60% pump speed.
 8. Pumps shall include tube failure alarm indication apparatus.
 9. Provide equipment compatible with specified service conditions.
 10. Tube material and size shall be provided per recommendations from pump manufacturer for each chemical.

B. Performance Criteria for Skid-Mounted Pumps:

Service Conditions	Sodium Hypochlorite
Location	Sodium Hypo Feed Room
Number of Pump Skids Required	1
Number of Pumps Required per Skid (Duty + Standby)	3 (2+1)
Service – Chemical and % Solution By Weight	Sodium Hypochlorite (8%)
Specific Gravity of Pumped Fluid at 60 degrees F	1.21

Skid Mounted Peristaltic Metering Pumps and Appurtenances

Service Conditions	Sodium Hypochlorite	
Equipment Tag Nos.	63-MP-01 63-MP-02 63-MP-03	
pH of Pumped Fluid	12	
Temperature Range of Pumped Fluid (degrees F)	45 - 100	
Chemical Delivery Description	Pre-filter (Duty: 63-MP-01 Standby: 63-MP-02)	Post-filter (Duty: 63-MP-03)
Minimum Dose Flow Rate (gallons/hr)	1.7	4.4
Maximum Dose Flow Rate (gallons/hr)	5.7	17.6
Future Maximum Dose Flow Rate (gallons/hr)	8.2	25.6
Maximum Pump Discharge Operating Pressure (psi)	10	10
Maximum Rated Discharge Pressure (psi)	100	50

Service Conditions	Hydrofluorosilicic Acid	
Location	Fluoride Feed Room	
Number of Pump Skids Required	1	
Number of Pumps Required per Skid (Duty + Standby)	2 (1+1)	
Service – Chemical and % Solution By Weight	Hydrofluorosilicic Acid (25%)	
Specific Gravity of Pumped Fluid at 60 degrees F	1.25	
Equipment Tag Nos.	62-MP-01 62-MP-02	
pH of Pumped Fluid	1.0	
Temperature Range of Pumped Fluid (degrees F)	45 - 100	
Chemical Delivery Description	Post-filter (Duty: 62-MP-01 Standby: 62-MP-02)	
Minimum Dose Flow Rate (gallons/hr)	0.5	
Maximum Dose Flow Rate (gallons/hr)	1.7	

Skid Mounted Peristaltic Metering Pumps and Appurtenances

Service Conditions	Hydrofluorosilicic Acid
Future Maximum Dose Flow Rate (gallons/hr)	2.4
Maximum Pump Discharge Operating Pressure (psi)	10
Maximum Rated Discharge Pressure (psi)	50

2.2 MANUFACTURERS

- A. The Engineer and the Owner believe that the Manufacturers listed below are capable of producing equipment and products which will satisfy the requirements of this and associated Sections.
- B. Contractor shall note that the named Manufacturers listed are acceptable sources for equipment specified in this Section, however, the design within these Contract Documents is largely based on the first named Manufacturer. If the Contractor chooses to proceed with another then the first named Manufacturer, it will be the responsibility of the Contractor to coordinate with the equipment Manufacturer to modify the equipment, layout and overall design as required to meet the intent and requirements of these Contract Documents. Alternative approaches to achieve the functional performance per the specified requirements may be acceptable pending review and acceptance by the Owner in accordance with substitution procedures outlined in the General Conditions. Acceptance of the alternative approach will be based on meeting the same functional performance as that specified for the first named Manufacturer in no more space than allocated for equipment per space allocated in the drawings. All changes required that result from providing other than the equipment of the first named Manufacturer including changes to structures, piping, ancillary building support items, upstream and downstream circuiting and all associated controls and control interfaces to other equipment and revisions to the Contract Documents shall be provided by the Contractor at no additional cost to the Owner.
- C. Candidate Manufacturers include:
 - 1. Watson Marlow:
 - a. Sodium Hypochlorite:
 - i. Pre-filter: Qdos H-Flo 300
 - ii. Post-filter: Qdos H-Flo 300
 - iii. Standby: Qdos H-Flo 300
 - b. Hydrofluorosilicic Acid:
 - i. Post-filter: Qdos 30

2.3 DETAILS OF CONSTRUCTION

- A. The peristaltic metering pumps shall be manufactured of the following materials:

Skid Mounted Peristaltic Metering Pumps and Appurtenances

Component	Material
Pumphead Enclosure	30% GF PPE +PS
Pumphead Enclosure Seals	NBR
Rotor	PA6
Bearings	Steel
Internal baffle	POM
Vent Body	30% GF PPE +PS
Vent Spring	316 Stainless Steel

- B. As this work is located at a drinking water facility, all wetted materials that are in contact with drinking water or chemicals delivered to drinking water shall be NSF-61 approved if available.
- C. Pump and Drive Mechanism:
1. Pump shall be of the positive displacement peristaltic type utilizing a flexible tube. The tubing shall be in contact with the inside diameter of the track (housing) and be held in place on the suction and discharge by a clamp mechanism. The entire ReNu pumphead shall be easily replaceable. Pumphead shall come with integral leak detection.
 2. Each pump shall be capable of self priming when completely dry with a suction lift capability of up to 30 feet of water. The pump shall be capable of running dry without damaging effects to the pump or tubing. The pump shall require no check valves or diaphragms and shall not require any dynamic seals in contact with the process fluid. The process fluid shall only be in contact with the inside of the pump tubing.
- D. Tubing:
1. The manufacturer shall furnish the appropriate tube material for the conditions of use.
- E. Rotor Assembly and Track:
1. The rotor assembly shall be equipped with two or four self lubricating geared compression rollers mounted on spring loaded arms. Rotor material of construction shall be as specified above. Compression rollers shall be symmetrical about the rotor for compression of the hose against the track. The track material shall be as specified above, and if cast aluminum; shall be factory coated with trimite polyurethane. One roller shall at all times be fully engaged with the tubing providing complete compression to prevent back flow or siphoning. The pumping action shall be created by the occlusion of the pump hose and its subsequent restitution causing a vacuum effect to draw the fluid into the suction side of the hose.
- F. Piping Connection:

1. Adapters and connective fittings between the flexible tubing and the fixed piping shown on the Contract Drawings shall be provided by the manufacturer for each size tubing that is compatible with each pump.
- G. Drive Unit:
1. Adjustable Speed Drive:
 - a. Pumps shall be provided with an integrally mounted adjustable speed drive. The speed setting of the drive shall be continuously adjustable over a minimum 110:1 operating range. The adjustable speed drive shall be for use with brush motors, and be located in a NEMA 4X cabinet. Drive shall be supplied with one 120 VAC input.
 2. Motors:
 - a. Drive motor shall be servo permanent magnet DC with integral gear box.
 - b. Drive shall be rated for continuous 24-hour operation. Pumps shall have non-maintained maximum speed switches for purpose of priming. Pump drives shall be close coupled and self aligning, requiring no flexible couplings.
 - c. The drive enclosure shall be NEMA 4X rated and be factory coated with a corrosion resistant non-reactive (e.g. polyester and/or polyurethane) coating. Drive motors shall be integrally mounted in drive enclosure.
- H. Controls:
1. Local controls shall consist of a speed adjusting potentiometer, a START pushbutton, a STOP pushbutton, and an AUTO/MANUAL switch. Control shall be such that when the drive is running in the MANUAL mode, speed shall be adjusted with the local potentiometer. In the AUTO mode, the drive shall operate in response to an external run command and 4-20 mA external speed reference signal as shown on the Drawings. Include four configurable relay outputs.
 2. NEMA 4X rated controls shall be provided on the pumps. The controls shall provide as a minimum the following features:
 - a. Accept a 4-20 mA speed reference input signal
 - b. Accept dry REMOTE-RUN contact (Run/Stop input)
 - c. Accept a remote pressure switch high input signal
 - d. Provide a 4-20 mA drive speed output signal
 - e. Provide programmable/configurable dry contact relay outputs rated for 1 amp at 120 VAC for the following statuses: Run status output, alarm output, in automatic, and pump leaking.
 3. Selector switches:
 - a. HAND-OFF-AUTO
 - b. Speed Control
 4. Digital Displays:
 - a. VFD Speed Indication
 - b. Pump RUNNING (Red)
 - c. Pump FAULT (Amber)
 5. Skid shall be prewired to a NEMA 4X control junction box.

2.4 APPURTENANCES

A. General:

1. Avoid threaded joints to the maximum extent possible.

B. Calibration Columns:

1. Construction: Transparent, chemical resistant clear borosilicate glass tube with protective polycarbonate outer shield. Calibration columns must have an inlet port (bottom) and outlet port (top) with connections as specified.
2. Connections: 316 stainless steel flanged, top and bottom.
3. O-rings: FKM.
4. Calibration columns shall be calibrated in gallons/hr.
5. Size calibration columns to provide at least 30 seconds of storage at maximum rated pump flow – basis of design model with 500 mL capacity.
6. Manufacturer:
 - a. Griffco Valve
 - b. Koflo Corporation
 - c. Or approved equal.

C. Pulsation Dampeners:

1. Provide pulsation dampener on discharge piping of each peristaltic tube metering pump as shown or indicated on the Drawings, and as specified in this Section.
2. Pulsation dampeners shall be air-charged, diaphragm type, complete with 316 stainless steel valved air charge connection and pressure gauge graduated for zero to 100 psi.
3. Size pulsation dampeners to allow no more than five percent discharge pressure fluctuation. Pulsation dampener bladder and lower housing shall be fabricated of materials recommended by manufacturer and suitable for the chemical being pumped.
4. Provide each pulsation dampener with four, extra-long bolts at 90 degrees to one another for mounting dampener support brackets.
6. Process Connection: Flanged.
7. Materials of Construction:
 - a. Pulsation dampener shall be manufactured with 316 stainless steel and Viton diaphragm.
8. Manufacturer:
 - a. Griffco Valve
 - b. Or approved equal.

D. Pressure Relief Valves:

1. Refer to Section 40 05 53: Thermoplastic Chemical Resistant Spring Operated Pressure Relief Valve (RPVC)

E. Thermoplastic True Union Ball Valve:

1. Refer to Section 40 05 53 2.2 Type 1

- F. Thermoplastic True Union Ball Valve (Vented):
 - 1. All ball valves used in Sodium Hypochlorite service shall be internally vented to prevent off-gas based over-pressurization.
 - 2. Refer to Section 40 05 53 2.2 Type 2
- G. Thermoplastic Ball Check Valve:
 - 1. Refer to Section 40 05 53 2.3 Type 1
- H. Pressure Gauges:
 - 1. Provide in accordance with requirements of Section 40 60 05 Pressure Gauge – Bourdon Tube.
- I. Diaphragm Seals:
 - 1. Refer to Section 40 60 05: Diaphragm Seal
- J. Quick Connects:
 - 1. Size and Extent: As shown on the Drawings.
 - 2. Type: Pipes shall be furnished with male adapter/threaded type couplings as shown in the drawings for hose connection. Threaded connections acceptable to process piping are acceptable in this case given they are downstream of an isolation valve that would typically be closed except during draining/flushing.
 - 3. Materials: 316 stainless steel.
 - 4. Provide dust cap with security chain for each quick connect coupling.
 - 5. Manufacturer:
 - a. Banjo Corporation
 - b. Evertite
 - c. Dixon
 - d. Murray Equipment Inc.
- K. Piping:
 - 1. Refer to Sections 40 05 05, for additional information on piping requirements including materials of construction and joint types.
- L. Miscellaneous Accessories:
 - 1. Provide flexible reinforced 316 stainless steel hose for connection to 316 stainless steel suction and discharge piping. By Thunder Technologies, LLC, or approved equal.

2.7 COATINGS

- A. Standard factory finish system.

2.8 SOURCE QUALITY CONTROL

Skid Mounted Peristaltic Metering Pumps and Appurtenances

- A. Peristaltic Metering Pumps: Test each pump in the shop as follows:
 - 1. Calibration test.
 - 2. Inspect all components prior to and during shop testing.
- B. Controls: Test controls in the shop as follows:
 - 1. Verify operation in all operating modes.
 - 2. Inspect control components and panels for defects.
 - 3. Perform manufacturer's standard quality tests.
- C. Valves: Test valves and appurtenances in the shop as follows:
 - 1. Inspect components for defects.
 - 2. Perform manufacturer's standard quality tests.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which products are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install materials and equipment in conformance with Laws and Regulations, applicable standards, manufacturer's instructions and recommendations, and the Contract Documents.
- B. Anchorages and Base Plates:
 - 1. Provide anchorages in new or existing concrete, as applicable, in accordance with equipment manufacturer's recommendations and the Contract Documents.
- C. General:
 - 1. Perform drilling and fitting required for installation. Set equipment accurately in location, alignment, and elevation, plumb, true, and free of rack.
 - 2. Making plate cutouts or openings at the Site is not allowed.
 - 3. Fit exposed connections accurately together to form tight hairline joints.
 - 4. Provide utility connections in accordance with the Contract Documents.
 - 5. Align and adjust equipment including motors, belts, drives, support stands, and appurtenances in presence of the Engineer.
 - 6. Do not energize equipment until safety devices are installed, connected, and functional.
 - 7. Install valves in accordance with applicable provisions of Section 40 05 53, Process Valves and Appurtenances.
- D. Conform to Section 01 75 11, Checkout and Startup Procedures.

3.3 FIELD QUALITY CONTROL

- A. Once installation is complete, skid mounted peristaltic metering pump manufacturer representative shall inspect the installation and provide certification on manufacturer's letterhead that the skid mounted peristaltic metering pumps and appurtenances have been properly installed in accordance with the Drawings, Specifications, and Manufacturer's Shop Drawings and recommendations, and that the system is ready to be tested and placed into operation.
- B. Site Tests:
 - 1. Following installation, the Contractor and qualified field service representative of skid manufacturer shall conduct operating tests of all equipment, functions, and controls at the Site in presence of Engineer.
 - 2. Field Operating Test:
 - a. Field test equipment and its controls in local mode, followed by demonstrating proper operation and controls in automatic mode. Demonstrate that each part individually and all parts together function properly in manner intended. Total duration of testing shall be minimum 4 hours, continuous and uninterrupted, in automatic mode and using the chemicals to be fed. All testing equipment and labor shall be by the Contractor.
 - b. Should tests result in malfunction, make necessary repairs, revisions, and adjustments and restart test from the beginning. Repeat tests and repairs, revisions, and adjustments until, in opinion of Engineer, installation is complete, and equipment is functioning properly and accurately and is ready for permanent operation.
- C. Skid Manufacturer's Services: Provide a qualified, factory-trained service member to perform the following:
 - 1. Instruct the Contractor in installing equipment.
 - 2. Supervise installation of materials and equipment.
 - 3. Inspect, calibrate, adjust, and test equipment after installation and ensure proper operation.
 - 4. Instruct the Owner's personnel in operating and maintaining the equipment.
 - 5. Manufacturer's representative shall make a minimum of two visits with a minimum of 8 hours at the Site each. The visits shall be for instructing the Contractor, supervising the installation of the equipment, checking, adjusting, and calibrating the completed installation, starting up the system, and instructing operations and maintenance personnel. Representative shall revisit the Site as often as necessary until installation is acceptable.
 - 6. Training: Furnish services of Supplier's qualified factory trained specialists to instruct the Owner's operations and maintenance personnel in recommended operation and maintenance of materials and equipment. Training requirements, duration of instruction and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.

Skid Mounted Peristaltic Metering Pumps and Appurtenances

7. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

+ + END OF SECTION + +